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# Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (97)
June 1978



National Aeronautics and Space Administration

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## ACCESSION NUMBER RANGES

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NASA SP–7037(97)

# AERONAUTICAL ENGINEERING

## A Continuing Bibliography

## Supplement 97

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 May 1978 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 Continuing Bibliography* (NASA SP-7037) lists 420 reports, journal articles, and other documents originally announced in May 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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

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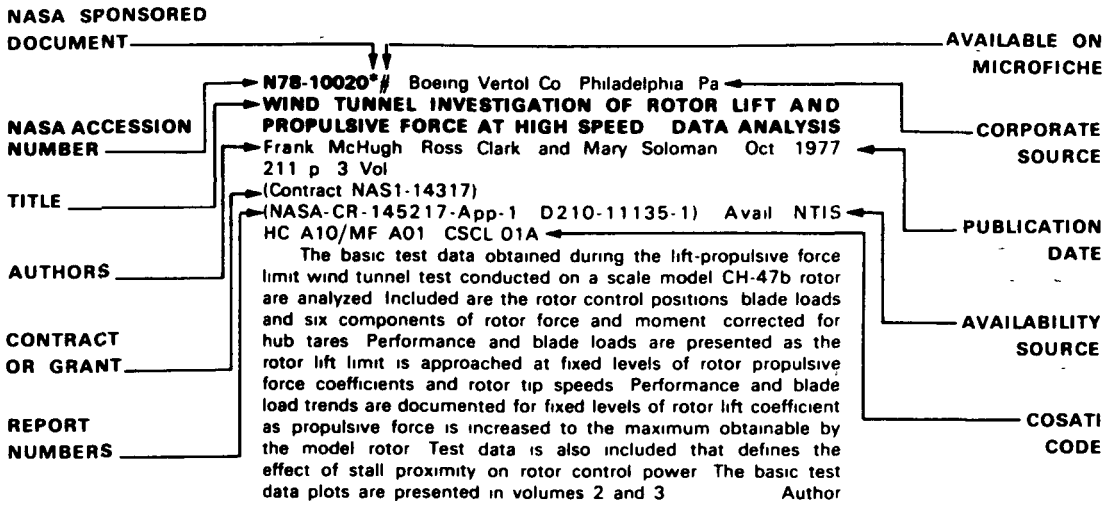


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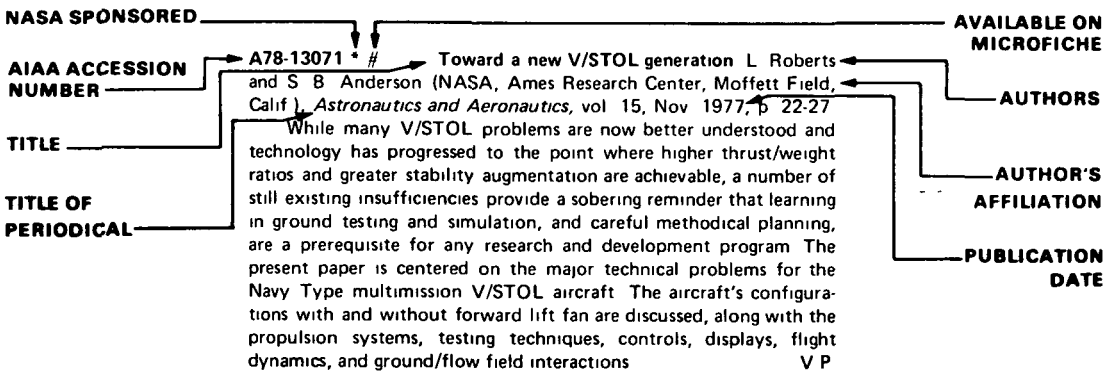

# AERONAUTICAL ENGINEERING

*A Continuing Bibliography (Suppl. 97)*

JUNE 1978

## IAA ENTRIES

**A78-24877 * #** **Noise of deflectors used for flow attachment with STOL-OTW configurations** U von Glahn and D Groesbeck (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 94th, Miami Beach, Fla , Dec 13-16, 1977, Paper* 16 p

Future STOL aircraft may utilize engine-over-the-wing (OTW) installations in which the exhaust nozzles are located above and separated from the upper surface of the wing An external jet-flow deflector can be used with such installations to provide flow attachment to the wing/flap surfaces for lift augmentation In the present work, the deflector noise in the flyover plane measured with several model-scale nozzle/deflector/wing configurations is examined The deflector-associated noise is correlated in terms of velocity and geometry parameters The data also indicate that the effective overall sound pressure level of the deflector-associated noise peaks in the forward quadrant near 40 deg from the inlet axis (Author)

**A78-24878 * #** **Combustor fluctuating pressure measurements in-engine and in a component test facility A preliminary comparison** M Reshotko and A Karchmer (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 94th, Miami Beach, Fla , Dec 13-16, 1977, Paper* 18 p 5 refs

Combustor internal fluctuating pressure and far-field noise generated in a YF-102 turbofan engine are investigated, combustor internal measurements are also made in a duct-component test facility operating over a range of conditions encompassing those characteristic of the aircraft engine Although directly measured spectra for the engine and the duct-component test facility show discrepancies, the results of coherence function, transfer function and phase relationship comparisons suggest that the internal dynamics of the combustor as an acoustic source may be preserved in a component test facility J M B

**A78-24879 * #** **An empirical model for inverted-velocity-profile jet noise prediction** J R Stone (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 94th, Miami Beach, Fla , Dec 13-16, 1977, Paper* 28 p 12 refs

It is known that the noise generated by inverted-velocity-profile coaxial (without center plug) and coannular (with center plug) nozzles should be modeled as the combined contributions of various source regions and noise generation mechanisms In this paper, an empirical noise-prediction model is described which considers the noise generated by two jet-mixing regions and two potential regions of shock/turbulence interaction Results calculated from the empirical model are compared with model-scale experimental data for static and simulated flight conditions These comparisons are made for cases where both streams are subsonic, where the outer stream is supersonic with the inner stream subsonic, and where both streams are supersonic The cases considered cover a range of inner-to-outer-stream area ratios and include both coaxial and coannular nozzles It is shown that the model gives reasonable predictions of absolute noise spectra and even better predictions of incremental changes S D

**A78-24880 * #** **Effectiveness of an inlet flow turbulence control device to simulate flight fan noise in an anechoic chamber** R P Woodward, J A Wazyniak, L M Shaw, and M J MacKinnon (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 94th, Miami Beach, Fla , Dec 13-16, 1977, Paper* 21 p 13 refs

A hemispherical inlet flow control device was tested on a 50 8 cm (20-inch) diameter fan stage in the NASA-Lewis Anechoic Chamber The control device used honeycomb and wire mesh to reduce turbulence intensities entering the fan Far field acoustic power level results showed about a 5 dB reduction in blade passing tone and about 10 dB reduction in multiple pure tone sound power at 90% design fan speed with the inlet device in place Hot film cross probes were inserted in the inlet to obtain data for two components of the turbulence at 65 and 90% design fan speed Without the flow control device the axial intensities were below 1 0%, while the circumferential intensities were almost twice this value The inflow control device significantly reduced the circumferential turbulence intensities and also reduced the axial length scale (Author)

**A78-24882 * #** **The promise of eutectics for aircraft turbines** H R Gray (NASA, Lewis Research Center, Cleveland, Ohio) *American Society for Metals, Materials Show and Conference, Chicago, Ill , Oct 25-27, 1977, Paper* 20 p 13 refs

Gas turbine blades and vanes for the 1980s call for new materials with higher operational temperature capabilities The potential increase of from 40 to 110 C in operational temperature capabilities predicted for directionally solidified eutectics is a larger increment over currently available alloys than previously obtained in any new turbine blade alloy The paper discusses the properties of gamma/gamma prime-delta and NiTaC-13 directionally solidified first-generation eutectics for use as gas turbine blade materials A few of the more promising second-generation eutectics for blade applications (gamma/gamma prime-alpha, NiTaC 3-116A) and for vane applications (gamma-beta, COTAC 74) are also discussed Attention is given to mechanical properties, such as transverse ductility and shear strength, that can be inherently critical in a directionally solidified eutectic Further R&D requirements for properties, coatings, and lower cost processing technology are identified S D

**A78-24898 * #** **Output feedback regulator design for jet engine control systems** W Merrill (NASA, Lewis Research Center, Cleveland, Ohio) *National Electronics Conference, Chicago, Ill , Oct 13, 14, 1977, Paper* 13 p 6 refs

A multivariable control design procedure based on the output feedback regulator formulation is described and applied to an F100 turbofan engine model Full order model dynamics, are incorporated in the example design The effect of actuator dynamics on closed loop performance is investigated Also, the importance of turbine inlet temperature as an element of the dynamic feedback is studied Step responses are given to indicate the improvement in system

performance with this control Calculation times for all experiments are given in CPU seconds for comparison purposes (Author)

**A78-24900 * #** **Technical and economic evaluation of advanced air cargo system concepts** A H Whitehead, Jr (NASA, Langley Research Center, Hampton, Va ) *International Forum on Airfreight Contribution in Securing Markets Abroad, Aéroport de Paris, France, Nov 17, 18, 1977, Paper* 36 p 26 refs

The paper reviews NASA air cargo market studies, reports on NASA and NASA sponsored studies of advanced freighter concepts, and identifies the opportunities for the application of advanced technology The air cargo market is studied to evaluate the timing for, and the potential market response to, advanced technology aircraft The degree of elasticity in future air freight markets is also being investigated, since the demand for a new aircraft is most favorable in a price-sensitive environment Aircraft design studies are considered with attention to mission and design requirements, incorporation of advanced technologies in transport aircraft, new cargo aircraft concepts, advanced freighter evaluation, and civil-military design commonality M L

**A78-24902 * #** **Effects of film injection on performance of a cooled turbine** J D McDonel and J E Eiswerth (General Electric Co , Aircraft Engine Group, Evendale, Ohio) *NATO, AGARD, Propulsion and Energetics Panel Meeting, 50th, Middle East Technical University, Ankara, Turkey, Sept 19-23, 1977, Paper* 10 p Contract No NAS3-16732

Some of the most dramatic increases in the performance of turbojet and turbofan aircraft engines have been obtained as a result of increased thermodynamic cycle temperatures made possible by the use of film cooling techniques The realization of the potential performance gains, however, is only possible if the quantity of cooling air and the aerodynamic mixing losses resulting from the injection of coolant in the form of film on the flowpath surfaces are minimized Such a minimization requires a more complete understanding of the relationship between cooling and aerodynamics A review is conducted of tests which have been conducted to determine the effects of coolant injection on turbine performance The results obtained in the tests are compared with an analytical technique developed for predicting coolant injection effects Particular attention is given to the effects of turbine cooling on overall cycle thermodynamic efficiency, taking into account incremental changes in turbine thermodynamic efficiency for various incremental changes in coolant flow rate G R

**A78-24906 * #** **Hydrocarbon group type determination in jet fuels by high performance liquid chromatography** A C Antoine (NASA, Lewis Research Center, Cleveland, Ohio) *Federation of Analytical Chemistry and Spectroscopy Societies, Annual Meeting, 4th, Detroit, Mich , Nov 7-11, 1977, Paper* 12 p

Results are given for the analysis of some jet and diesel fuel samples which were prepared from oil shale and coal syncrudes Thirty-two samples of varying chemical composition and physical properties were obtained Hydrocarbon types in these samples were determined by fluorescent indicator adsorption (FIA) analysis, and the results from three laboratories are presented and compared Recently, rapid high performance liquid chromatography (HPLC) methods have been proposed for hydrocarbon group type analysis, with some suggestion for their use as a replacement of the FIA technique Two of these methods were used to analyze some of the samples, and these results are also presented and compared Two samples of petroleum-based Jet A fuel are similarly analyzed (Author)

**A78-24910 * #** **Progress in advanced high temperature turbine materials, coatings, and technology** J C Freche and G M Ault (NASA, Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Propulsion and Energetics Panel Meeting, 50th, Middle East Technical University, Ankara, Turkey, Sept 19-23, 1977, Paper* 43 p 89 refs

Several NASA-sponsored benefit-cost studies have shown that very substantial benefits can be obtained by increasing material capability for aircraft gas turbines Prealloyed powder processing holds promise for providing superalloys with increased strength for turbine disk applications The developement of advanced powder metallurgy disk alloys must be based on a design of optimum processing and heat treating procedures Materials considered for high temperature application include oxide dispersion strengthened (ODS) alloys, directionally solidified superalloys, ceramics, directionally solidified eutectics, materials combining the high strength of a gamma prime strengthened alloy with the elevated temperature strength of an ODS, and composites Attention is also given to the use of high pressure turbine seals, approaches for promoting environmental protection, and turbine cooling technology G R

**A78-25011 #** **Automatic system employing radioactive radiation to level-out an aircraft at landing (Avtomaticheskaia sistema vyravnivaniia samoleta pri posadke s ispol'zovaniem radioaktivnykh izluchenii)** A B Bushuev (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR) *Priborostroenie,* vol 20, no 11, 1977, p 44-46 In Russian

The automatic landing system described in the present paper will flatten-out an aircraft at the end of a curvilinear glide path with the aid of instruments which measure the altitude and vertical velocity by recording back-scattered gamma-radiation The block diagram of the system is given and discussed Radio-isotope instruments are shown to improve system reliability V P

**A78-25013 #** **Generalized algorithm of the analytical method of gyrocompassing (Obobshchennyi algoritm analiticheskogo metoda girokompasirovaniia)** V V Seregin (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR) *Priborostroenie,* vol 20, no 11, 1977, p 77-83 In Russian

Gyrocompassing is understood to mean a method of determining the position of the meridional plane, in which the horizontal component of the earth's angular velocity vector is used as the unit vector of the axis that coincides with the northern continuation (ray) of the meridian line In the case of a fixed base, examined in the present paper, it is sufficient to determine the direction of the angular velocity vector of the horizontal plane's rotation in inertial space This can be accomplished with an angular velocity transducer In the analytical approach, the input axis of the transducer is either fixed or possesses a finite number of discrete positions relative to the meridional plane, the azimuth of the position taken as the prime position being determined on a digital computer A generalized algorithm of this method is proposed, and means of passing from the algorithm to specific realizations are indicated Some special cases are examined, and expressions for the errors characteristic of each case are derived V P

**A78-25033** **Simulation of airport air quality by box photochemical and Gaussian models** G B Frame (Beak Consultants, Ltd , Vancouver, Canada) *Air Pollution Control Association, Journal,* vol 28, Feb 1978, p 155-157 8 refs

A comparison is made between two models used to simulate airport air quality The first of these, the arbitrary reactor volume (box) includes all airport sources on the ground, in aircraft flight paths to the mixing layer, and receptor points The model's kinetic photochemical mechanism treats hydrocarbons as lumped reactive or unreactive species, and peroxy radicals are lumped into a free radical species The mechanism includes reactions involving molecular oxygen, hydroxyl radical, and nitrous acid The second, Gaussian models, are found to more accurately represent the actual situation, and to be dependent on the choice of horizontal and vertical standard variation values Results are presented, in terms of five

remote sensors as compared to the in-stack monitors are discussed (Author)

**A78-25046** **VHF/UHF direction-finding in air traffic control** F R Huber (Rohde and Schwarz Co , Munich, West Germany) *Interavia,* vol 33, Feb 1978, p 146, 147

Although VHF/UHF direction-finding has been largely supplanted by primary and secondary radar (as well as advanced distance-measuring equipment), computerized synthetic displays based on radio direction finding may be useful aids in air traffic control In particular, radio direction finders for electronic surveillance and for navigation are considered Instruments described range from low-cost high-performance Doppler direction finders to large custom-made systems used as triangulation networks An automatic-response direction finder giving the magnetic bearing of the ground transmitter and an identifying signal in clear text is also mentioned J M B

**A78-25141** # **RB 211 - Progress and prospects** T E Ford *Aircraft Engineering,* vol 50, Jan 1978, p 4-8

The paper summarizes the significant improvements accomplished in the first two versions of the 1 RB 211 engine - the -22B version and the more powerful -524 version - and highlights some of the planned improvements for future versions The objective of 25% reduction in specific fuel consumption (SFC) over the previous generation of gas turbine engines was achieved in the RB 211 Removal of the original hot stream spoilers and installation of a 15 deg afterbody resulted in further SFC improvements in the -22B A major improvement in high pressure turbine blade cooling has resulted from the introduction of high pressure feed air to the cooling air supply The -524 achieved thrust increases of up to 19% over the earlier engine by means of a revised engine cycle and improved component efficiencies Later versions will each have added thrust, with a maximum thrust of 55,000 lb projected for the 524G The -535 will be a new engine designed for the specific needs of the B 7X7, and differs mainly in having a fan 13 inches smaller than the other RB 211's It will be a three-shaft design and be rated at 32,000 lb thrust P T H

**A78-25142** # **Economic and safety aspects of prolonging engine life** G McRae (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn ) *Aircraft Engineering,* vol 50, Jan 1978, p 9-13

The paper examines the interacting factors to be considered in attempting to achieve minimum overall operating costs by optimizing maintenance and repair procedures without compromising reliability and safety For example, savings can be achieved by eliminating regularly scheduled overhauls and using salvaged parts When fuel was not expensive, this savings offset the cost of the resulting higher fuel consumption, but today, with higher fuel costs, this may not be true A study conducted with the participation of a number of JT9D operators found that the optimum interval in which to conduct compressor refurbishment was 9,000 to 10,000 hours Factors affecting performance of the JT8D fan, compressors, burner, and turbine are summarized P T H

**A78-25149** **ALIDADE - The alignment on board aircraft carriers of the inertial navigation units of Super-Etendard aircraft (ALIDADE - Alignement sur porte-avions des unités de navigation inertielle des Super-Etendard)** M de Cremiers (Société d'Applications Générales d'Electricite et de Mécanique, Paris, France) *Navigation* (Paris), vol 26, Jan 1978, p 52-57 In French

The pre-flight alignment of the inertial navigation instruments on board Super-Etendard aircraft poses special problems due to the motions of the aircraft carriers from which the Super-Etendard craft are launched Determination of the true vertical and the north orientation are performed with an advanced alignment method termed ALIDADE, which involves a hybrid inertia/Omega/sillometer aircraft carrier reference system, an infrared link to transmit reference information to the aircraft on deck, and sea alignment systems on board the aircraft The ALIDADE method is scheduled to be operational in the 1980s J M B

**A78-25150** **Strategic positioning and traffic regulation in the terminal zone (Ordonnancement strategique et régulation du trafic en zone terminale)** A J Fossard and N Imbert (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) *(European Organization for Civil Aviation Electronics Manufacturers, Assemblée Générale, Neuilly-sur-Seine, Hauts-de-Seine, France, Oct 14, 1977 ) Navigation* (Paris), vol 26, Jan 1978, p 58-79 11 refs In French

A system of strategic positioning and tactical trajectory modification is proposed to rationalize aircraft arrivals and departures and to reduce fuel wastes due to delays, the system is applied to a control region 30 to 60 nautical miles from an airport The strategic positioning is based on a prediction of spatial/temporal arrival points at the boundary of the control region and the assignment of descent trajectories (late arrivals are taken into account) The tactical trajectory modification includes aircraft velocity and heading corrections during the descent phase A simulation of the system involving about 200 approaches of various types is reported J M B

**A78-25176** **Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977** Conference sponsored by the Society for the Advancement of Material and Process Engineering Azusa, Calif , Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series Volume 9), 1977 575 p $40

The performance of materials relevant to aircraft construction is discussed, and improved methods of evaluation are described Metals and composites are examined from the viewpoint of manufacturer, military, and airline experience Areas of interest include fracture mechanics, materials in marine applications, corrosion prevention, durability and reliability, and adhesion Topics reported on include high strength aluminum alloys, measurement techniques for low expansion materials, stress corrosion of structural adhesive bonds, high-strength steel processing variables that affect fatigue, lubrication of equipment for waste water reclamation, high-modulus graphite/epoxy tubes, and advanced composites for high-temperature applications M L

**A78-25177** **The need for improved materials in integral aircraft fuel tanks** M H Trimble (Delta Air Lines, Inc , Atlanta, Ga ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 3-8 5 refs

This paper is based on an extensive Engineering Investigation of corrosion frequently found in jet aircraft integral fuel tanks Documentation will be presented concerning the cause, the effects, and corrective action program implemented The evidence presented will clearly show the need for development and use of improved coatings, sealants, and assembly methods in future jet aircraft fuel tanks (Author)

**A78-25180** **Analytical representation of the initial quality of fastener holes** J L Rudd (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 27-39 8 refs

This paper describes a method, the Equivalent Initial Quality Method, of analytically representing fastener hole initial quality

resulting from material and structural manufacturing and processing operations The representation is accomplished by representing the imperfections which are either inherent in a material or introduced during the manufacturing of a structure with a fatigue crack of a particular size and shape Such a representation allows the damage accumulation process to be considered as entirely crack growth with zero time to initiate a crack The Equivalent Initial Quality Method can be used both to determine the operational limits (i e , economic repair limit, inspection interval and fracture limit) of existing aircraft and in the design of new aircraft Applications of the method are presented which include its use on the F/RF-4C/D, F-4E(S), and A-7D damage tolerance and life assessment programs Potential applications and possible limitations of the Equivalent Initial Quality Method are discussed (Author)

**A78-25185 Metallurgical behavior of arresting gear deck pendants** L Moskowitz (U S Navy, Naval Air Engineering Center, Lakehurst, N J ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 87-99

The paper discusses wire breakage in cables used as deck pendants on aircraft carriers Visual inspection, metallographic, SEM, microhardness, tensile, and impact investigations were conducted The more common cause of premature wire breakage is a form of low-cycle fatigue aggravated or caused by cracks in the base metal emanating from cracks in the brittle surface layer A brittle martensitic surface layer, possibly a special fine-celled form of martensite mixed with ferrite or retained austenite, is produced by rapid sliding of a hook when an arrestment occurs These martensitic-type layers greatly reduce the force required for fracture, especially after the cable becomes deformed to an oval shape M L

**A78-25194 Evaluation of protective coatings applied under adverse conditions** D L Behmke (U S Navy, Naval Air Engineering Center, Lakehurst, N J ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977
Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 224-235

Major maintenance problems in the case of the launching area aboard aircraft carriers are related to corrosion effects Flight deck hardware is exposed to cyclic heat (400 F max), hydraulic fluid, lube oil, jet fuel, sea water spray, aqueous film forming foams, and a marine atmosphere A program was, therefore, initiated to obtain performance data on various primer coatings applied under adverse conditions and tested in a simulated shipboard environment Twenty protective coatings were selected on the basis of a literature search along with four rust stabilizing pretreatment formulations A better performance of several of the selected coatings compared to previous exposure tests is traced to a heavier coating thickness used in these later tests The results suggest that a multiple coat system of approximately 8 mils thickness will provide adequate corrosion protection in the catapult/flight deck environment G R

**A78-25196 Today's non-metallic composite airframe structure - An airline assessment** M H Kuperman and R G Wilson (United Air Lines, Inc , San Francisco, Calif ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977
Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 255-275 15 refs

The environmental durability and repair characteristics of new high performance composite materials considered for a use in aircraft design can be evaluated best on the basis of actual in-service experience during routine airline operation A description is presented of problems with nonmetallic composite structure on today's aircraft This structure consists mainly of epoxy-resin-reinforced fiberglass skins over 'Nomex' or phenolic honeycomb core The ply count may vary from three to fourteen It has been found that heavily loaded panels tend to deteriorate more quickly from environmental effects than lightly loaded panels Design improvements are discussed, taking into account impact damage, lightning strike and moisture resistance, flammability, and corrosion, erosion and hole elongation Attention is given to design objectives for nonmetallic airframe structure and cost effective design for durability G R

**A78-25197 Service experience of composite parts on the L-1011 and C-130** R H Stone (Lockheed-California Co , Burbank, Calif ) and W E Harvill (Lockheed-Georgia Co , Marietta, Ga ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 276-288 9 refs

Composite flight service programs are in progress on two Lockheed aircraft, the L-1011 and C-130 A set of Kevlar-49/epoxy fairings are being flight tested on three L-1011's, and have had no major service problems after 10,000 hours service The center wing box aluminum skins and hat stiffeners were reinforced with pre-cured, bonded boron/epoxy strips on three C 130's After almost three years and over 4000 flight hours, these components are continuing to perform satisfactorily in service Another flight service component on the L-1011 is a graphite/epoxy floor post, which is free of service problems or defects after 10,000 flight hours These components provide significant verification of the serviceability of all three major composite reinforcement types (Author)

**A78-25199 Application of composites on civil aircraft** A E Anderjaska and J R Soderquist (FAA, Engineering and Manufacturing Div , Washington, D C ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977
Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 297-304

The requirements of primary concern in a civil certification of composite aircraft structures are considered The materials must be shown to be suitable and durable and the fabrication processes must be shown to be reliable The structure must be shown to support design ultimate load without failure Areas of special consideration are also discussed, taking into account the repeated exposure of the structure to extremes of temperature and moisture It is pointed out that manufacturing processes and test procedures should be carefully evaluated to assure that the moisture problem is not aggravated or improperly assessed A description is presented of the experience obtained in scheduled airline service with components consisting of composites Attention is given to a boron/epoxy wing foreflap, graphite/epoxy spoilers, graphite/polysulfone spoilers, and a graphite/epoxy floor G R

**A78-25200 * Material development for laminar flow control wing panels** L E Meade (Lockheed-Georgia Co , Marietta, Ga ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 305-312 Contract No NAS1-14409

The absence of suitable porous materials or techniques for the economic perforation of surface materials has previously restricted the design of laminar flow control (LFC) wing panels to a consideration of mechanically slotted LFC surfaces A description is presented of a program which has been conducted to exploit recent advances in materials and manufacturing technology for the fabrication of reliable porous or perforated LFC surface panels compatible with the requirements of subsonic transport aircraft Attention is given to LFC design criteria, surface materials, surface concepts, the use of microporous composites, perforated composites, and perforated metal The described program was successful in that fabrication processes were developed for producing predictable perforated panels both of composite and of metal G R

**A78-25202** **Durability of adhesive bonded honeycomb sandwich in accelerated adverse environments** D R Askins (Dayton, University, Dayton, Ohio) and H S Schwartz (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 329-350

The environmental degradation of various types of honeycomb core sandwich constructions was investigated The constructions included combinations of aluminum and plastic core materials with aluminum, graphite composite, and fiberglass composite skins and various types of adhesives The objectives of the investigation were to assess (1) the degree of improvement in durability of new, corrosion resistant aluminum over the untreated type, (2) the significance of the adhesive on interfacial durability, (3) possible adverse galvanic corrosion of aluminum honeycomb bonded to graphite composite skins, and (4) comparative durability of aluminum versus plastic honeycomb Analysis of the results established the significance of environmental degradation upon the various skin/core/adhesive combinations and assessed the existence and extent of synergistic interactions between the various structural constituents and the environmental factors (Author)

**A78-25205** **In-service performance of polyurethane and fluorocarbon rain erosion resistant radome coatings** G F Schmitt, Jr (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 377-391

Erosion effects produced by rain on radomes and other exterior plastic parts of aircraft and missiles are a serious problem for an operation at subsonic and, even more, at supersonic speeds The use of ceramic caps or all-ceramic radomes presents certain problems in connection with the inherent brittleness of this material, thermal mismatch problems, and the structural weaknesses of the ceramics Polyurethane and fluorocarbon coatings were, therefore, developed to provide for the radome protection against rain erosion under subsonic flight conditions Initially developed polyurethane coatings showed outstanding performance in actual service However, the polyurethanes are limited to service temperatures of not more than 150 C in case of long-term exposure, while 175 C can be tolerated for periods up to 24 hours A variety of thermally stable polymers were investigated with the objective to obtain a coating material which can withstand higher temperatures The investigation led to the development of a new fluoroelastomer coating for applications involving a long-term exposure to 260 C G R

**A78-25207** **C-141A service experience - Materials and processes.** L D Griffin and D Latterman (USAF, Warner Robins Air Logistics Center, Robins AFB, Ga ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977
Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 445-456

The C-141A, which was first delivered to the U S Air Force (USAF) in late 1963, has become the intercontinental workhorse of the USAF Military Airlift Command The primary structure of the C-141 represents a combination of high-strength aluminum and steel alloys The principal structural materials are 7075-T6 and 7079 T6 aluminum and 4340 steel Fatigue has not been a major problem with the 7075-T6 structure in the C-141A This is mainly the result of the moderate operating stress levels for most of the aircraft structure A number of examples are considered for corrosion problems which occurred in connection with the 4340 steel. Problems experienced with honeycomb structures are related to the difficulty of maintaining honeycomb, the cost of maintenance and inspection problems G R

**A78-25208** **Service experience and materials evolution in Air Force jet engines** L D Parsons, R H Williams, and C A Kelto (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 457-469 19 refs

Developments concerning cold section components in Air Force jet engines are examined Radial-flow air compressors utilized in early gas turbine engines were operating at low temperatures and could, therefore, be fabricated of strong and light but thermally unstable materials such as aluminum alloys The axial-flow compressors used currently in large engines are partly exposed to temperatures as high as 1300 F A use of nickel, cobalt, or iron-base superalloys is, therefore, required for the manufacture of components exposed to such temperatures Titanium has become the material of choice for rotating parts in environments below 1000 F Special design problems related to unexpected and unpredictable compressor failures are discussed, taking into account difficulties related to the employment of titanium and approaches for overcoming the difficulties Attention is also given to hot section failures, the development of nickel-base alloys containing the reactive metals Al and Ti, and the employment of high chromium, high-titanium nickel-base alloys G R

**A78-25209** **S-3A composite spoiler in-service evaluation** R C Knight and S A McGovern (Vought Corp , Dallas, Tex ) In Materials and processes - In service performance, Proceedings of the Ninth National Technical Conference, Atlanta, Ga , October 4-6, 1977 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1977, p 470-477

Seven ship sets of S-3A graphite/epoxy lower spoilers are installed on East Coast and West Coast Naval squadron aircraft as part of the S-3A Composite Spoiler Service Tracking and Evaluation program Spoiler usage data has been gathered pertaining to flight hours, inspections, repairs, removals, and special incidences pertinent to spoiler function From the monitoring of the composite spoilers, the service environment in which composites will exist is being defined, along with the performance of composite structure in a service environment (Author)

**A78-25261** **Air France's new 'freight' installations at Charles de Gaulle Airport at Roissy, France (Les nouvelles installations 'fret' de la compagnie nationale Air-France sur l'Aéroport Charles de Gaulle à Roissy en France)** M J Gardez and M M Roger (Jeumont-Schneider, Puteaux, Hauts-de-Seine, France) *Sciences et Techniques,* Feb 1978, p 38-42 In French

The paper describes a new type of airport freight installation designed for greater mechanization on the runway side The Cargo Dock, as it is called, enables continuous loading and unloading of large aircraft, made possible by raising by 5 m the zones of mechanized stock and introducing a mechanized conveyance path between these zones and the aircraft bridge, that takes into account the variations of height and inclination of the aircraft Special liaison bridges are described P T H

**A78-25263** **The new railroad artery Paris-Sud-Est and high-speed trains How the Paris Sud-Est was born - Basic options (La nouvelle artère ferroviaire Paris-Sud-Est et les trains à grande vitesse Comment est né le Paris Sud-Est - Les options fondamentales)** M J Dupuy (Société Nationale des Chemins de Fer Français, Paris, France) *Sciences et Techniques,* Feb 1978, p 53-55 In French

The desire to operate high-speed passenger trains on the new Paris-Sud-Est artery led to the decision that the line be reserved exclusively for passenger trains, since the optimal geometric parameters of the track layout in the case of high-speed trains do not coincide with those for freight trains For example, for a high-speed train, the maximum allowable declivity in the track can be raised to 35 per mill, which would enable a considerable reduction in the cost

of laying the track If the track load of high-speed-train car sets is limited to 16 or 17 tons, the cost of track maintenance will not offset the previously mentioned savings Aerodynamic qualities of the high-speed train will enable high speeds to be attained at an energy consumption (energy per seat-km) which is smaller than that of the electric train 'le Mistral' and about half that of a medium-performance automobile P T H

**A78-25384 Aircraft vortex effects on ground level pollutant concentration** B T Delaney (Exxon Research and Engineering Co , Mountainville, N Y ) and J O Ledbetter (Texas, University, Austin, Tex ) *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-41,5* 16 p 20 refs

The effect of aircraft wake vortex transport on airport air pollution models is assessed In particular, the emission of nitrogen oxides by aircraft during one segment of the takeoff phase (i e , during the first 943 m of climb) is not adequately simulated by models adopted by the U S Air Force and the Environmental Protection Agency In a study conducted at a major airport, inclusion of the effects of a rolled up contrarotating vortex pair generated by aircraft in the takeoff phase is found to improve the nitrogen oxides prediction capability of a conventional airport air quality model J M B

**A78-25385 Remote sensing of aircraft wake vortex movement in the airport environment** B T Delaney (Exxon Research and Engineering Co , Mountainville, N Y ), R V Noonkester (U S Naval Electronics Laboratory Center, San Diego, Calif ), and J O Ledbetter (Texas, University, Austin, Tex ) *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-41,4* 16 p 16 refs

The use of FM-CW radar to track aircraft wake vortices at airports is discussed, remote tracking of vortices may aid in studying ground level pollution dispersion and the effects of vortex trails on encountering aircraft Results are reported for a month-long test of a FM-CW radar system placed at the edge of a runway at Lindbergh Field, San Diego V-echoes detected by the FM-CW radar appear to reflect the water and/or exhaust products trapped in the descending vortex trails of aircraft departing from the runway Thus FM-CW radar detection seems a possible alternative to vortex sensing systems based on acoustic energy, anemometers, or laser backscatter J M B

**A78-25391 Air quality impact of aircraft at ten U S Air Force bases** D F Naugle, B C Grems, III, and P S Daley (USAF, Civil and Environmental Engineering Development Agency, Tyndall AFB, Fla ) *Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-41,6* 16 p 7 refs

Emissions data and a computerized Gaussian dispersion model were employed to study aircraft-produced pollutants (hydrocarbons, oxides of nitrogen, particulate matter, carbon monoxide and sulfur oxides) and ambient air quality at 10 major Air Force bases In addition, a modified version of the Pollutant Standards Index (PSI), developed by the Environmental Protection Agency to relate short-term pollutant concentrations to adverse health effects, was applied to the modeling results PSI values of 4 9 for NO2, 2 1 for CO, 1 9 for total suspended particulates and 1 4 for SO2 were found, the value at which health effects may occur has been set at 100 However, the effects of hydrocarbons, dependent on complex photochemical reactions in the base areas, require further study to assess the need for a control strategy J M B

**A78-25475 # Test of an aviation oil, increased-density MS-20 (Ispytanie aviatsionnogo masla MS-20 povyshennoi plotnosti)** A I Shcherbinin, M A Popov, and R N Iudina (Groznenskii Neftianoi Nauchno-Issledovatel'skii Institut, Groznyi, USSR) *Severo-Kavkazskii Nauchnyi Tsentr Vysshei Shkoly, Izvestiia, Seriia Tekhnicheskikh Nauk,* vol 5, no 2, 1977, p 108, 109 In Russian

Performance characteristics of increased-density MS-20 (density 0 897 g/cc) and standard MS-20 (density 0 895 g/cc) aviation oils were experimentally compared, and it was found that the choice of oil does not affect operation parameters or cause any difference in carbon or gum deposition Values of physical and chemical parameters of the two oils and data on piston performance and depositions are reported M L

**A78-25516 Return of the propeller** R B Aronson *Machine Design,* vol 50, Feb 23, 1978, p 20-22, 24

The propeller has been rediscovered in connection with the search for ways to reduce aircraft fuel costs Preliminary investigations indicate that aircraft turbine engines equipped with newly designed propellers would consume 10 to 40% less fuel than present turbofan engines and might also contribute to other reductions in aircraft operating costs Prototype propellers have been under test that, theoretically, could move an aircraft at Mach 0 8 The redesigned propellers combine properties of older propellers with those of turbine-engine fans and have been called prop-fans According to NASA, a prop-fan engine could be available commercially by 1990 Attention is given to prop-fan models, the solution of noise problems, and engine design considerations G R

**A78-25584 # Description of transient motion of aviation mechanisms with double-winding electromagnetic clutches (Opisanie neustanovivshegosia dvizheniia aviatsionnykh mekhanizmov s dvukhobmotochnymi elektromagnitnymi friktsionnymi muftami)** V I Panchishin and V S Manzii In Solution of boundary value problems by means of mathematical modeling Kiev, Institut Matematiki AN USSR, 1976, p 124-130 5 refs In Russian

**A78-25585 # Method for solving problems of flow past a wing with fuselage bounded by an ideal fluid flow (Metody resheniia zadachi ob obtekanii kryla s fiuzeliazhem ogranichennym potokom ideal'noi zhidkosti)** A O Ditman, S N Okunev, L G Tsvetkov, and A N Shebalov In Solution of boundary value problems by means of mathematical modeling Kiev, Institut Matematiki AN USSR, 1976, p 140-148 In Russian

The problem of translational-circulatory flow of an ideal fluid past an undeformable wing-fuselage combination is formulated The motion of the body is steady and the Chaplygin-Zhukovskii condition is satisfied at the vortex sheet The flow is three-dimensional, but can be bounded by a surface parallel to the vector of steady motion The problem was modeled on the basis of an electromagnetic-hydrodynamic analog This analog lies in the fact that on the surface of a metal model placed in a magnetic field of ultrasonic frequency a condition is fulfilled which is analogous to the condition of nonpermeability on the surface of a solid in the flow of an ideal fluid, while a wire filled with a current in phase with the frequency is the analog of the vortex filament The effects of finite fuselage dimensions, wing thickness and planform, and number and location of free vortices along the trailing edge were evaluated P T H

**A78-25636 # Application of a finite difference scheme to the numerical solution of the direct problem of a two-dimensional cascade of airfoils (Primenenie metoda ustanovleniia k chislennomu resheniiu priamoi zadachi ploskoi reshetki profilei)** G A Sokolovskii, V I Gnesin, R A Nazarenko, and Zh V Shliakhova (Akademiia Nauk Ukrainskoi SSR, Institut Problem Mashinostroeniia, Kharkov, Ukrainian SSR) *Problemy Mashinostroeniia,* no 3, 1976, p 78-85 9 refs In Russian

A mathematical model is developed for transonic flow in a two-dimensional airfoil cascade with (in the general case) shock waves Consideration is given to the selection of the number and form of correct boundary conditions, ensuring stability and uniqueness of the numerical solution A Godunov finite-difference algorithm is proposed for application to a two-dimensional cascade of arbitrary airfoils Computational results are compared with experimental data on various turbine-blade cascades B J

**A78-25703** **Continuation and direct solution of the flutter equation** C Cardani and P Mantegazza (Milano, Politecnico, Milan, Italy) *Computers and Structures*, vol 8, Apr 1978, p 185-192 17 refs

The flutter equation is rewritten as a system of nonlinear algebraic equations A continuation technique is used to solve the system, and the behavior of the system is established by a tracking procedure that proceeds from mode to mode among those of interest When only flutter frequency and speed are needed and their values are approximately known, a direct search method is used Numerical examples are given, one for a three-degree-of-freedom system, the other for a system with six symmetric vibration modes and two rigid body motions P T H

**A78-25728** # **Similar solutions in nonequilibrium nozzle flows.** M Muthukrishnan and N M Reddy (Indian Institute of Science, Bangalore, India) *Indian Institute of Science, Journal*, vol 59, Nov 1977, p 396-418 12 refs

A method of obtaining similar solutions for pseudo-one-dimensional, nonequilibrium nozzle flows is discussed A diatomic gas undergoing simultaneous relaxation of both vibrational and dissociational modes including coupling among them is considered Similar solutions for oxygen and nitrogen, with nonequilibrium effects starting from the nozzle reservoir are presented General correlating parameters have been deduced from the transformed governing equations It is shown that all the approximate correlating parameters that have been hitherto formulated using approximate methods can be deduced from the present general correlating parameters as special cases With the present similar solutions the flow quantities in the nozzle can be readily obtained from the charts for any given initial conditions in the nozzle (Author)

**A78-25773** # **Study of the propagation of higher modes in cylindrical ducts with impedance walls (Issledovanie rasprostraneniia vysshikh mod v tsilindricheskom kanale s impedantsnymi stenkami)** M A Il'chenko and A N Rudenko *Akusticheskii Zhurnal*, vol 23, Nov Dec 1977, p 884-889 7 refs In Russian

In this investigation of higher mode propagation in cylindrical ducts with uniform flow, the dependence of the propagation constant on the impedance is determined for every mode by conformal mapping The branch point of the functions at which two modes are joined correspond to the optimum values for the given modes at which attenuation is maximum The optimum impedance, the maximum value of attenuation, and the corresponding eigenvalues are calculated for the first 40 modes Their dependence on the Mach number, frequency, and duct diameter is examined, and an asymptotic expression is derived Experimental and theoretical results are compared M L

**A78-25777** **Spanwise structure of the plane turbulent wake** M L Barsoum, J G Kawall, and J F Keffer (Toronto, University, Toronto, Canada) *Physics of Fluids*, vol 21, Feb 1978, p 157-161 9 refs National Research Council of Canada Grant No. A-2746

An experimental investigation of a developed plane turbulent wake has been carried out to gain some insight into the spanwise structure of the large scale intermittent turbulent bulges The results indicate that these bulges are three dimensional, and that their extent in the spanwise direction is less than in the streamwise direction and greater than in the lateral direction No evidence of periodicity was found (Author)

**A78-25879** # **Multipath fading simulation model and full-scale results** H S Hayre (Houston, University, Houston, Tex ) In Union Radio Scientifique Internationale, Open Symposium, La Baule, Loire-Atlantique, France, April 28-May 6, 1977, Proceedings Issy-les-Moulineaux Hauts de-Seine, France, Comite National Français de la Radio-electricite Scientifique, 1977, p 475-480 10 refs

Vertically and horizontally polarized electromagnetic signals have been simulated for multipath fading applications such as microwave landing systems and aircraft antenna coverage It has been found that the simulations are valid for both remote and low angle separated receiver locations Error distributions for digital data transmission during multipath conditions are not associated with beam shape and positional shift errors often found in microwave landing systems Environmental conditions are noted to influence error analysis during multipath fading S C S

**A78-25945** # **Experimental research on high lift airfoil section HL235** J Sato (Tokyo, University, Tokyo, Japan) *Tokyo, University, Faculty of Engineering, Journal, Series A*, no 15, 1977, p 26, 27 13 refs In Japanese

A high lift airfoil section which does not have sharp pressure suction peaks around its leading edge even at high incidence has been designed using numerical wind tunnel computer program The section has been tested in low speed wind tunnels at a Reynolds number of 3 3 x 10 to the 5th and is proved to have C-Lmax of 1 78 and (L/D)max of 70 at C-L=1 5 (Author)

**A78-26000** # **The Mi-6A helicopter (Vertolet Mi-6A)** A F Vakhitov and B V Burov Moscow, Izdatel'stvo Transport, 1977 220 p In Russian

The work examines the design, flight performance and aerodynamic characteristics of the Mi-6A helicopter The following structures and systems are discussed in detail, with copious technical data and diagrams the fuselage, takeoff and landing equipment, the powerplant, the transmission the propellers, and the hydraulic system Consideration is also given to cabin heating and ventilation, the anti-icing system, the safety equipment, the balancing and leveling of the helicopter, and performance of the helicopter in winter conditions B J

**A78-26036** **Recent progress and technical and economic outlooks in the processing of materials for airframe elements (Progrès récents, perspectives techniques et économiques, dans la mise en oeuvre des matériaux pour cellules)** G Hilaire (Societé Nationale Industrielle Aérospatiale, Direction de la Qualité, Paris, France) and J -P Brusson (Societé Nationale Industrielle Aérospatiale, Direction Industrielle, Paris, France) *(Colloque des Aciers et Alliages Spéciaux dans l'Aéronautique, 7th, Le Bourget, Seine-Saint-Denis, France, June 1977 ) Matériaux et Techniques*, vol 65, Nov -Dec 1977, p 659-672, Discussion, p 672 In French

**A78-26040** **Assessment of processing methods for titanium alloys for aircraft structures (Bilan des moyens de mise en oeuvre des alliages de titane pour structures d'avions)** J Bevalot (Avions Marcel Dassault-Bréguet Aviation, Vaucresson, Hauts-de-Seine, France) *(Colloque des Aciers et Alliages Spéciaux dans l'Aéronautique, 7th, Le Bourget, Seine-Saint-Denis, France, June 1977 ) Matériaux et Techniques*, vol 65, Nov -Dec 1977, p 695-700, Discussion, p 701

An economic and technical assessment of the feasibility of using titanium alloys for airframe elements is presented Attention is given to mechanical and chemical processing, cold-forming (for alpha titanium alloys), hot-forming (for alpha-beta titanium alloys), arc welding under an argon atmosphere, point-welding, and electron bombardment welding Although the high cost of the raw material rules out a rapid rise in the use of titanium alloys for aircraft structures, economical processing techniques and the high fatigue resistance of the materials may make them at least competitive J M B

**A78-26041** **The development of materials for turbojets (Evolution des matériaux pour turboréacteurs)** R Brunetaud (SNECMA, Paris, France) *(Colloque des Aciers et Alliages Spéciaux*

*dans l'Aéronautique, 7th, Le Bourget, Seine-Saint-Denis, France, June 1977) Matériaux et Techniques,* vol 65, Nov-Dec 1977, p 705-711, Discussion, p 711, 712 In French

High-performance materials for applications in turbojets are reviewed, with attention given to materials suitable for use at temperatures between 250 to 300 C in turbine and compressor disks, carters and structural elements, and turbine blades Glass fiber/resin, Kevlar/resin, carbon fiber/resin, and boron fiber/aluminum systems are considered, aluminum and titanium alloys, as well as high-performance steels, are also discussed Costs, density, moduli of elasticity, and fracture behavior of the materials are contrasted

J M B

**A78-26107** # **Effect of high levels of confinement upon the aerodynamics of swirl burners** N Syred (University College, Cardiff, Wales) and K R Dahman (Continental Carbon Co, Houston, Tex) *Journal of Energy,* vol 2, Jan-Feb 1978, p 8-15 15 refs

The confinement ratio of a swirl burner/furnace combination is defined as the ratio of the cross-sectional area of the furnace to the cross-sectional area of the swirl burner, ignoring the effect of any bluff body New experimental results are presented for the effects of high values of confinement ratio on swirling flow leaving a swirl burner Three differing configurations are tested straight exit to swirl burner, conical diverging exit plus large insert to swirl burner, and straight exit plus deflector plate to swirl burner Velocity profiles are measured under isothermal conditions using a calibrated five-hole Pitot tube calibrated by the method of Lee and Ash (1956) It is shown that when the confinement ratio is 4, the expected aerodynamic flow patterns are considerably altered, due primarily to a reduction in the decay rate of swirl velocity, the main effect on the system is the generation of a central forward flow zone inside the central reverse flow zone Aerodynamic flow patterns suitable for flame stabilization are identified

S D

**A78-26156** **Principles and simulation of JTIDS relative navigation** W R Fried (Hughes Aircraft Co, Fullerton, Calif) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 76-84 17 refs

The time-synchronous operation and high accuracy time of arrival (TOA) measurement capability of Joint Tactical Information Distribution System (JTIDS) terminals makes possible a high performance relative navigation (RELNAV) function through addition of only software in the terminal's computer program The principles of operation, the basic observation equations, and the system architecture for both absolute (geographic) and relative navigation are described Sequential passive ranging by means of the TOA measurements, in conjunction with appropriate source selection logic and a recursive (e g, Kalman) filter mechanization are employed to determine the user's position, velocity, and time bias The filter algorithms and error sources, the software functional flow, and some simulation results are presented

(Author)

**A78-26157** **Multipath limitations on low-angle radar tracking** A V Mrstik and P G Smith (General Research Corp, Santa Barbara, Calif) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 85-102 12 refs ARPA Order 2731

This paper investigates the problem of tracking targets at a low elevation angle in the presence of specular and diffuse multipath Quantitative estimates are derived of the elevation angles, and hence, range, at which targets of specified height can be accurately tracked A parametric approach is followed in which the long-standing uncertainty of how terrain forward-scatters at low grazing angles is recognized at the outset Particular attention is given to the effects of target motion which permit rejection of multipath components falling outside the radar tracker's passband The results are presented in a form which can be readily applied to a spectrum of radar trackers with differing requirements The limited experimental data on the specular and diffuse scattering parameters for several generic types of terrain are applied to estimate the significance of multipath under different situations and to indicate specific areas in which additional experimental data are critically needed

(Author)

**A78-26158** **Multistatic-radar binomial detection** A V Mrstik (General Research Corp, Santa Barbara, Calif) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 103-108 5 refs

The performance of multistatic-radar binomial detectors is investigated Although conceptually similar to the well-known 'M-out-of-N' detector frequently considered for monostatic systems, the multistatic detector must cope with false alarms generated by target ghosting as well as by noise threshold crossings A procedure for deriving the detection statistics of multistatic binomial detectors is presented The procedure is applied to derive the detection probabilities for a spectrum of false alarm probabilities, target densities, and numbers of radar receivers

(Author)

**A78-26159** **Radar electronic counter-countermeasures** S L Johnston (U S Army, Missile Research and Development Command, Redstone Arsenal, Ala) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 109-117 56 refs

The efficacy of radar equipment against jamming by electronic countermeasures (ECM) is secured by electronic counter-countermeasures (ECCM) Various types of ECCM are described, including those built into the transmitter, the antenna, the receiver-signal processor, and any combination of these Electromagnetic compatibility of various electronic systems with weapons systems is discussed Different types of ECM-ECCM matrix hardware are cataloged, although no mention is made of electronic counter-counter-countermeasures (ECCCM)

D M W

**A78-26160** **Some results on digital chirp** S C Iglehart (Hughes Aircraft Co, Santa Monica, Calif) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 118-127

Generating chirp waveforms by means of phase coding yields a simple, cost-effective mechanization The coding process, however, introduces phase errors whose effect must be included in the design An approximate analysis is presented, valid for moderate to high compression ratios, which allows error effects on compressed pulse amplitude and sidelobes to be calculated in a simple manner The analysis provides criteria for selecting the coding bit width (sample rate), weighting network bandwidth, and phase-coder quantization interval and transition times Weighting functions for maximizing the signal-to-noise ratio (SNR) or for producing desired close-in sidelobe performance are derived, as is an exact expression for the transmitted spectrum Numerical results are presented for Gaussian and the maximum-SNR weighting The results indicate that performance will be satisfactory for many applications

(Author)

**A78-26167** **Adaptive tracking filter for maneuvering targets** G G Ricker and J R Williams (Interstate Electronics Corp, Anaheim, Calif) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-14, Jan 1978, p 185-193 9 refs

A general method of continually restructuring an optimum Bayes-Kalman tracking filter is proposed by conceptualizing a growing tree of filters to maintain optimality on a target exhibiting maneuver variables This tree concept is then constrained from growth by quantizing the continuously sensed maneuver variables and restricting these to a small value from which an average maneuver is calculated Kalman filters are calculated and carried in parallel for each quantized variable This constrained tree of several parallel Kalman filters demands only modest computer time, yet provides very good performance This concept is implemented for a Doppler tracking system and the performance is compared to an extended Kalman filter Simulation results are presented which show dramatic tracking improvement when using the adaptive tracking filter

(Author)

**A78-26229** # **A quasisteady theory for incompressible flow past airfoils with oscillating jet flaps** J M Simmons (Queensland, University, Brisbane, Australia) and M F Platzer (U S Naval

Postgraduate School, Monterey, Calif ) *AIAA Journal*, vol 16, Mar 1978, p 237-241 14 refs Navy-supported research, Australian Research Grants Committee Grant No F70/17452

Quasisteady concepts are used for an approximate analysis of incompressible flow past airfoils with harmonically oscillating jet flaps The instantaneous flowfield is considered as a sequence in the streamwise direction of steady flows with a properly enforced tangency condition between the jet and the external flow The jet kinematics are found from experimentally determined jet decay characteristics, and the time-frozen jet is modeled by using Spence's steady jet flap analysis Computed lift response shows substantial agreement with available measurements (Author)

**A78-26230** # **Potential flow around axisymmetric bodies - Direct and inverse problems** M F Zedan and C Dalton (Houston, University, Houston, Tex ) *AIAA Journal*, vol 16, Mar 1978, p 242-250 18 refs

The axial source distribution method for solving the direct and inverse problems of the incompressible potential flow around an axisymmetric body is modified by allowing the source intensity to vary linearly over the element length Comparison is made with the von Karman method (constant source strength) for the direct problem and with the method of Zedan and Dalton (1978) (referred to as ZD1) for the inverse problem The present direct method was more accurate and stable than the von Karman method It has the ability to deal with bodies having an inflection point in the meridian contour, and it requires only single-precision calculations The present method for the inverse problem was more accurate than ZD1, especially for bodies with low fineness ratio Fewer iterations are required in the present method than in the Bristow method (1974), but it cannot deal with bodies with sharp corners P T H

**A78-26234** # **Some singular aspects of three-dimensional transonic flow** W C Chin (Boeing Commercial Airplane Co , Seattle, Wash ) *AIAA Journal*, vol 16, Mar 1978, p 275-277

Certain singular aspects in the steady formulation for three-dimensional transonic flows are discussed The method of inner and outer expansions is used to show how two separate limits can be distinguished for the inner crossflow problem, the first leading to Laplace's equation and the second leading to a mixed-type equation The particular equation in any problem is determined by the relative value of an aspect ratio to a measure of the flow nonlinearity The required matching process then determines the role of the outer small disturbance equation in calculating near field surface pressures P T H

**A78-26235** # **Driver gas contamination in a high-enthalpy reflected shock tunnel** R J Stalker (Australian National University, Canberra, Australia) and K C A Crane *AIAA Journal*, vol 16, Mar 1978, p 277 279 7 refs

The calculations of Davies and Wilson (1969) are extended in order to account for experimentally observed contamination of the test gas by the driver gas in a high-enthalpy reflected shock tunnel at shock Mach numbers down to 60% of the tailored interface value At high primary shock speeds, the minimum Mach number in the boundary layer with respect to the transmitted shock does not occur at the wall, which suggests that bifurcation and, consequently, contamination are possible By means of a momentum relation, the wall jet velocity could be calculated, which was then used to estimate the time to contamination of the test section flow P T H

**A78-26238** # **Entrainment characteristics of unsteady subsonic jets** M F Platzer (U S Naval Postgraduate School, Monterey, Calif ), J M Simmons, and K Bremhorst (Queensland, University, Brisbane, Australia) *AIAA Journal*, vol 16, Mar 1978, p 282 284 16 refs Research supported by the University of Queensland and U S Navy, Australian Research Grants Committee Grant No F70/17452

Recent results on the entrainment characteristics of two types of unsteady jet flows are presented and discussed namely, oscillating jets with time-varying jet deflection and pulsating jets with time-varying mass flow A fluidically oscillated jet shows increase of up to 55% in the entrainment as compared to a steady jet Full jet pulsation is shown to have a powerful effect on entrainment In this case, entrainment increases with frequency of pulsation Volumetric flow rate measurements on a sinusoidally oscillated jet flap showed negligible variation from corresponding steady jet measurements This indicates that any significant influence of jet oscillation on entrainment processes must be confined to the vicinity of the nozzle P T H

**A78-26266** # **Stresses and deformations in stiffened panels with rectangular cut-outs I - On case of uniform tensile loads.** M Kuranisi, J Niisawa, R Sato, A Koiso, and T Nisimura *Nihon University, Research Institute of Science and Technology, Journal*, Aug 1977, p 205-220 In Japanese, with abstract in English

Formulas for calculating the stresses and deformations in panels, stiffened by stringers, with rectangular holes and with a uniform tensile load are presented, and the results obtained by use of these formulas are compared with experimental results The theoretical analysis considers the case of six stringers instead of the actual number of ribs and stringers, and exact solutions to the six-stringer problem are provided The procedure is intended for use in design problems involving aircraft and ship hulls M L

**A78-26274** * # **Three-dimensional canard-wing shape optimization in aircraft cruise and maneuver environments** B M E de Silva and R L Carmichael (NASA, Ames Research Center, Moffett Field, Calif ) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-99* 8 p 39 refs

This paper demonstrates a numerical technique for canard-wing shape optimization at two operating conditions For purposes of simplicity, a mean surface wing paneling code is employed for the aerodynamic calculations The optimization procedures are based on the method of feasible directions The shape functions for describing the thickness, camber, and twist are based on polynomial representations The primary design requirements imposed restrictions on the canard and wing volumes and on the lift coefficients at the operating conditions Results indicate that significant improvements in minimum drag and lift-to-drag ratio are possible with reasonable aircraft geometries Calculations were done for supersonic speeds with Mach numbers ranging from 1 to 6 Planforms were mainly of a delta shape with aspect ratio of 1 (Author)

**A78-26470** **The future determines the past - Bermuda I in the light of Bermuda II** A F Lowenfeld (New York University, New York, N Y ) *Air Law*, vol 3, no 1, 1978, p 2-10 47 refs

Differences between the First and Second U S -British Bermuda Agreements on air traffic are discussed Attention is given to the 'fair and equal opportunity' clause in the First Bermuda Agreement and the 'fair competition' clause in the Second Bermuda Agreement The Fifth Freedom clause of Bermuda I, which deals with secondary justification traffic, is critiqued, and the distinctions drawn in Bermuda II among transit, on-line connecting, and local traffic are analyzed Rate making and rate abrogation provisions of the agreements are also considered J M B

**A78-26471** **Bermuda II and after** T E Bridges (British Embassy, Washington, D C ) *Air Law*, vol 3, no 1, 1978, p 11-16

Some elements of the British viewpoint in renegotiating the Bermuda Agreement are presented Particular attention is given to the capacity control provisions that have been incorporated in the Bermuda II Agreement, and to the increase in the number of U S gateway cities to Great Britain The role of Bermuda II capacity control mechanisms in limiting competition on scheduled services is described, and the counterbalancing increase in charter and low-fare services is mentioned Rationalization of the fare structure to lessen advantages for those booking in advance is proposed J M B

**A78-26472** **The impact of Bermuda II on future bilateral agreements** R R Gray (Hale Russell Gray Seaman and Birkett, New York, N Y , Washington, D C ) *Air Law,* vol 3, no 1, 1978, p 17-22

The effect of the Bermuda II air transport agreement on future bilateral pacts negotiated by the U S is assessed The double-tracking system instituted by the agreement (a British carrier serving every route held by a U S carrier), as well as the gateway city policy and the reduction in U S carrier Fifth Freedom rights in the Pacific, is considered However, double-tracking and restrictions of U S carrier Fifth Freedom rights will probably not be introduced into future bilateral agreements between the U S and other nations, as shown by recent Japanese-U S negotiations. The possibility that the Bermuda II agreement is illegal under U S law is also discussed J M B

**A78-26474** **The Concorde v the United States - Some conclusions** S B Rosenfield (New England School of Law, Boston, Mass ) *Air Law,* vol 3, no 1, 1978, p 30-38 54 refs

Legal questions related to the approval of commercial service by the Concorde to the U S are reviewed The sixteen-month trial period for the Concorde at Dulles Airport, litigation over landing rights at Kennedy Airport in New York, and the possibility of Concorde service to other U S airports figure in the discussion The relevance of low-frequency vibration and vibration-rattle tests for determining the effective compliance of the Concorde with noise regulations is mentioned The prospects of Concorde landing rights at Philadelphia and Dallas-Fort Worth are also assessed J M B

**A78-26480** # **Optimum design of a landing gear shock absorber system** R Sankaranarayanan and J Nagabhushanam (Hindustan Aeronautics, Ltd , Bangalore, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 191-193

The nonlinear equations of motion of an oleo pneumatic shock absorber of a landing gear are set up for the touch-down condition These are solved using an analog computer and the optimum orifice diameter is obtained The criterion for optimization is that the integrated value of the modulus of the difference of energy stored in the shock absorber and the tire is a minimum Application of this method to a particular landing gear shows that the theoretical value of the best orifice diameter agrees with the results obtained from drop tests (Author)

**A78-26481** # **Maslen analysis of power-law shocks in inviscid hypersonic stream** S Hariharan and N R Subramanian (Indian Institute of Technology, Madras, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 195 199 8 refs

The thin shock layer approximation of Maslen (1964) for inviscid hypersonic flow past smooth symmetric bodies has been applied to power-law shocks and the corresponding body shapes obtained The existence of similarity solutions, as established by the hypersonic small disturbance theory, in regions away from the nose where nose bluntness will not be felt, is verified Body-to-shock radii ratios as well as pressure and density ratios obtained by this method for various power-law indices have been compared with similar results given by Kubota Body surface pressure compare excellently with calculations made using the laminar layer model (Author)

**A78-26482** # **Wildhaber-Novikov profiles for aircraft gears - A photoelastic study of the efficiency of strength-utilisation** K Ramachandra and K Lingaiah (Bangalore University, Bangalore, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 201-205 5 refs Research supported by Bangalore University and Council of Scientific and Industrial Research

The experimental method of evaluating the strength-utilization factor, the ratio of the maximum contact-stress to the maximum bending-stress by three-dimensional photoelastic technique, for Wildhaber-Novikov circular arc gears, is explained in this paper It was found that the experimental value of this factor ranges between 1 2 and 2 0 and that the profiles tested are suitable for case-carburized and nitrided steels The experimental results are also compared with those obtained by theoretical analysis (Author)

**A78-26484** # **Evaluation of torsional rigidity of circular arc aerofoil section twisted bars** H B Khurasia, L D Balani, and S Rawtani (M A College of Technology, Bhopal, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 213-217 5 refs

A method based on the solution of the integral equation approach and the evaluation of a modified warping function on the boundary of the section is discussed for the determination of torsional rigidity of any general cross-section The method is used for circular arc aerofoil section and the study of change in its dimensional parameters on the value of torsional rigidity A twist correction factor has also been evaluated through the use of which the torsional rigidity of twisted circular arc aerofoil section can be obtained The results have been presented in the form of empirical formulae (Author)

**A78-26487** # **A free-oscillation test rig for pitch-damping measurements in N A L trisonic wind tunnels** H Sundara Murthy (National Aeronautical Laboratory, Bangalore, India) and T Narayana (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 227-230 18 refs

A free-oscillation test rig has been developed for measuring pitch- or yaw-damping derivatives of sting-mounted models in a trisonic wind tunnel The rig is limited in applicability to sting-mounted models with moderate fineness ratios and with fairly aft centers of rotation Results of evaluation testing of the rig with a 25 deg cone model are in good agreement with published data J M B

**A78-26488** # **One axis artificial feel system** S Balakrishna and A Santharam (National Aeronautical Laboratory, Bangalore, India) *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 231-236 12 refs

Joy stick feel forces, called proprioceptive cues, provide an important sensory feedback to the pilot Ideally the stick would possess feel forces governed by maneuvers, aerodynamic and structural forces and manual control requirements Such ideal systems are not normally incorporated in aircraft, since these forces vary continuously and are difficult to produce artificially This paper discusses a mechanization technique by which such a goal can be achieved The technique consists of combining an electro-hydraulic position and load closed loop system which can accept any load-position-time command from an electronic function generator The closed loop dynamic analysis is made and the system is synthesized Such a feel system is being used in a ground based motion simulator (Author)

**A78-26489** # **Effect of blockage ratio on the turbulent near wake of a bluff body** R K Sullerey, A K Gupta (Indian Institute of Technology, Kanpur, India), and C S Moorthy *Aeronautical Society of India, Journal,* vol 28, May 1976 (Dec 1977), p 237-239 8 refs

The influence of blockage ratio on the turbulent near wake of a bluff body is studied for blockage ratios of 10 6%, 17 7% and 25 0% Mean velocity and turbulence intensity distributions across the wakes are reported Results indicate that the recirculation region is the source of most of the turbulence produced out of the mean flow Viscous dissipation is the mechanism accounting for turbulence flow decreases beyond the mean flow J M B

**A78-26498** **Noise generated by low pressure axial flow fans III - Effects of rotational frequency, blade thickness and outer blade profile** T Fukano, Y Kodama, and Y Takamatsu (Kyushu University, Fukuoka, Japan) *Journal of Sound and Vibration,* vol 56, Jan 22, 1978, p 261-277 7 refs

A78-26533 **Black Hawk, Lamps and AAH** M Lambert *Flight International*, vol 113, Feb 25, 1978, p 503-509

Based on experience gained in Vietnam, the Army has opted to maintain and refine its helicopter assault capability Design and operating parameters of the Sikorsky UH-60A (Black Hawk) are presented, together with a cutaway illustrating major components Among the advantages of the UH-60A over the older UH-1 Huey are increased capacity, greatly increased maneuverability, better survivability against electronic warfare, improved med evac capability, and ease of maintenance through modular subsystems Also discussed are the Navy Lamps Mk III and the AH-64 attack helicopter, with attention to anti-submarine warfare and anti armor capability, respectively D M W

A78-26549 # **Precision DME for new landing system - Fast or slow pulse** D Graziani (Fabbrica Apparecchiature per Comunicazioni Elettriche Standard S p A , Milan, Italy) *Electrical Communication*, vol 52, no 4, 1977, p 289-292 6 refs

Slow and fast pulse techniques for precision distance measuring equipment used for collocation with microwave landing systems are compared Each system is evaluated on the basis of multipath echo effects on ground and airborne equipment, dynamic signal range, accuracy and timing requirements, compatability with existing equipment, modification to ICAO specifications, overall costs, and inherent risks It is found that the fast pulse method offers both technical and economic advantages over the slow pulse method S C S

A78-26599 * **A uniqueness proof for a transonic flow problem** L P Cook (California, University, Los Angeles, Calif ) *Indiana University Mathematics Journal*, vol 27, Jan -Feb 1978, p 51-71 11 refs Grant No NsG-2171

The uniqueness of the first-order lifting-line correction to the two-dimensional transonic small disturbance potential for the flow past a lifting, three-dimensional, large-aspect-ratio wing is proved The correction is the solution of a linear equation of mixed type in the plane slit along the positive x-axis The boundary data consist of Neumann data, continuity restrictions, the Kutta condition, and the form of the asymptotic behavior at infinity The zeroth-order flow is assumed to be shock-free, and hence the correction is shock-free P T H

A78-26739 **The Concorde and cosmic rays** J Lavernhe, E Lafontaine, and R Laplane (Compagnie Nationale Air France, Paris, France) *Aviation, Space, and Environmental Medicine*, vol 49, Feb 1978, p 419-421 5 refs

The Concorde is known to cruise at an altitude between 15,300 and 18,300 m and is therefore exposed to increased cosmic radiation due to the reduced thickness of the overlying protective shield of the atmosphere From January 21, 1976 - date of the inaugural flight to Rio de Janeiro - through December 31, 1976, Air France's Concordes operated 2642 hr of commercial flights between Paris and Rio de Janeiro, Caracas, and Washington During each of these flights, the amount of cosmic radiation dose equivalent rate was measured in order to collect a great amount of information about the possible risks of supersonic air transportation It is found that the dose equivalent rates recorded do not represent the slightest risk for passengers, who would have accumulated about 150 mrem of radiation when flying a round trip every month throughout 1976, this figure is much lower then the annual limit of 500 mrem recommended for the general public Likewise, a crew member flying a total of 500 hr aboard Concordes would absorb less than 500 mrem S D

A78-26756 # **Temperature characteristics of the speed of sound and compressibility of standard fuels and petroleum oils (Charakterystyki temperaturowe predkosci ultradzwiekow i scisliwosci standardowych paliw i olejow naftowych)** W Szachnowski and B Wislicki *Instytut Lotnictwa, Prace*, no 69-70, 1977, p 79-102 6 refs In Polish

The speed of sound and compressibility of liquid fuels and lubricating and hydraulic oils were measured by an ultrasonic interferometric method in the temperature range from near the solidification point up to 20 C for fuels and 90 C for oils Products tests were standard ones of Polish and non-Polish production, and included gasolines, jet fuels, diesel fuels, heating fuels, pure mineral lubricants with additions, synthetic aviation oils, viscosity improvers, and ethyl liquid P T H

A78-26780 # **Radar beacon tracking with downlinked heading and airspeed** W M Hollister (MIT, Cambridge, Mass ) and M S Venturino (MIT, Cambridge, Mass , R Dixon Speas Associates, Inc , Lake Success, N Y ) *Journal of Guidance and Control*, vol 1, Jan -Feb 1978, p 21-25 7 refs

Position, ground velocity, and the wind are estimated using flight data acquired by the Discrete Address Beacon System (DABS) The measurements consist of radar range and bearing plus telemetered airspeed and heading sampled every 4 s The data are used to determine statistics for the random errors in range and bearing, the random compass and airspeed errors, and the flight technical error in holding heading and airspeed The random errors were found to be small in comparison to airspeed and heading-dependent compass biases After correction for biases a fixed-gain filter provided wind estimates with an uncertainty of 2 knots (1 sigma) over a bandwidth of 0 05 Hz The air-derived data were effective in improving tracking during vehicle accelerations or when a component of the DABS data was missing or inaccurate Deterioration of the quality of measured data was detectable by monitoring the measurement residuals The results have implications for systems which attempt to do large-area wind mapping with radar and telemetered air data (Author)

A78-26784 # **Dual-control guidance strategy for homing interceptors taking angle-only measurements** R J Casler, Jr (Charles Stark Draper Laboratory, Inc , Cambridge, Mass , Bethlehem Steel Corp , Bethlehem, Pa ) *Journal of Guidance and Control*, vol 1, Jan Feb 1978, p 63-70 9 refs Grant No DASG60-76 C 0020

A discrete dual-control homing guidance law is proposed to improve intercept capabilities when angle-only measurements are available A two-maneuver intercept is considered where the first maneuver inserts a measurable line-of-sight (LOS) rate to enhance the estimate of a key guidance parameter prior to the terminal maneuver used to null intercept miss A numerical technique is proposed to evaluate the gradient of the variance of the chosen parameter with respect to a velocity correction A first order search is used to find a velocity correction that minimizes or substantially reduces the terminal variance The algorithm is extended to multiple-burn scenarios and is evaluated using the terminal estimation error in miss, velocity correction, and time-to-go, respectively, as the control criterion The results yield interesting insights into the information content in the angle measurements More importantly, they indicate that the dual control guidance law suggested here could reduce rms angle-measurement accuracy requirements by a factor of 10 or more, compared to that needed by a more traditional guidance approach, while still maintaining terminal intercept performance (Author)

A78-26785 * # **Kalman filter divergence and aircraft motion estimators** A E Bryson, Jr (Stanford University, Stanford, Calif ) *Journal of Guidance and Control*, vol 1, Jan -Feb 1978, p 71-79 11 refs Grant No NGL-05-020-007

Kalman filters designed for many aerospace systems turn out to be unsatisfactory The estimate errors become large compared to the errors predicted by the theory ('divergence') One of the principal causes of this failure is that the system model contains states or modes that are undisturbed by the modeled process noise, and are neutrally stable (NS) One cure for such problems is periodic restarting of a time-varying Kalman filter Other cures include minimum variance observers with eigenvalue constraints, added noise, pole-shifting, and destabilization Several examples are given, including effective time-invariant estimators for the longitudinal and lateral motions of an airplane where several NS modes are undisturbed by wind gusts An interpretation of these estimators as a

'strapdown IMU' without accelerometers, gimbaled gyros, or servos is given (Author)

**A78-26791** # **Discrete maneuver pilot models for flying qualities evaluation** E D Onstott and W H Faulkner (Northrop Corp , Aircraft Group, Hawthorne, Calif ) *Journal of Guidance and Control,* vol 1, Mar -Apr 1978, p 97-100 7 refs Contract No F33615-77-C-3008

A new approach to flying qualities specification and evaluation is presented which coordinates current research in the areas of pilot ratings, pilot-aircraft modeling techniques, and simulation and flight test procedures A time domain pilot model is described which can model discontinuous and nonlinear pilot behavior in conjunction with completely general time-varying nonlinear aircraft models to simulate both discrete and continuous maneuvers This pilot-aircraft model is applied to an existing set of in-flight simulation data, and calculates tracking error and time-on-target statistics for step target tracking that directly relate to the reported pilot comments and ratings (Author)

**A78-26793** * # **Multivariable quadratic synthesis of an advanced turbofan engine controller** R L DeHoff and W E Hall, Jr (Systems Control, Inc , Palo Alto, Calif ) *Journal of Guidance and Control,* vol 1, Mar -Apr 1978, p 136-142 16 refs NASA-sponsored research, Contract No F33615-75-C-2053

A digital controller for an advanced turbofan engine utilizing multivariate feedback is described The theoretical background of locally linearized control synthesis is reviewed briefly The application of linear quadratic regulator techniques to the practical control problem is presented The design procedure has been applied to the F100 turbofan engine, and details of the structure of this system are explained Selected results from simulations of the engine and controller are utilized to illustrate the operation of the system It is shown that the general multivariable design procedure will produce practical and implementable controllers for modern, high-performance turbine engines (Author)

**A78-26795** * # **Ride quality flight testing** R L Swaim (Purdue University, West Lafayette, Ind ) *Journal of Guidance and Control,* vol 1, Mar -Apr 1978, p 159, 160 5 refs Grant No NsG-4003

The ride quality experienced by passengers is a function of airframe rigid-body, elastic dynamic responses, autopilot, and stability augmentation system control inputs A frequency response method has been developed to select sinusoidal elevator input time histories yielding vertical load factor distributions, within a given limit, as a function of fuselage station The numerical technique is illustrated by applying two-degree-of-freedom short-period and first symmetric mode equations of motion to a B-1 aircraft at Mach 0 85 during sea level flight conditions S C S

**A78-26796** # **Squeeze film damper characteristics for gas turbine engines** R A Marmol (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla ) and J M Vance (Florida, University, Gainesville, Fla ) *(American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77-DET-23 ) ASME, Transactions, Journal of Mechanical Design,* vol 100, Jan 1978, p 139-146 9 refs Army-supported research

A mathematical model for squeeze film dampers is developed, and the solution results are compared with data from four different test rigs A special feature of the analysis is the treatment of several different types of end seals and inlets, with inlet feedback included A finite difference method is used to solve the Reynolds equation, with a banded matrix inversion routine The test data are taken from a new high-speed free-rotor rig, and from three previously tested controlled-orbit rigs (Author)

**A78-26834** **The damage sum in fatigue of structure components** A Buch (Technion - Israel Institute of Technology, Haifa, Israel) *Engineering Fracture Mechanics,* vol 10, no 2, 1978, p 233-247 35 refs

The effect of loading spectrum parameters and type of tested specimen was studied from the viewpoints of deviations from Miner's rule and of the value of the minimum cycle ratio sum at failure It was found that a minimum cycle ratio sum may be chosen for sufficiently high values of spectrum parameters maximum stress and mean stress The increase of the cycle ratio sum with the parameters of the spectrum is connected with the effect of increased strain hardening and residual compressive stresses Some complex effects of the maximum stress and of the failure stress level on the damage sum were observed, which cannot be explained by the residual stress concept A normal and a reversed loading sequence effect was established in two-stress level tests (Author)

**A78-27027** **Access study and simulation of the Marots communication system** P J Emstad and G R Stette (Norwegian Institute of Technology, Trondheim, Norway) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 41 6-108 to 41 6-112 Research sponsored by the European Space Agency

The first part of the paper describes multiple access, signalling and channel assignment of the maritime satellite communication system Marots Several shore stations may on an equal basis be sharing the satellite capacity Basic ideas of a shore-to-shore station control procedure are given To verify and evaluate this part of the system prior to implementation, it was found necessary to simulate the system on a digital computer The paper describes this simulator, written in SIMULA 67 The simulator has been designed with high degree of modularity and it can therefore be modified to represent systems of similar structure (Author)

**A78-27032** **UHF demand assigned multiple access /UHF DAMA/ system for tactical satellite communications.** J A Nooney (U S Navy, Naval Electronic Systems Command, Washington, D C ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3
New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 45 5-200 to 45 5-204

A military tactical communications system is described which uses 25 KHz hard-limiting UHF satellite repeater channels Data will be transmitted over the system at a rate of 75 to 4800 bps, with a burst speed of 2400 to 32,000 bps with BPSK and QPSK modulation Data interleaving and convolution encoding minimize interference from other satellite transmissions System design and parameters are discussed with attention to user platforms, e g , vehicles, surface ships, submarines, and aircraft An increasingly automated assignment of priority channels will pre-empt data slots as necessary D M W

**A78-27037** **Null steering antennas in the tactical scenario** F L Cloutier (USAF, Electronic Systems Div , Bedford, Mass ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3
New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 48 1-257, 48 1-258

This paper serves as an introduction to a series of papers relative to null steering antennas Although null steering antennas have been the subject of much analysis and several types of systems are in use, the employment of this technology for tactical aircraft continues to be extremely difficult Representative tactical scenarios and their impact on the design of airborne null steering antenna systems are discussed The unstructured, multi-terminal, nodeless, unlimited access system used by tactical air forces constitutes a formidable challenge to the designer of advanced antenna systems (Author)

**A78-27038** **Active reference null steering for spread spectrum signals** G H Piesinger (Motorola, Inc , Government Electronic Div , Scottsdale, Ariz ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3

New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 48 2-259 to 48 2-262

This paper describes Motorola's narrowband and wideband null steerers for airborne tactical communication systems Both null steerers utilize the LMS algorithm and active references to achieve null depths on the order of 50 dB The wideband configuration incorporates a weighted tapped delay line to achieve broadband null depths comparable to those provided by the narrowband system (Author)

**A78-27039** **Analog versus digital null-steering controllers** G G Rassweiler, F Wallace, and C Ottenhoff (Harris Corp , Melbourne, Fla ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 48 3-263 to 48 3-265

Adaptive optimization of phased arrays may be achieved by correlation control (steepest descent approach or optimum calculation) or search optimization control The paper discusses several possible implementations of adaptive arrays, both analog and digital, and provides results of a digitally searched adaptive array All the arrays use output power as a straightforward performance measure for minimization Digital search control of analog RF weights, where no correlations are required, is discussed, the digital logic searches the weights to obtain a minimum output power It is shown that for the adaptive processing of wideband RF signals (greater than 10 MHz), the simplest implementation appears to be the digital search of RF weights The results of a simple four-element experimental digital search breadboard are examined, with special attention to questions of jitter search and obtainable null depth It is shown that even with actual weights and D/A control, digital search control using fine quantization can achieve very deep nulls in 30-40 iterations S D

**A78-27040** **Adaptive phased arrays for tactical communication systems** C D Wang (Cutler-Hammer, Melville, N Y ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 48 5-267 to 48 5-272 9 refs

An adaptive array that rejects undesired or interfering signals for tactical communication systems is presented The array pattern is controlled by an adaptive feedback system based on a steepest descent maximization of signal-to-interference ratio (SIR) Maximization of SIR is closely related to minimization of mean-square error This paper presents an All Digital Adaptive Phased Array (ADAPA) performance in the presence of interference Time domain design and analysis employing digital signal processing techniques to simulate the ADAPA performance are presented The structure of the software routines reflect the exact hardware configurations to implement the system Both the transient and steady-state behavior of the array can be evaluated Examples of the simulations are included (Author)

**A78-27041** **An adaptive interference cancellation system for elimination of co-located interference signals** W F Geist (Hazeltine Corp , Greenlawn, N Y ) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 48 6-273 to 48 6-276

Design concept and capabilities are described for a single-loop adaptive interference canceller that permits a substantial reduction in the frequency and spatial separation of colocated receive and transmit frequencies and antennas Performance specifications are frequency range from 118 to 136 MHz, cancellation greater than 55 dB null depth, and response time less than 20 msec The canceller is designed to protect VHF voice communication receivers from multiple AM, FM, or CW interference signals Test results suggest that the adaptive interference canceller offers a suitable alternative to currently used methods of eliminating colocated interference signals Rejection levels exceeding 55 dB can be achieved with a frequency separation between receive and transmit frequencies of only 14 kHz Since the canceller requires minimum alterations for installation, the impact on existing physical terminal facilities is negligible S D

**A78-27049** **The MAROTS maritime satellite programme** T F Howell (European Space Agency, Paris, France) In International Conference on Communications, Chicago, Ill , June 12-15, 1977, Conference Record Volume 3 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 321-324

The paper describes the MAROTS satellite programme of the European Space Agency, and continues by concentrating on the mission foreseen for this satellite for maritime communications The paper illustrates services that will be possible, together with additional experiments, concerning access control and signaling, the performance of voice and data channels, the evaluation of various types of ship terminals, experiments to explore the use of satellites for distress and safety messages and operational experiments which may lead to the quantification of channel requirements for future service possibilities (Author)

**A78-27139** # **Experimental investigation of the temperature field in a plane channel carrying a stratified turbulent air stream (Eksperimental'noe issledovanie polia temperatury pri turbulentnom stratifitsirovannom techenii vozdukha v ploskom kanale)** V A Kuleshov, A F Poliakov, and Iu V Tsypulev (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *Teplofizika Vysokikh Temperatur,* vol 15, Nov Dec 1977, p 1316-1318 10 refs In Russian

**A78-27143** **Artificial control of the laminar-turbulent transition of a two-dimensional wake by external sound** H Sato and H Saito (Tokyo, University, Tokyo, Japan) *Journal of Fluid Mechanics,* vol 84, Feb 27, 1978, p 657-672 8 refs

Artificial acceleration and deceleration of the transition process in a two-dimensional wake were attempted The wake was produced behind a thin aerofoil placed parallel to uniform flow The sound from a loudspeaker introduced into the wake acted as an artificial disturbance Various kinds of sound were tested and the effect on the transition was judged by the energy spectrum Sinusoidal sound of the frequency of the maximum growth rate in the linear region decelerates the transition, whereas sound of a different frequency accelerates it Sound of two or four frequencies is more effective in accelerating the transition when the frequencies are properly chosen White noise from the loudspeaker is not effective, but a two-peak noise specially designed for strong nonlinear interaction is the most effective in accelerating the transition process These results can be explained by two empirical properties of the nonlinear interaction the growth suppression induced by a large amplitude fluctuation and the stronger interaction between fluctuations of closer amplitudes (Author)

**A78-27144** **The noise from the large-scale structure of a jet** J E Ffowcs Williams and A J Kempton (Cambridge University, Cambridge, England) *Journal of Fluid Mechanics,* vol 84, Feb 27, 1978, p 673-694 24 refs

In this paper we assess the importance as a noise source of the well-ordered large-scale structure of a jet We propose two simple models of the structure the first emphasizes those features in common with waves that initially grow on an unstable shear layer but eventually saturate and decay, while the second regards the abrupt pairing of eddies as the most significant event in the jet's development Our models demonstrate the possibility that forcing at one frequency could increase the broad-band noise of a jet, though, for jets with supersonic eddy convection velocities, the sound propagating in the direction of the Mach angle retains the spectrum of the excitation field These features are consistent with the available experimental data, and strongly support the view that the large-scale structure of jet turbulence provides the dominant contribution to jet noise (Author)

**A78-27146** **The wave system attached to a finite slender body in a supersonic relaxing gas stream** Y L Sinai and J F Clarke (Cranfield Institute of Technology, Cranfield, Beds., England) *Journal of Fluid Mechanics*, vol 84, Feb 27, 1978, p 717-741 42 refs

The results of a companion paper are extended to encompass the flow about smooth, but otherwise general body shapes The wave behavior depends on three important parameters, namely the body thickness ratio, a quantity proportional to the difference between the frozen and equilibrium sound speeds, and the ratio of a relaxation time to a characteristic flow time Both analytical and numerical solutions have been obtained, account is taken of nonlinearity for complete spectra of the three parameters, enabling an assessment to be made of the evolution of the wave forms for a host of situations In particular, it is possible to predict the structures of the shock waves in various regions, and it transpires that under certain conditions vibrational relaxation can overwhelm other dissipative effects (Author)

**A78-27259** **Fatigue resistance of aircraft propeller blades** M N Stepnov, A S Seregin, O V Leonova, Iu L Sukhorosov, E I Kulikov, and E V Dunaev *(Problemy Prochnosti*, May 1977, p 36-39 ) *Strength of Materials*, vol 9, no 5, Jan 1978, p 550-554 7 refs Translation

In the present paper, fatigue data obtained for aircraft propeller blades and helicopter rotors of various type are generalized The distribution of aircraft propeller fatigue strength logarithms is found to be satisfactorily described by a normal law Equations providing a satisfactory description of the fatigue curves are derived, along with relations characterizing the behavior of the rms deviations of the number-of-cycle logarithms from the experiment V P

**A78-27266** **Nonuniformity of the flow, exciting vibrations in working turbine blades** A S Laskin, N D Salivon, and V F Kondrat'ev (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) *(Problemy Prochnosti*, May 1977, p 94-96 ) *Strength of Materials*, vol 9, no 5, Jan 1978, p 612-615 Translation

The flow behind a turbine blade cascade was studied by a continuously recording device The nonuniformity of the flow depends on potential perturbations and the aerodynamic vortex wakes behind the blade edges Plots of the nonuniformities are presented Energy losses resulting from the nonsteady-state interactions of the blades and complications requiring attention to the first harmonic of the joint nonuniformities are considered M L

**A78-27267** **Automated vibrating bench for studying fatigue in gas turbine blades with programmed changes in load and temperature** V T Troshchenko, A P Voloshchenko, B A Griaznov, V A Rovkov, V G Grishko, N A Fot, V I Tseitlin, D S Elenevskii, R S Bekbulatov, and E G Konopliannikov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti*, May 1977, p 97-104 ) *Strength of Materials*, vol 9, no 5, Jan 1978, p 616-622 Translation

**A78-27383** **Error analysis and simulation concerning an inertial navigation system with vehicle-fixed sensors (Fehleranalyse und Simulation eines Traghelts-Navigationssystems mit fahrzeugfesten Sensoren)** H Baumann Braunschweig, Technische Universitat, Fakultat fur Maschinenbau und Elektrotechnik, Dr -Ing Dissertation, 1976 163 p 89 refs In German

The reported investigation has the objective to obtain information concerning the navigational errors which are to be expected as a consequence of effects related to the individual components of the system (sensors, computer) A simulation of the dynamics and the error characteristics of a strapdown integrating gyroscope with momentum feedback is conducted It is found that the described procedure of 'ternary feedback' leads to amplitude-dependent frequency characteristics in connection with the existence of pronounced nonlinearity effects Attention is also given to the requirements which the onboard computer will have to satisfy, directional processes needed in connection with the great effect of the initial orientation on the accuracy of platform systems, and the effect of various component errors on the navigation accuracy in the case of a rocket flight trajectory and the flight path of an airliner G R

**A78-27406** # **Optimal aperture-shape for an antenna array (Ob optimal'noi forme apertury antennoi reshetki)** Iu F Uchaev *Radiotekhnika*, vol 32, Dec 1977, p 50-54 In Russian

Cost quality criteria are used to develop an optimization procedure for the aperture shape of a radionavigation-system antenna-array The optimal shape for such an array is determined to be a surface of revolution with a curvilinear generatrix, determined in accordance with the obtained value of A-max(beta) - the required relationship between the effective surface of the array and the angle of elevation Since this optimal shape is difficult to realize, it is suggested that quasi-optimal shapes (an aperture composed of simpler apertures in the form of conical or cylindrical surfaces with a common axis of symmetry and placed one on top of the other) be used instead B J

**A78-27451** **All-Union Seminar on Inverse and Conjugate Problems of Heat Transfer, 2nd, Moscow, USSR, October 19-21, 1976, Proceedings (Vsesoiuznyi Seminar po Obratnym i Sopriazhennym Zadacham Teploobmena, 2nd, Moscow, USSR, October 19-21, 1976, Materialy)** *Inzhenerno-Fizicheskii Zhurnal*, vol 33, Dec 1977 192 p In Russian (For individual items see A78-27452 to A78-27474)

The papers deal essentially with advanced methods of processing heat-test data and with inverse heat transfer problems which form the basis for analyzing heat transfer processes, modeling thermal modes of operation, and designing heat shields Practical applications of solutions to inverse and adjoint heat conduction problems are outlined V P

**A78-27452** # **Some aspects of the thermal design of flight vehicles and processing of heat-test data (Nekotorye problemy teplovogo proektirovaniia letatel'nykh apparatov i ikh eksperimental'noi obrabotki)** B M Pankratov *(Vsesoiuznyi Seminar po Obratnym i Sopriazhennym Zadacham Teploobmena, 2nd, Moscow, USSR, Oct 19-21, 1976 ) Inzhenerno-Fizicheskii Zhurnal*, vol 33, Dec 1977 p 967-971 In Russian

The current status of thermal testing and designing is reviewed and some methodological problems arising in such tests are examined Attention is given to the application of computer methods for solving inverse problems to the thermal design and modeling of flight vehicles for thermal constraints It is shown that modern thermal testing requires rational planning (including the development of effective mathematical planning methods), as well as automation of the principal functions involved in data processing The feasibility of simulating numerically complex unsteady heat and mass transfer processes occurring in the interaction between bodies and gas flows is discussed V P

**A78-27455** # **Application of a new test method and a new wind-tunnel-data processing technique to the study of unsteady heat conduction processes (Primenenie novoi metodiki ispytaniia i obrabotki rezul'tatov eksperimenta v teplovoi aerodinamicheskoi trube pri issledovanii protsessov nestatsionarnoi teploperedachi)** O M Alifanov, N I Batura, A M Bespalov, M I Gorshkov, N A Kuz'min, and A I Maiorov *(Vsesoiuznyi Seminar po Obratnym i Sopriazhennym Zadacham Teploobmena, 2nd, Moscow, USSR, Oct 19-21, 1976 ) Inzhenerno-Fizicheskii Zhurnal*, vol 33, Dec 1977, p 988-992 In Russian

A78-27542 # **Future CTOL aircraft characteristics** J P Braaksma (Carleton University, Ottawa, Canada) *ASCE, Transportation Engineering Journal*, vol 103, July 1977, p 477-490 23 refs Research supported by the Air Transportation Administration of Canada, National Research Council of Canada Grant No A-8927

A suitable planning of the design of the physical facilities of an airport requires a consideration of current and future aircraft characteristics A description is in this connection presented of some of the main trends concerning the development of CTOL aircraft characteristics Factors affecting aircraft development are examined, taking into account the air transport market, the supply of aircraft, and new developments in advanced technology Seventeen aircraft characteristics are considered No new aircraft types are expected to be introduced into service from now until 1980 The only problem airport operators would face during this period would be related to gate requirements and passenger handling inside the terminal building If economic conditions continue to improve, then for the period from 1980-1990 new aircraft in the form of derivatives of existing aircraft will enter service Assuming a continuous growth in the economy, it could be expected that larger aircraft of 700-passenger to 900-passenger capacity would appear during the period from 1990 to the year 2000 G R

A78-27547 **Airport choice in low demand region** F-B Lin (Clarkson College of Technology, Potsdam, N Y) *ASCE, Transportation Engineering Journal*, vol 103, Nov 1977, p 711-727 11 refs

Airport choice characteristics of residents in the Massena-Ogdensburg-Potsdam area of St Lawrence County, NY were studied using data obtained in a telephone survey The area is remote from large U S metropolitan areas, Montreal Airport is the closest major airport The most influential factors governing the choice of airport were found to be the international boundary, ground access distance, and level of service represented by flight frequency and number of reachable destinations Airport choice behaviors were explained by a binary choice process The modeling approach, which calls for the combination of limited data with heuristic reasonings, is described The application of this method to the problem of choosing a site for a regional airport is considered M L

A78-27548 **Formulation of Iowa State airport system** R L Carstens (Iowa State University of Science and Technology, Ames, Iowa) and J W Murphy *ASCE, Transportation Engineering Journal*, vol 103, Nov 1977, p 751-762 10 refs Research supported by the Iowa Department of Transportation, Engineering Research Institute and FAA

The paper describes a method for comparing direct economic benefits with the costs of developing general aviation airports to serve as incremental additions to a state airport system Implementation of the method is discussed with reference to Iowa and the airports there Criteria for system formulation are explained, and methodological techniques, including direct benefits, indirect benefits, the map method, and the shortcut method are discussed A basic selection of 25 airports was made, and 29 incremental additions to the system satisfied economic criteria Since this system of 54 airports did not afford sufficient geographical coverage, an additional 26 airports were selected (by a described procedure) to provide 96 4% coverage and to serve (within 45 minutes surface travel) 98 7% of the state's population M L

A78-27567 # **Tentative establishment of a mathematical model of a turbojet engine as a controlled system (Proba okreslenia modelu matematycznego silnika turboodrzutowego jako obiektu regulacji)** F Lenort *Instytut Lotnictwa, Prace*, no 68, 1977, p 3-25 21 refs In Polish

With the aid of the equations of state of a turbojet engine known from the literature, a mathematical model of the engine, which is considered to constitute a controlled system, is determined in the form of a nonlinear difference-differential equation of the second order The coefficients of this equation are derived by the method of regression functions on the basis of statistical data obtained from engine flight tests The regression functions are constructed, for particular coefficients, according to the principles of the theory of similarity as applied to the turbojet engine The importance of the regression functions and the regression coefficients is assessed by statistical methods by applying Snedecor's F-test The agreement between the regression functions and the experimental data is tested by the method of root-mean square errors (Author)

A78-27568 # **Static electricity in aviation and methods for preventing its effects II (Elektrycznosc statyczna w lotnictwie oraz sposoby zabezpieczenia przed jej skutkami II)** K Zuchowicz *Instytut Lotnictwa, Prace*, no 68, 1977, p 27-46 11 refs In Polish

The article discusses problems associated with static electricity in aviation and suggests methods for preventing its effects The factors which influence the formation of electrostatic charges during fuel flow are identified, and the necessary conditions for igniting mixtures of various fuels with the air are discussed Techniques for reducing the possibility of static electricity formation during fuel flow are outlined S C S

A78-27588 **The fluid dynamics of rarefied molecular flow over convex bodies - A new theory and applications.** N Bellomo (Torino, Politecnico, Turin, Italy) *Zeitschrift fur angewandte Mathematik und Physik*, vol 29, Jan 25, 1978, p 112-122 23 refs

A methodology is proposed for the determination of the interaction coefficients in the case of a system involving a monochromatic gas in contact with an aluminum surface The methodology takes into account recent results obtained by Liu et al (1977) and theoretical considerations reported by Bellomo et al (1977) The scattering kernel corresponding to a gas beam interacting with an aluminum surface is determined and an expression is obtained of the dimensionless force and the heat flux in the case of an elementary area in Knudsen flow The results are employed to determine the drag and the heat flux for convex bodies under rarefied gas conditions The values of the accommodation coefficients are given on the basis of a minimization of the distance between a theoretical and an experimental function G R

A78-27721 # **Aircraft measurements of the spatial fluctuation characteristics of atmospheric radio emission at wavelengths of 0 8 and 1 35 cm (Samoletnye izmereniia prostranstvennykh kharakteristik fluktuatsii radiozluchenila atmosfery na volnakh 0,8 i 1,35 cm)** S P Gagarin and B G Kutuza (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR) *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol 13, Dec 1977, p 1307-1311 8 refs In Russian

A78-27840 # **A case for a new model for turbulent flame propagation** U S P Shet, K S Padiyar, and M C Gupta (Indian Institute of Technology, Madras, India) In National Conference on Internal Combustion Engines and Combustion, 3rd, Roorkee, India, December 10-12, 1976, Proceedings Meerut, India, Sarita Prakashan, 1976, p 359-368 17 refs

This paper highlights the need for a fresh look at the mechanism of turbulent flame propagation A critical review of the existing theories of turbulent flame propagation is made and the inherent contradiction in them is emphasized Though the recent correlations of the turbulent burning velocity data are improvements over the earlier models, there are still some deficiencies in the correlations which are brought out in this paper It is proposed that the correlations could be improved by considering the effects of both large-scale and small-scale eddies represented by two dimensionless parameters The turbulent burning velocity data of Vinckier and Van Tiggelen (1968) could be correlated successfully according to the above proposal The success of the correlation points out the need for a new model of turbulent flame propagation (Author)

A78-27886 * **Response of periodic beam to supersonic boundary-layer pressure fluctuations** Y K Lin, S Maekawa, H Nijim (Illinois, University, Urbana, Ill ), and L Maestrello (NASA,

Langley Research Center, Hampton, Va ) In Stochastic problems in dynamics, Proceedings of the Symposium, Southampton, England, July 19-23, 1976 London, Pitman Publishing, Ltd , 1977, p 468-485, Discussion, p 486 10 refs

The response of a periodic beam (modeling a periodic fuselage) to supersonic boundary-layer pressure fluctuations is analyzed on the basis of a scheme in which a decaying turbulence is treated as a superposition of frozen-pattern components, thus allowing the structural response to be similarly superposed and the advantage of frozen-pattern analysis to be maximally utilized The fundamental solution required for the construction of the total response is one corresponding to the excitation of a frozen-pattern sinusoid To obtain this fundamental solution, the formulation follows Mead's wave-propagation method (1971), but also takes into account the effect of freestream velocity on the same side of the turbulence excitation and the effect of a cavity on the opposite side of the excitation As a numerical example, the spectral density of the structural response is computed and the results are compared with experimental data B J

**A78-27887 Optimum structural design of sheet-stringer panels subjected to jet noise excitation** S Narayanan (Indian Institute of Technology, Madras, India) and N C Nigam (Indian Institute of Technology, Kanpur, India) In Stochastic problems in dynamics, Proceedings of the Symposium, Southampton, England, July 19-23, 1976 London, Pitman Publishing, Ltd , 1977, p 487-513, Discussion, p 514 16 refs

The minimum weight design problem for sheet-stringer panels subjected to jet noise excitation is formulated in a reliability framework for the case of the jet-noise pressure distribution treated as a stochastic process The problem is reduced to a nonlinear programming problem and solved on a digital computer using the unconstrained minimization problem It is found that the optimum design is sensitive to constraints in specified probability of failure and fatigue damage level, but that the design is insensitive to the manner in which the constraints on stresses are applied It is noted that the side constraint in the stringer spacing is active in all cases B J

**A78-27907** # **On the flow in a centrifugal impeller II - Effects of change in impeller width** S Murata, T Ogawa (Osaka University, Suita, Japan), and M Gotoh (Ebara Corp , Fujisawa, Japan) *JSME, Bulletin,* vol 21, Jan 1978, p 90-97 17 refs

In this paper, a method is presented to analyze the flow in a variable-width centrifugal impeller This analysis has been based on Hoffmeister's method and new considerations have been added to the analyses of through flow and displacement flow This method is applied to the calculation of nonviscous and incompressible fluid flow through the centrifugal impeller with thin logarithmic spiral vanes, the velocity and pressure distributions on the vane surfaces and the influence of the impeller width ratio on the performance of the impeller are shown (Author)

**A78-27908** # **Decay and modification of trailing vortex** S Tanaka (Osaka University, Suita, Japan), M Kaibara (Matsushita Electric Industrial Co , Ltd , Osaka, Japan), and A Tanaka (Nihon Steel Co , Japan) *JSME, Bulletin,* vol 21, Jan 1978, p 98-103

Some experiments of decay and modification of a trailing vortex which is shed from the tip of a lifting wing, are described Flow fields of the trailing vortex are shown and the effects of the air jet injection from the wing-tip on the attenuation of the disturbances caused by the trailing vortex are discussed When the air jet is not injected, changes in the flow fields near the trailing vortex in the flow direction are quite small and the total circulation and the disturbances due to the trailing vortex such as the large circumferential velocity, defects in the axial velocity and the static pressure are maintained in the region far downstream of the wing When the air jet is injected, vortex filaments are distributed over a wide region and the disturbances can be suppressed to small quantities The turbulence caused by the trailing vortex increases with the distance from the wing when the air jet is not used, but the jet injection has the effect of attenuating the turbulence (Author)

**A78-27910** # **Swirl flow in conical diffusers** Y Senoo, N Kawaguchi (Kyushu University, Fukuoka, Japan), and T Nagata (Kurume Technical College, Fukuoka, Japan) *JSME, Bulletin,* vol 21, Jan 1978, p 112-119 7 refs

Five conical diffusers with different divergence angles were tested to clarify the influences of swirl on the pressure recovery coefficients Pressure recovery coefficients of all diffusers were improved by swirl, and the highest coefficient was observed in an 8-deg diffuser when the flow had a moderate swirl The flow patterns in the diffusers were examined at various conditions to clarify the relationship between the swirl and the pressure recovery coefficient (Author)

**A78-27938** # **Experimental verification of an annular aerofoil theory** S Pivko *Académie Serbe des Sciences et des Arts, Bulletin, Classe des Sciences Techniques,* vol 57, no 11, 1977, p 65-70

The results of an approximate annular aerofoil theory are presented To provide a check of the theory, calculated pressure distributions on both outer and inner surfaces of an annular aerofoil are compared to values measured in the wind tunnel (Author)

**A78-28056** # **The supersonic flow past cusped wings (Sverkhzvukovoe obtekanie ostrokonechnykh kryl'ev)** G P Voskresenskii, A S Il'ina, and V S Tatarenchik *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Nov -Dec 1977, p 35-42 In Russian

Solutions to numerical problems concerning the steady-state, supersonic, inviscid flow past cusped wings are presented A shock wave is attached to the wing's front edge A boundary problem having initial data given by a finite-difference method to the second order of accuracy is solved Flow characteristics at the freestream Mach number 3 0, and at various angles of incidence for triangular, sweptback, and rhombiform wings having different profiles are reviewed It is shown that surface variations in the central, upper, and particularly lower wing surfaces are important factors to be considered in analyzing this type of flow S C S

**A78-28057** # **Calculating the interaction of a turbulent near wake behind a step and a supersonic jet (Raschet vzaimodeistviia turbulentnogo blizhnego sleda za ustupom so sverkhzvhkovoi struei).** A N Antonov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Nov -Dec 1977, p 43-51 14 refs In Russian

An approximation method for calculating the interaction between a turbulent near wake behind a step and a supersonic flow is proposed Calculations are also presented for the flow in the ground region of a truncated central body of an annular nozzle and the flow behind a one-dimensional step S C S

**A78-28102** # **Unsteady boundary layer with self-induced pressure (O nestatsionarnom pogranichnom sloe samoindutsirovannym davleniem)** O S Ryzhov and E D Terent'ev *Prikladnaia Matematika i Mekhanika,* vol 41, Nov -Dec 1977, p 1007-1023 15 refs In Russian

Asymptotic equations are derived that govern the unsteady processes in a boundary layer with self-induced pressure The pressure gradient is assumed to be determined by the growth of the displacement thickness of jets situated near the surface of the body Second-order terms are retained in the asymptotic series A solution satisfying a linearized system of equations for the principal terms of the expansions is constructed The connection between unsteady phenomena and boundary layer stability is discussed P T H

**A78-28147** # **Antimisting fuel kinematics related to aircraft crash landings** A San Miguel (U S Naval Weapons Center, China Lake, Calif ) *Journal of Aircraft,* vol 15, Mar 1978, p 137-142 12 refs U S Department of Transportation Contract No FA76-WAI-589

An approximate analysis is presented to quantitize the kinematic behavior of antimisting Jet A fuel in an airstream representative of survivable aircraft crash landings Antimisting fuel data were generated from a fuel-expulsive airfoil placed in an airstream adjacent

to a pulsing propane flame Measurements of burning-front velocities and accelerations were obtained from a camera located within the airfoil These data were used in the analysis to predict the diameter, shear stress, and shearing strain rate of the average particle of antimisting fuel in the airstream under the airfoil A description is given of the airflow-airfoil apparatus in the context of its simulation of crash landing conditions The feasibility of using antimisting agents to suppress a fuel fire during a crash landing is evaluated (Author)

**A78-28148** # **Display augmentation in manual control of remotely piloted vehicles** S J Merhav (Technion - Israel Institute of Technology, Haifa, Israel) and A J Grunwald *Journal of Aircraft,* vol 15, Mar 1978, p 182-189 12 refs Research supported by the Ministry of Defence

The effectiveness of display aids for manual control of remotely piloted vehicles by television during landing approach is investigated The task is lateral and vertical control along a required glide-slope trajectory in the presence of lateral and vertical random disturbances By superimposing suitable glide-slope reference lines on the TV monitor, the glide-slope error can be derived directly from the visual field It is theoretically investigated whether and under what conditions the display of higher-order state components is required It is shown that for a body-mounted camera, essential angular rate information can be detected from the vertical relative motion of the visual field due to vehicle pitching This information is particularly required for relatively slow vehicle dynamics Rapid pitching, which occurs with fast vehicle dynamics, may be detrimental to its effective control These disturbing motions can be easily eliminated by a gyrostabilized camera, but the essential angular and pitch information is also eliminated and control becomes difficult A display configuration is proposed in which position, rate, and acceleration cues are derived from a single error displayed by special reference bars (Author)

**A78-28149** # **Ideal tail load for minimum aircraft drag** E V Laitone (California, University, Berkeley, Calif ) *Journal of Aircraft,* vol 15, Mar 1978, p 190-192 5 refs

It is found that aircraft can have a maximum weight-to-drag ratio when the tail load is slightly positive This corresponds to the minimum trimmed drag of conventional aircraft having an aft tail A fuel savings of up to 5% has been predicted for the proposed configuration S C S

**A78-28194** # **The Aérospatiale helicopter factory at Marignane (Wytwornia smiglowcow Aérospatiale w Marignane).** W Waskowski *Technika Lotnicza i Astronautyczna,* vol 33, Jan 1978, p 6-10 In Polish

The paper outlines the production activities of Aerospatiale in the field of helicopters Attention is called to the rapid growth of the helicopter-building industry in France The sales and licensing policies of Aerospatiale are examined The organization of the production and training activities at Aerospatiale plants is discussed P T H

**A78-28195** # **Theory of dolphin-style glider flight and principles of dynamic flight I (Teoria przelotu szybowcowego metoda delfinowania oraz zasady lotu dynamicznego I)** J Sandauer (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Jan 1978, p 10-16 5 refs In Polish

The current state of the theory of dolphin-style gliding and the flight tactics ensuing from it are reviewed Optimal flight parameters under model meteorological conditions are analyzed The theory of dolphin-style gliding is analyzed as a problem in variational calculus The possibility of further progress in the use of vertical air currents is demonstrated P T H

**A78-28196** # **MSP/ITWL airborne measuring system (Pokladowy system pomiarowy typu MSP/ITWL)** R Kudelski and W Zabkowicz *Technika Lotnicza i Astronautyczna,* vol 33, Jan 1978, p 16-18 In Polish

The design and operation of a modular airborne measuring system for measuring parameters of other aircraft are presented Since such a system involves the transducing of a variety of different signals into an electric signal, special attention is given to the problem of matching the output signals of the sensors Matching is accomplished with the aid of a modular approach The circuits of the three main modules the potentiometer, the tensometer, and the thermometer modules - are described P T H

**A78-28197** # **Corrosion of fuel assembly components of turbine engines and its prevention (Korozja elementow agregatow paliwowych silnikow turbinowych i jej zapobieganie)** J Blachnio and M Stukonis (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Jan 1978, p 27-32 6 refs In Polish

This paper examines the general characteristics of the corrosion process in the components of the fuel feed system of jet engines The essential features of chemical corrosion and electrochemical corrosion are discussed, and some attention is also given to biochemical corrosion Factors accelerating corrosion are identified, and the main effects of corrosion are enumerated Measures for preventing corrosion are described P T H

**A78-28218** * # **The year for shaping a digital operations R&D program** H J E Reid, Jr (NASA, Langley Research Center, Flight Electronics Div , Hampton, Va ) *Astronautics and Aeronautics,* vol 16, Mar 1978, p 41 46, 63 9 refs

Digital systems which deal with functions outside the aircraft in commercial aviation are discussed with attention to navigation and communication New systems of air traffic control (ATC) are described, including time division multiple access (TDMA) to ground-based ATC units and to the Navstar/GPS (global positioning system) Such innovations are expected to come on-line before the mid 1980s, and greatly increase air safety, while at the same time making a pilot's work easier D M W

**A78-28219** * # **Integrated controls for a new aircraft generation** W D Mace and W E Howell (NASA, Langley Research Center, Flight Electronics Div , Hampton, Va ) *Astronautics and Aeronautics,* vol 16, Mar 1978, p 48-53 12 refs

Many of the commercial aircraft now flying will have to be phased out in the early 1980s because of fuel inefficiency and unacceptable noise levels This paper discusses the role of new digital technology in making aircraft more fuel efficient, more reliable, and quieter Attention is given to the integration of sensing and control functions in an aircraft in order to provide a simple, lightweight, and high redundancy system Technology under development now is expected to come on-line in the 1990s D M W

**A78-28220** * # **Coming cockpit avionics** D McIver and J J Hatfield (NASA, Langley Research Center, Flight Electronics Div , Hampton, Va ) *Astronautics and Aeronautics,* vol 16, Mar 1978, p 54 63 18 refs

Digital and display technology combined with human factors research under development today are expected to become operational in the commercial aircraft of the 1990s Attention is given to reducing the pilot's workload and increasing aircraft reliability through integration of electronic systems, and through multi-mode displays Recent advances in display technology are outlined, including electroluminescent panels, beam penetration color CRTs, liquid crystal modules, and LED panels and indicators Research cockpits are described in terms of simplification of aircraft systems evaluation and control D M W

**A78-28273** **Modification of an ambient air quality model for assessment of U S naval aviation emittants** K I Weal, D W Netzer (U S Naval Postgraduate School, Monterey, Calif ), and G R Thompson *Air Pollution Control Association, Journal,* vol 28, Mar 1978, p 247, 248 10 refs Navy-supported research

The landing-takeoff (LTO) cycle was modeled for USN purposes by modifying 'A generalized air quality assessment model for Air Force operations' (AQAM) to include operational modes such as hot refueling, field carrier landing practice, Navy touch-and-go, and visual flight rule approaches Take-off delays and operations peculiar to rotary wing operations (hover work, pad work, autorotations) were also incorporated, and a LTO cycle with 21 operational modes was derived The simulation patterns of the added features are reported Data were obtained by observation at an airbase, and seven simulations of airbase operations were performed Pollution effects associated with several of the simulated situations are briefly described M L

**A78-28370 Structural castings for aircraft - A progress report from Boeing** D D Goehler (Boeing Commercial Airplane Co , Seattle, Wash ) *Metal Progress,* vol 113, Mar 1978, p 38-43

A cast aluminum structure technology (CAST) program is described Its purpose is to establish necessary structural and manufacturing technologies and to demonstrate and validate the integrity, producibility, and reliability of cast aluminum primary airframe structures The program goal is to demonstrate, for a certain aircraft, a minimum of 30% acquisition cost saving with no weight penalty Foundry practices and manufacturing technology used to produce partial bulkhead castings are reviewed with attention to fluidity, holding temperature, pouring temperature, screening and filtering, degassing, mold and core making, chilling requirements, and weld correction The costs, advantages, and disadvantages of three CAST concepts - stiffened web, hybrid, and truss - are compared M L

**A78-28371 Use of hot-stage-equipped scanning electron microscope in weld repair study of jet engine turbine vanes** J F Collins, C E Maduell, and L E Schwab (U S Navy, Materials Engineering Div , Alameda, Calif ) *Metal Progress,* vol 113, Mar 1978, p 44-51 11 refs

The paper is concerned with repair welds of first-stage air-cooled turbine vanes (Alpak coated IN 713) in the engines of antisubmarine warfare patrol aircraft exposed to the marine environment A hot-stage SEM test was developed to aid in weld repair evaluation by providing relative hot-corrosion characteristics of weld-repaired and re-Alpak-coated vanes Repair welding of the vanes is complicated by their rapid rate of sulfidation, great propensity for cracking, and their complex construction, furthermore, the repaired vanes must be compatible with the Alpak coating system, which is a pack cementation diffused aluminum coating Weld repair characteristics and surface features are described M L

**A78-28374 Selecting plastics for aircraft applications** H V Pellegrini (de Havilland Aircraft of Canada, Ltd , Downsview, Ontario, Canada) *Metal Progress,* vol 113, Mar 1978, p 72-76

The paper describes the use of plastic in several aircraft components Basic design requirements for the floors of one model and the forward baggage compartments and landing gear blocks of another model are considered in connection with the properties of plastics or plastic hybrids which led to their selection Stress strain curves for various fibers as well as specific tensile strength and specific tensile modulus of reinforcing fibers are compared Structural adhesive bonding is discussed, and some characteristics of prepregs are examined M L

**A78-28399 Utilization of Precilec information /aircraft attitude and position/ for geometric image corrections (Utilisation des informations Precilec /attitude et position avion/ pour les corrections géométriques des images)** J C Carrou (Centre National d'Etudes Spatiales, Toulouse, France) In Workshop on Remote Sensing, Toulouse, France, October 26-28, 1976, Proceedings Volume 2 Toulouse, Groupement pour le Développement de la Teledétection Aérospatiale, 1977, p 407-420 In French

The Daedalus multispectral rotating scanner is used for the remote sensing of earth resources These data are then recorded along with Precilec data on the attitude and position of the aircraft Corrections are made for geometrical errors, and it is found that a correction model employing Precilec data is significantly more accurate than a model not using these data S C S

**A78-28436 The wear of aluminum-bronze on steel in the presence of aviation fuel** W Poole and J L Sullivan (Aston, University, Birmingham, England) *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Joint Lubrication Conference, Kansas City, Mo , Oct 3-5, 1977, ASLE Preprint 77-LC-5C-1* 6 p 13 refs Research supported by the Science Research Council and Lucas Aerospace, Ltd

A study has been made of the action of a commercially available corrosion inhibitor added to hydrofined aviation fuels in reducing the wear of aluminum bronze sliding on KE180, 13 percent chromium steel From measurements of friction and wear and an extensive examination of surfaces using Auger electron spectroscopy, a surface model has been proposed which elucidates the mechanism of wear protection (Author)

**A78-28439 * Evaluation of aircraft brake materials** T L Ho, F E Kennedy, and M B Peterson (Rensselaer Polytechnic Institute, Troy, N Y ) *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Joint Lubrication Conference, Kansas City, Mo , Oct 3-5, 1977, ASLE Preprint 77-LC-6B-2* 8 p 9 refs Grant No NGR-33-018-152

A test program was carried out to evaluate several new high-temperature friction materials for use in aircraft disk brakes A specially built test apparatus utilizing a disk brake and wheel half from a small jet aircraft was used The apparatus enabled control of brake pressure, velocity and braking time Tests were run under both constant and variable velocity conditions and covered a kinetic energy range similar to that encountered in aircraft brake service The materials evaluation showed that two newly developed friction materials show potential for use in aircraft disk brakes One of the materials is a nickel-based sintered composite, while the other is a molybdenum-based material Both materials show much lower wear rates than conventional copper-based materials and are better able to withstand the high temperatures encountered during braking Additional materials improvement is necessary, however, since both materials show a significant negative slope of the friction-velocity curve at low velocities (Author)

**A78-28451 1977 report to the aerospace profession, Proceedings of the Twenty-first Symposium, Beverly Hills, Calif , October 12-15, 1977** Symposium sponsored by the Society of Experimental Test Pilots *Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977 255 p

This book represents a conference whose purpose is to evaluate aerospace technology from the pilot's point of view Among the topics covered are F 15, F-16, and F-18A flight testing, YC-14 and -15 prototype testing, Learjet pressure tests, UTTAS tests, and B-1 terrain following analysis D M W

**A78-28452 F-16 flight test progress report** R C Ettinger and M B Johnston (USAF, Flight Test Center, Edwards AFB, Calif ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 1-13

The F-16 aircraft is evaluated in terms of aerial performance and weapons delivery capability Test flights in both air-superiority and ground-attack modes were conducted to measure g-stress resistance, payload capacity, climb and cruise parameters, and maneuverability using visual and instrument systems Attention is given to weapons configuration, and to the ability to track and destroy a target either on the ground or in the air D M W

A78-28453 **F-15/16 canopy off testing** I J Singleton (USAF, Flight Test Center, Edwards AFB, Calif ) and W F Kendall, Jr (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 14-32

The history of canopy loss in USAF aircraft during 1965-75 is reviewed in terms of pilot injury and subsequent difficulties in controlling the plane It is found that since most canopy losses occur at low speeds (due to aircraft pressurization schedules), injury and control impairment are minimal if there is a windscreen, but severe if there is not The unitary construction of the F-16 cockpit could, therefore, pose a problem in this regard Tests are described in which dummies and humans were subjected to both simulated (wind tunnel) and actual (runway) canopy-off conditions in F 16 and one- and two-seater F-15 aircraft Various evasive maneuvers are outlined to help reduce air drag around the pilot, and modifications in helmet design are discussed to help the pilot maintain communication with the ground The possibility of a pop-up windscreen for F 16 emergency use is also mentioned D M W

A78-28454 **F-18A** W H Brinks (McDonnell Douglas Corp , St Louis, Mo ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 32-42

This paper discusses the configurational development of the F-18 from the YF-17 prototype Various changes in the YF 17 are described in terms of the forseen mission requirements of the F-18, i e , a carrier-based all-weather escort and interdiction aircraft Attention is given to the leading edge extension (LEX), whose main function is to produce a high energy vortex to provide maximum lift, especially at high angles of attack, and to handling characteristics, in general Also dealt with are the aircraft's armaments, including the AIM-7F missile and automatic fire-control system D M W

A78-28455 **YAV-8B/AV-8B advanced Harrier program** C A Plummer, Jr (McDonnell Douglas Corp , St Louis, Mo ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 43-65

Modifications of the Hawker Siddeley Harrier are discussed in terms of the AV-8B Harrier, produced under license in the United States Attention is given to lift improvement devices (LIDs) and to wing and flap modifications, in general Program objectives for the YAV 8B prototype are outlined, including improved payload capability, flight radius, cruise thrust, and handling characteristics Test results (both wind tunnel and flight) are summarized and supporting programs are reviewed Cutaway diagrams and design parameters of various aircraft structural components are also presented D M W

A78-28456 **B-1 terrain following development** P S Sharp (USAF, Flight Test Center, Edwards AFB, Calif ) and R Abrams (Rockwell International Corp , El Segundo, Calif ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 67-84

This paper presents results of tests of the B-1 terrain following capability The following components of the terrain following system are reviewed both separately and in coordination with each other forward looking radar, terrain following computer, radar altimeter, terrain following/flight control system adapter, automatic throttle system, and flight control/autopilot system The primary armaments system, the short range attack missile (SRAM), is considered with reference to other system parameters Operational requirements are outlined, and flight test results are presented with attention to rise-over-run descriptions of various flight courses, ranging in difficulty from flat (over ocean) to severe (1,000 to 1,500 meters over 16 km) The performance of the structural mode control system (SMCS) is evaluated in terms of flight course characteristics D M W

A78-28457 **YC-15 development and test highlights - Phase III** J P Lane (McDonnell Douglas Corp , St Louis, Mo ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 85-111

Four phases of the YC-15 test program are described, with attention to Phase III, in which the propulsion system was reconfigured to four JT8D-17 engines, and the flaps were extended to the fuselage Test program highlights are reviewed, including STOL capability on an unpaved runway, stability control augmentation system (SCAS) function, automatic localizer mode and engine evaluation, and thrust management STOL operational tests are stressed as being critical to the fulfillment of the mission requirements of the aircraft Diagrams and descriptions of various aircraft components and flight characteristics are also presented D M W

A78-28458 **YC-14 flight test program** R L McPherson (Boeing Co , Seattle, Wash ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 112 127 9 refs

The prototype STOL, YC-14, is evaluated in terms of configuration and performance Attention is given to the electronic flight control system (EFCS) and to the flight test program, including envelope expansion by varying flap position, engine and thrust reverser, minimum speed, takeoff and climb, and approach and landing (using head-up display and ILS glide-slope reference) Tests proved that the upper surface blowing concept of powered lift is both practical and efficient, and that the prototype, in general, met or exceeded design specifications D M W

A78-28459 **YC-14B prototype testing** F D Hadden (Lockheed-Georgia Co , Marietta, Ga ) and H Klein (USAF, Edwards AFB, Calif ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12 15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 128-136

Tests in two phases, C-141 A baseline data testing and YC-141 B flight testing, are described in terms of design and operating characteristics Included in the first phase are tests of configurational features, e g , standard vortex generators, vortex generators and stall strips removed, a larger vortex generator, and stretch modifications (increased fuselage dimensions) The second phase tests flying performance, e g , airspeed calibration, flutter, loads, aerial refueling, aerial delivery systems and parachute jumps, and systems operations D M W

A78-28460 **Tri-Gull amphibian development** N Ronaasen (Canadair, Ltd , Montreal, Canada) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 143-152

Various structural components of the Tri-Gull-320 seaplane are evaluated separately, and with reference to available manufacturing equipment Structures dealt with include wings, constructed on the two-spar, multi-rib principle, empennage, using thickened spars and beaded skins, and with an 8 deg trim range for a wide choice in flap, power, and landing gear setting, power plant, with a power loading of 12 lb/BHP supplied by a Tiara 6-320 engine, landing gear (retractable tricycle), and structural materials, with PVC foam as the core material Flight tests revealed acceptable levels of flutter and vibration, as well as good handling in rough water Also mentioned is the use of a spin chute for runway landings D M W

A78 28461 **UTTAS testing** J C O'Connor (U S Naval Test Pilot School, Patuxent River, Md ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 153-162

The Boeing-Vertol YUH 61 A and the Sikorsky YUH-60 A UTTAS are compared with each other and with the UH-1 Huey helicopter in terms of performance and handling qualities, e g ,

survivability in medium-intensity combat environments, operability in extremes of heat and cold, payload capacity, flight stability, maneuverability, air speed, crash worthiness, and systems stability In virtually all areas the Sikorsky UTTAS was found superior, and was awarded the Army contract D M W

**A78-28462** **Certifying the Learjet to 51,000 feet** P T Reynolds and J P Dwyer (Gates Learjet Corp , Wichita, Kan ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 163-175

Substantial fuel savings can be achieved by flying at higher altitudes This paper describes modifications of the Learjet which enable it to fly safely at 51,000 feet Among the changes discussed are improvements in the pressure vessel and redesign of the bleed air supply system to maintain the cabin pressure at 8,000 feet The failure warning system and emergency procedure for the crew are also readjusted to the new conditions A description of tests of the modified system are presented, including ground testing to a safety factor of 1 67 (up from 1 33), flight testing for aerodynamic stability and for emergency descent capability, and engine tests of the increased turbine inlet nozzle area D M W

**A78-28463** **Launching the Harrier from a ski jump** J F Farley (Hawker Siddeley Aviation, Ltd , Kingston-on-Thames, Surrey, England) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 186-189

Tests conducted on ground-based runways reveal that the Harrier aircraft can be successfully launched from an incline of at least 6 deg, and most probably from an incline of up to 20 deg Advantages of this method include launch speeds up to 40 knots slower than normal and/or heavier payloads D M W

**A78-28464 *** **Shuttle carrier aircraft flight tests** F L Fulton, Jr (NASA, Flight Research Center, Edwards, Calif ) *(Society of Experimental Test Pilots, Symposium, 21st, Beverly Hills, Calif , Oct 12-15, 1977 ) Society of Experimental Test Pilots, Technical Review,* vol 13, no 4, 1977, p 191 204

Since the Space Shuttle will need to be transported from its place of assembly to the launch site, a method has been developed whereby the Shuttle rides piggyback on a modified Boeing 747, called the Shuttle carrier aircraft (SCA) This paper describes tests of the SCA in its mated configuration Tests include flutter, found to decrease when fiberglass and wood fairings were added to the base of each supporting pylon, stability and control, found to be acceptable after damping with control pulses, noise and buffet, found high but acceptable, and climb, in which drag was marked but acceptable with the special rated thrust (SRT) power setting Simulated launch maneuvers were undertaken at an airspeed of 273 KCAS Transport of the Shuttle takes place with the Shuttle tail cone on, at a cruise speed of 288 KCAS at an altitude of 22,000 feet D M W

# STAR ENTRIES

**N78-17990*#** Boeing Vertol Co Philadelphia, Pa
**RESEARCH REQUIREMENTS TO REDUCE MAINTENANCE COSTS OF CIVIL HELICOPTERS**
Daniel J Million and Kenneth T Waters Feb 1978 62 p refs
(Contract NAS1-13624)
(NASA-CR-145288) Avail NTIS HC A04/MF A01 CSCL 01C

The maintenance problems faced by the operators of civil helicopters that result in high costs are documented Existing technology that can be applied to reduce maintenance costs and research that should be carried out were identified Good design practice and application of existing technology were described as having a significant impact on reducing maintenance costs immediately The research and development that have potential for long range reduction of maintenance costs are presented Author

**N78-17991*#** Pratt and Whitney Aircraft, East Hartford Conn Commercial Products Div
**MEAN VELOCITY, TURBULENCE INTENSITY AND TURBULENCE CONVECTION VELOCITY MEASUREMENTS FOR A CONVERGENT NOZZLE IN A FREE JET WIND TUNNEL COMPREHENSIVE DATA REPORT**
C J McColgan and R S Larson Apr 1977 262 p
(Contract NAS3-17866)
(NASA-CR-135238, PWA-5516) Avail NTIS HC A12/MF A01 CSCL 01A

The effect of flight on the mean flow and turbulence properties of a 0 056m circular jet were determined in a free jet wind tunnel The nozzle exit velocity was 122 m/sec and the wind tunnel velocity was set at 0 12 37, and 61 m/sec Measurements of flow properties including mean velocity turbulence intensity and spectra and eddy convection velocity were carried out using two linearized hot wire anemometers This report contains the raw data and graphical presentations The final technical report includes a description of the test facilities test hardware, along with significant test results and conclusions Author

**N78-17992*#** National Aeronautics and Space Administration Langley Research Center, Langley Station Va
**THEORETICAL EVALUATION OF HIGH SPEED AERODYNAMICS FOR ARROW WING CONFIGURATIONS**
Samuel M Dollyhigh Feb 1978 66 p refs
(NASA-TM-78659) Avail NTIS HC A04/MF A01 CSCL 01A

A limited study in the use of theoretical methods to calculate the high speed aerodynamics of arrow wing supersonic cruise configurations was conducted The study consisted of correlations with existing wind tunnel data at Mach numbers from 0 8 to 2 7, using theoretical methods to extrapolate the wind tunnel data to full scale flight conditions and presentation of a typical supersonic data package for an advanced supersonic transport application prepared using the theoretical methods A brief description of the methods and their application was given In general, all three methods had excellent correlation with wind tunnel data at supersonic speeds for drag and lift characteristics and fair to poor agreement with pitching moment characteristics The VORLAX program had excellent correlation with wind tunnel data at subsonic speeds for lift and pitching moment characteristics and fair agreement in drag characteristics Author

**N78-17993*#** Kansas Univ Center for Research Inc , Lawrence
**A THEORETICAL INVESTIGATION OF THE AERODYNAMICS OF LOW-ASPECT-RATIO WINGS WITH PARTIAL LEADING-EDGE SEPARATION**
Sudhir Chandra Mehrotra and C Edward Lan Jan 1978 85 p refs
(Grant NsG-1046)
(NASA-CR-145304, CRINC-FRL-266-1) Avail NTIS HC A05/MF A01 CSCL 01A

A numerical method is developed to predict distributed and total aerodynamic characteristics for low aspect-ratio wings with partial leading-edge separation The flow is assumed to be steady and inviscid The wing boundary condition is formulated by the quasi-vortex-lattice method The leading-edge separated vortices are represented by discrete free vortex elements which are aligned with the local velocity vector at mid-points to satisfy the force free condition The wake behind the trailing-edge is also force free The flow tangency boundary condition is satisfied on the wing including the leading- and trailing-edges Comparison of the predicted results with complete leading-edge separation has shown reasonably good agreement For cases with partial leading-edge separation the lift is found to be highly nonlinear with angle of attack Author

**N78-17994*#** Vought Corp , Hampton Va Technical Center
**A PROCEDURE FOR THE DETERMINATION OF THE EFFECT OF FUSELAGE NOSE BLUNTNESS ON THE WAVE DRAG OF SUPERSONIC CRUISE AIRCRAFT**
Kenneth B Walkley Jan 1978 56 p refs
(Contract NAS1-13500)
(NASA-CR-145306) Avail NTIS HC A04/MF A01 CSCL 01A

The incremental wave drag penalty due to nose blunting of a fuselage was investigated using a three dimensional finite difference scheme An aircraft typical of current supersonic cruise concepts was considered Computational problems with the finite difference scheme as the fuselage afterbody closes were addressed A linear theory method was employed to compute the afterbody aerodynamics and effectively extends the finite difference scheme to closing afterbodies Acceptable drag increments for various levels of nose bluntness were demonstrated using this approach Author

**N78-17995*#** Pennsylvania State Univ University Park Dept of Aerospace Engineering
**COMPRESSOR AND FAN WAKE CHARACTERISTICS**
**Semiannual Progress Report**
B Reynolds C Hah, B Lakshminarayana and A Ravindranath Jan 1978 104 p refs
(Grant NsG-3012)
(NASA-CR-155766, PSU/TURBO-R78-1) Avail NTIS HC A06/MF A01 CSCL 01A

A triaxial probe and a rotating conventional probe, mounted on a traverse gear operated by two step motors were used to measure the mean velocities and turbulence quantities across a rotor wake at various radial locations and downstream stations The data obtained was used in an analytical model developed to study how rotor flow and blade parameters and turbulence properties such as energy velocity correlations, and length scale affect the rotor wake characteristics and its diffusion properties The model includes three dimensional attributes, can be used in predicting the discrete as well as broadband noise generated in a fan rotor, as well as in evaluating the aerodynamic losses, efficiency and optimum spacing between a rotor and stator in turbomachinery Author

**N78-17997*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif
**EFFECT OF WINGLETS ON A FIRST-GENERATION JET TRANSPORT WING 4 STABILITY CHARACTERISTICS FOR A FULL-SPAN MODEL AT MACH 0 30**
Robert R Meyer, Jr Feb 1978 74 p refs
(NASA-TP-1119, L-11705) Avail NTIS HC A04/MF A01 CSCL 01A

The static longitudinal and lateral directional characteristics of a 0 035 scale model of a first generation jet transport were

obtained with and without upper winglets The data were obtained for take off and landing configurations at a free stream Mach number of 0 30 The results generally indicated that upper winglets had favorable effects on the stability characteristics of the aircraft Author

**N78-17998*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

**EFFECT OF DESIGN CHANGES ON AERODYNAMIC AND ACOUSTIC PERFORMANCE OF TRANSLATING-CENTERBODY SONIC INLETS**

Brent A Miller Feb 1978 49 p refs

(NASA-TP-1132 E-9283) Avail NTIS HC A03/MF A01 CSCL 01A

An experimental investigation was conducted to determine the effect of design changes on the aerodynamic and acoustic performance of translating centerbody sonic inlets Scale model inlets were tested in the Lewis Research Center's V/STOL wind tunnel The effects of centerbody position, entry lip contraction ratio, diffuser length, and diffuser area ratio on inlet total pressure recovery distortion, and noise suppression were investigated at static conditions and at forward velocity and angle of attack With the centerbody in the takeoff position (retracted) good aerodynamic and acoustic performance was attained at static conditions and at forward velocity At 0 deg incidence angle with a sound pressure level reduction of 20 dB, the total pressure recovery was 0 986 Pressure recovery at 50 deg was 0 981 With the centerbody in the approach position (extended), diffuser flow separation occurred at an incidence angle of approximately 20 deg *However, good performance was attained at lower angles* With the centerbody in the takeoff position the ability of the inlet to tolerate high incidence angles was improved by increasing the lip contraction ratio However at static conditions with the centerbody in the approach position, an optimum lip contraction ratio appears to exist, with both thinner and thicker lips yielding reduced performance Author

**N78-17999*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

**TWO-DIMENSIONAL TRANSONIC TESTING WITH SPLITTER PLATES**

Sanford Davis and Bodapati Satyanarayana Feb 1978 24 p refs

(NASA-TP-1153 A-7221) Avail NTIS HC A02/MF A01 CSCL 01A

The use of splitter plates for two dimensional transonic testing in wind tunnels was investigated on a 12% biconvex airfoil section over the Mach number range 0 6 to 1 0 Measured pressure distributions were compared to transonic theory and to other experiments, including an investigation in the same facility without splitter plates The results of the experiment show the best agreement with theory over the entire transonic Mach number range Author

**N78-18000*#** Battelle Columbus Labs Ohio

**ANALYTICAL STUDY OF A FREE-WING/FREE-TRIMMER CONCEPT Final Report**

Richard F Porter David W Hall, Joe H Brown, Jr , and Gerald M Gregorek Feb 1978 130 p refs

(Contract NAS4-2378)

(NASA-CR-2946) Avail NTIS HC A07/MF A01 CSCL 01A

The free-wing/free-trimmer is a NASA-Conceived extension of the free-wing concept intended to permit the use of high-lift flaps Wing pitching moments are balanced by a smaller external *surface attached by a boom or equivalent structure The* external trimmer is, itself a miniature free wing, and pitch control of the wing-trimmer assembly is effected through a trailing-edge control tab on the trimmer surface The longitudinal behavior of representative small free-wing/free-trimmer aircraft was analyzed Aft-mounted trimmer surfaces are found to be superior to forward trimmers, although the permissible trimmer moment arm is limited, in both cases, by adverse dynamic effects Aft-trimmer configurations provide excellent gust alleviation and meet fundamental stick-fixed stability criteria while exceeding the lift capabilities of pure free-wing configurations Author

**N78-18001#** Naval Ship Research and Development Center, Bethesda, Md

**DRAG, FLOW TRANSITION, AND LAMINAR SEPARATION ON NINE BODIES OF REVOLUTION HAVING DIFFERENT FOREBODY SHAPES**

John L Power Dec 1977 59 p refs

(AD-A048274, DTNSRDC-77-0065) Avail NTIS HC A04/MF A01 CSCL 20/4

Resistance has been measured of nine bodies of revolution, having equal volume but varying forebody shapes Forebody shapes ranged from extremely blunt to extremely fine and included two that were flat faced The forebodies were altered by changing their length-to-diameter ratios (L/D s) and prismatic coefficients Drag results indicate that when the prismatic coefficient is fixed and the L/D is decreased the residual resistance will increase modestly Increasing the prismatic coefficient at small L/D s increases residual resistance however at moderate L/D s it does not The results suggest that a flat-faced shape in itself does not increase resistance In addition to resistance experiments transition regions on the models were located, using hot film probes Calculations predicted laminar separation on five of the model forebodies The hot film measurements confirmed that separation did occur at the locations predicted downstream of the separation locations, turbulent flow occurred immediately The remaining four forebodies exhibited well-defined natural transition regions Flow properties in the transition regions measured by the hot film gages have been compared with predicted spatial amplification ratios of disturbances calculated by linear stability theory Results have failed to show a single relationship between measured flow properties and computed spatial amplification ratios Correlation of amplification factors with flow regimes varied both with forebody shape and Reynolds number Author (GRA)

**N78-18002#** Naval Ship Research and Development Center, Bethesda Md Aviation and Surface Effects Dept

**PARAMETRIC TRANSONIC EVALUATION OF TYPE A VSTOL NACELLE DRAG Final Report, Jan - Aug 1977**

Jonah Ottensoser Sep 1977 47 p refs

(AD-A048110, DTNSRDC/ASED-390) Avail NTIS HC A03/MF A01 CSCL 20/4

A parametric evaluation of the zero lift drag characteristics attributable to the large nacelles found on some Type A VSTOL candidate aircraft was conducted in the 7- by 10-foot transonic wind tunnel of the David W Taylor Naval Ship Research and Development Center Mounting the nacelles in proximity to the wings and fuselage yields levels of interference drag three to four times the isolated drag which results in the nacelle interference drag producing approximately 50 percent of the total aircraft drag Movement of the nacelles away from the wings either longitudinally or vertically tends to reduce drag Except for the nacelles mounted forward of the wing, the nacelles have an adverse effect on lift The particular wide nose body used proved to be highly unstable longitudinally although adding nacelles above or behind the wings tended to reduce this instability Five pairs of axisymmetric nacelles, four pairs of pylons, three longitudinal and two vertical positions were investigated on a 10-percent scale low (supercritical) wing model Author (GRA)

**N78-18003#** Air Force Systems Command, Wright-Patterson AFB Ohio

**INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF V-WINGS NEAR SOLID SURFACE**

N B Plisov and F F Latypov 13 Jul 1977 20 p Transl into ENGLISH from Tr Leningrad Korablestroitnogo Instituta (USSR) no 63, 1968 p 41-49

(AD-A048555 FTD-ID(RS)T-1237-77) Avail NTIS HC A02/MF A01 CSCL 20/4

Determined in this study are the position and rotary derivatives of a V-wing moving above a solid screen This problem is interesting for a number of problems in the dynamics of vehicles which use the screen effect during motion Studied is a thin V-wing of rectangular plane shape above a solid wall The induced velocities are considered low, while the vorticity beyond the wing lies in planes corresponding to the planes of the wing These assumptions are realized at small angles of attack, relatively

great distances between the wing and surface, and when the amplitudes of the harmonic oscillations are small The condition of equality to zero of the normal velocity component of liquid particles should be satisfied on the solid screen GRA

**N78-18004#** Air Force Systems Command, Wright-Patterson AFB Ohio
**THE MOVEMENT OF A WING WITH DEFLECTED AILERONS CLOSE TO A SCREEN**
V G Belinskiy and Yu I Laptev 16 Jul 1977 17 p Transl into ENGLISH from Gidrodinamika Bolshikh Skorostey (USSR), no 4 1968 p 39-48
(AD-A048651 FTD-ID(RS)T-1238-77) Avail NTIS HC A02/MF A01 CSCL 20/4

The effect of a free surface on the characteristics of an underwater wing with deflected ailerons showed that the proximity of a free surface decreases the lift and rolling moment but increases the induced drag and the yawing moment This work has obtained simple analytical dependences which permit estimating the effect of the proximity of a solid screen on the hydrodynamic characteristics of a wing with deflected ailerons GRA

**N78-18005#** Naval Postgraduate School, Monterey, Calif
**CIRCULATION CONTROL AIRFOIL STUDY Progress Report, Jan - Nov 1977**
Louis V Schmidt 21 Nov 1977 32 p refs
(AD-A048677, NPS-67SX77111 PR-4) Avail NTIS HC A03/MF A01 CSCL 20/4

The unsteady aerodynamics, and in particular the transfer functions, applicable to the circulation control airfoils were evaluated in an unsteady flow 2 x 2 ft wind tunnel Preliminary results were obtained disclosing the nature of unsteady surface pressures over the airfoil, both amplitude and phase, relative to the oscillating cavity pressures for a range of reduced frequencies, k = 0 to 0 46, at a model attitude approximating the zero lift condition (blowing-off) at a moderate value of momentum blowing coefficient Positive results were obtained towards indentifying the behavior of the Coanda sheet dynamics, airfoils lift transfer function and airfoil damping moment GRA

**N78-18006#** Air Force Flight Dynamics Lab, Wright-Patterson AFB Ohio Flight Control Div
**CAMBERED JET-FLAPPED AIRFOIL THEORY WITH TABLES AND COMPUTER PROGRAMS FOR APPLICATION Final Report, Jun 1976 - Apr 1977**
Henry W Woolard and Bernard F Niehaus Sep 1977 161 p refs
(AD-A048528, AFFDL-TR-77-63) Avail NTIS HC A08/MF A01 CSCL 20/4

A quadrature method is derived for calculating the incompressible-flow aerodynamics of arbitrarily cambered jet-flapped airfoils The anticipated application of the methodology is to high-speed subsonic flows (combat maneuvering aircraft) via the use of compressible-flow similarity transformations The method yields the aerodynamic properties in terms of integrals having integrands which consist of the product of the camber-line ordinate and an influence function which is a parametric function of the jet-momentum coefficient In general the integrals involved must be evaluated by numerical methods Tables of the necessary influence functions are given in the report GRA

**N78-18007#** Tennessee Univ Space Inst, Tullahoma
**FUNDAMENTAL STUDIES OF SUBSONIC AND TRANSONIC FLOW SEPARATION PART 2 SECOND PHASE SUMMARY REPORT Final Report, Jan 1974 - Sep. 1976**
J M Wu, C H Chen T H Moulden, K C Reddy, and F G Collins Dec 1977 194 p refs
(Contract F40600-74-C-0009)
(AD-A048615, AEDC-TR-77-10321-Pt-2) Avail NTIS HC A09/MF A01 CSCL 20/4

The work reported herein represents the second phase of a fundamental study of subsonic and transonic flow separation The detailed features of the turbulent boundary layer flow separation induced by a foward-facing step in transonic and high subsonic flow were studied The influences of an upstream disturbance upon the downstream separation were simulated by several shallow-cavity models of different depth to length ratios The free-stream conditions were varied over the ranges M = 0 6 to approx 0 9 and Re/ft = 5 x 10 to 6th power to approx 30 x 10 to the 6th power It was shown that certain upstream disturbances can produce higher separation pressure and skin friction than related to a single forward-facing step A separation pressure correlation was established empirically from the cavity flow data It was observed that a certain Reynolds number and depth-to-length-ratio cavity yielded a maximum separation pressure At the same time, an increase of free-stream Mach number continuously increased the separation pressure The flow relaxation along the cavity floor was explored by systematic measurements and analysis of surface pressures and velocity profiles These studies revealed that the flow relaxation started from the floor and spread outward Therefore the lower portion of the outer layer of the shear flow contained a longer memory, carrying the influence of the upstream disturbance to the downstream separation The law of the wall and the wake was used for the analysis of the velocity distributions and the estimation of the skin friction It was found that the slope of the law of the wall is different for velocity profiles of different strengths of wake GRA

**N78-18008#** Rockwell International Corp, Thousand Oaks Calif Science Center
**A COMPUTATIONAL MODEL FOR THREE-DIMENSIONAL INCOMPRESSIBLE SMALL CROSS FLOW WALL JETS Final Report, 30 Jun 1976 - 30 Jun 1977**
Norman D Malmuth and R K Szeto 15 Dec 1977 108 p (Contract N62269-76-C-0382)
(AD-A048450, SC5079 5FR NADC-76-105-30) Avail NTIS HC A06/MF A01 CSCL 20/4

A computational model based on H Keller s box scheme has been used to characterize turbulent incompressible wall jets in the small cross flow approximation prototypic of flows over upper-surface-blown and augmenter wings Submerged and coflowing cases are considered An eddy viscosity model was used to simulate the effects of turbulence Approximate models are identified for flows in which the jet height tends to zero If the span flow is introduced through a lateral curvature term appearing in the spanwise momentum equation the effect of the turbulent coupling on the surface pressures and peak spanwise velocities is weak Author (GRA)

**N78-18009#** National Aerospace Lab Amsterdam (Netherlands) Flight Dynamics Div
**COLLECTION OF SUPERCRITICAL AEROFOILS OBTAINED WITH THE NLR HODOGRAPH METHOD**
J A VanEgmond and J W Boerstoel 7 Sep 1977 57 p refs
(Contract NIVR-1754)
(NLR-TR-75115-U) Avail NTIS HC A04/MF A01

Graphical and tabulated data of eighteen airfoils calculated with the NLR transonic hodograph theory is presented to show the possibilities of the calculation method for application in airfoil design studies Author (ESA)

**N78-18010#** Dornier-System G m b H Friedrichshafen (West Germany)
**INFLUENCE OF WING TAPERING ON THE DEVELOPMENT OF A THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER EXEMPLIFIED WITH A TRANSONIC WING [EINFLUSS DER FLUEGELZUSPITZUNG AUF DIE ENTWICKLUNG EINER DREIDIMENSIONALEN, TURBULENTEN GRENZSCHICHT AM BEISPIEL EINES TRANSSONISCHEN TRAGFLUEGELS]**
H W Stock Bonn DOKZENTBw 1977 32 p refs In GERMAN, ENGLISH summary Sponsored by Bundesmin der Verteidigung
(BMVg-FBWT-77-7) Avail NTIS HC A03/MF A01 DOKZENTBw DM 20

The influence of the taper ratio of a wing was studied using a three-dimensional transonic wing The results obtained for a section in the middle of the tapered wing were calculated using

the same boundary layer method as for an infinite swept wing with an identical pressure distribution and a sweep angle which corresponds to the sweep angle at 50 % chord of the three-dimensional wing It is shown that the boundary layer integral thicknesses and their gradients in the chordwise direction are larger for the infinite swept wing than for the three-dimensional wing Marked differences were produced for the wall streamline angle beta For the three-dimensional wing beta was negative from the leading to the trailing edge i e the boundary layer mass is pushed into a direction towards the fuselage (alpha + beta smaller than 0) For the infinite swept wing beta was positive for x/c greater than 5 and became fairly large in the region of the trailing edge i e the boundary layer mass is pushed in a direction towards the wing tip (alpha + beta greater than 0) Author (ESA)

**N78-18011#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Hauptabt Flugbetrieb

**CALCULATION OF THE HORIZONTAL TAIL LOADS FROM ELEVATOR ACTUATION**

Jean Skudridakis 1976 129 p refs In GERMAN, ENGLISH summary

(DLR-IB-536-76/4) Avail NTIS HC A07/MF A01

An investigation was made of horizontal tail loads in maneuvering flight conditions as a result of different kinds of stabilizer inputs To achieve a reasonable approach to the problem the complete longitudinal set of equations of motion were simplified concerning the degrees of freedom of the system which were significantly reduced from 6 to 3 or 2 deg With these simplifications the equations of motions were solved by analog computer, numerical integration, or by Laplace transforms A detailed set of elevator input time histories and related equations is presented, according to MIL-A-008861 A (USAF) The application of these sets may help to establish conditions which are as close as possible to reality for the calculation of horizontal tail loads with respect to different airworthiness standards and design instructions The influence of elasticity of the aircraft structure is outlined Author (ESA)

**N78-18012#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Hauptabt Flugbetrieb

**SUPPORTING INVESTIGATIONS DURING TESTING OF THE WDL-1 AIRSHIP IN GHANA AND UPPER VOLTA**

DLR-IB-536-76/3 N78-14002

(DLR-IB-536-77/1,DLR-IB-536-76/3) Avail NTIS HC A04/MF A01

An evaluation is presented of the hull temperature measurements and flight data recorded during the test flight of an airship (blimp) in July and August, 1976, in Ghana and Upper Volta The hull temperature data and related environmental parameters allow analyzing the heat transfer characteristics of the hull, the emission behavior of the surface and the heat transfer coefficients as a function of the flow velocity The flight data provide insight into the airship s operational performance especially maximum and minimum cargo and fuel consumption ESA

**N78-18013#** Messerschmitt-Boelkow-Blohm G m b H , Ottobrunn (West Germany)

**A METHOD FOR CALCULATION OF THE PRESSURE DISTRIBUTION OF WING-BODY CONFIGURATIONS FOR LARGE ANGLE OF ATTACK AT SUBSONIC SPEED [EIN VERFAHREN ZUR BERECHNUNG DER DRUCKVERTEILUNG VON FLUEGEL-RUMPFANORDNUNGEN BEI HOHER ANSTELLUNG IM UNTERSCHALLBEREICH]**

G Gregoriou Bonn DOKZENTBw 1977 33 p refs In GERMAN, ENGLISH summary

(Contract T/RF-41/RF-410/51106)

(BMVg-FBWT-77-15) Avail NTIS HC A03/MF A01, DOKZENTBw DM 20

An iterative singularity method was developed based on the potential theory which yields the pressure distribution of symmetric wing-body configurations in the nonlinear angle of attack range at subsonic speeds The body is axisymmetric and of finite length and arbitrary thickness The wing is infinitely thin and located at mid-wing position The following mathematical model was used 1) wing lattice method, free vortices partially inclined to the wing plane, 2) body ring sources over the body surface Author (ESA)

**N78-18014#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Abt Elastomechanik und Aeroelastische Stabilitaet

**APPLICATION AND COMPARISON OF MODAL PERTURBATION METHODS AND MODAL CORRECTION PROCEDURES EXEMPLIFIED BY A SWEPT WING WITH TWO EXTERNAL STORES**

Raymond Freymann 27 May 1977 44 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-463)

(DLR-FB-77-21) Avail NTIS HC A03/MF A01 DFVLR, Cologne DM 22 60

Investigations on a swept wing model structure with two external stores were carried out by applying modal perturbation methods and modal correction methods to inertia modifications on the external stores Experimental modal data resulting from ground vibration tests on the same model structure in two different configurations were partially compared with calculated modal data in order to check the accuracy and suitability of the different modification methods Author (ESA)

**N78-18018#** European Space Agency Paris (France)

**UNSTEADY PRESSURE MEASUREMENTS ON WING-STORE COMBINATIONS IN INCOMPRESSIBLE FLOW**

Hermann Triebstein Jan 1978 78 p refs Transl into ENGLISH of Instationaere Druckverteilungsmessungen an Fluegel-Aussenlastkombinationen in inkompressibler Stroemung', DFVLR, Goettingen, West Ger Report DLR-FB-77-12, 28 Mar 1977 Original report in GERMAN previously announced as N78-11017 Original German report available from DFVLR, Cologne DM 36 20

(ESA-TT-426 DLR-FB-77-12) Avail NTIS HC A05/MF A01

Measurements of unsteady pressures on harmonically oscillating wingstore combinations in incompressible flow are dealt with The measurements were made in a subsonic wind tunnel The pressure was measured for yaw- pitch-, and heave oscillations of the store at different locations of the store in x-, y-, and z-direction The pitching and yawing oscillations were made about two different axes Further unsteady pressure distributions were measured on the wing-store combination at harmonically pitching oscillations of the wing and on the store at pitching and heaving oscillations of the store without the wing Some results were compared with theoretical results The flow speed was V = 40 m/s and the oscillation frequencies were f = 6, 12 and 20 Hz Author (ESA)

**N78-18019#** National Aerospace Lab , Amsterdam (Netherlands) Flight Dynamics Div

**PHAROS, PROCESSOR FOR HARMONIC ANALYSIS OF THE RESPONSE OF OSCILLATING SURFACES**

P H Fuijkschot 21 Apr 1977 10 p Presented at the 7th Intern Congr on Instrumentation in Aerospace Simulation Facilities, Wiltshire, Engl , Sep 1977

(NLR-MP-77012-U) Avail NTIS HC A02/MF A01

A computer controlled system is described which was primarily developed for investigating the relation between the movement of a harmonically excited windtunnel model and the resulting unsteady pressure distribution The application and the relevant measurement techniques are outlined, and a functional description of the configuration is given Some of the more interesting electronic principles are discussed PHAROS is essentially an accurate multichannel transfer function analyzer (TFA) with a frequency range of 0 to 10 kHz The TDA operation is performed on all channels simutaneously, giving high speed In addition to the fundamental components, the amplitude and phase of higher harmonics can be established, allowing a time waveform reconstruction of non-linear phenomena Author (ESA)

**N78-18020** Colorado Univ , Boulder
**A SIMULATION MODEL FOR AN ENPLANING-PASSENGER-VEHICLE CURBSIDE AT HIGH-VOLUME AIRPORTS Ph.D Thesis**
Charles Allen Hall 1977 297 p
Avail Univ Microfilms Order No 77-29923

How simulation of airport activities at the enplaning curbside can be used to accurately determine the efficiency of this important portion of the airport is described Simulation requires validating the computer model against the airport curbside system it simulates and was done by statistical comparisons between measured and computed quantities that were based on data taken at three airports A series of simulation models were developed The variables in the models include (1) number of lanes, (2) number of spaces per lane (3) interarrival patterns, (4) vehicle class distribution, (5) service times, (6) exit methods Dissert Abstr

**N78-18021#** Federal Aviation Administration Atlantic City, N J National Aviation Facilites Experimental Center
**THE ANALYSIS OF NATIONAL TRANSPORTATION SAFETY BOARD LARGE FIXED-WING AIRCRAFT ACCIDENT/INCIDENT REPORTS FOR THE POTENTIAL PRESENCE OF LOW-LEVEL WIND SHEAR Final Report**
Jack J Shrager Dec 1977 84 p refs
(FAA Proj 154-451-110)
(AD-A048354 FAA-NA-77-41 FAA-RD-77-169) Avail NTIS HC A05/MF A01 CSCL 01/2

The National Transportation Safety Board aircraft accident/incident data base covering the years 1964 through 1975 was screened to select those accidents involving aircraft of 12,500 pounds gross weight or greater in which the potential of low level wind shear as a factor could not be discounted The successive filtering techniques employed eliminated all but 25 of the 59,465 accidents or incidents which comprised the total data base used The presence of a low level wind shear was a distinct possibility in these 25 takeoff or approach and landing accidents/incidents Author

**N78-18022#** *Naval Postgraduate School, Monterey Calif*
**A COMPARISON OF INTEGRATED AND CONVENTIONAL COCKPIT WARNING SYSTEMS M S Thesis**
Joseph Dennis Mazza Sep 1977 42 p refs
(AD-A048670) Avail NTIS HC A03/MF A01 CSCL 01/4

An experiment was performed in which seventeen subjects responded to warning signals presented on displays simulating integrated and conventional aircraft cockpit warning systems Performance using the conventional system was superior in terms of both mean reaction time and number of errors committed Author (GRA)

**N78-18023#** Coast Guard Washington, D C
**PRELIMINARY TESTS OF INFLATABLE LIFERAFTS FOR STABILITY IN HIGH WINDS Final Report**
M R Daniels, Jr , R L Markle and S G Maness 1 Dec 1977 39 p
(AD-A048722, USCG-M-1-78) Avail NTIS HC A03/MF A01 CSCL 06/7

This report presents the results of a preliminary investigation of the stability of various marine-type inflatable liferafts when afloat and exposed to high wind forces The report describes capsizings resulting from wind forces generated by helicopter downdraft and the slipstream of a fixed-wing aircraft Author (GRA)

**N78-18024*#** Chicago Univ Ill Dept of the Geophysical Sciences
**AN ANALYSIS OF THREE WEATHER-RELATED AIRCRAFT ACCIDENTS**
T Theodore Fujita and Fernando Caracena (Environ Res Lab Boulder, Colo ) Apr 1977 44 p refs Submitted for publication Sponsored in part by NSF
(Grants NGR-14-001-008, NOAA-04-4-158-1)
(NASA-CR-155363 PB-275090/9, SMRP-RP-145 NOAA-77101302) Avail NTIS HC A03/MF A01 CSCL 01B

Two aircraft accidents in 1975 one at John F Kennedy International Airport at New York City on June 24 and the other at Stapleton International Airport at Denver on August 7 were examined The third accident on June 23 1976 at Philadelphia International Airport is being investigated All accidents occurred as aircraft, either descending or climbing lost altitude while experiencing strong wind shear inside downburst cells GRA

**N78-18025*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**FLIGHT TEST RESULTS OF THE STRAPDOWN HEXAD INERTIAL REFERENCE UNIT (SIRU) VOLUME 2 TEST REPORT**
Ronald J Hruby and William S Bjorkman (Analytical Mechanics Associates Inc Mountain View Calif ) Jul 1977 96 p refs
(NASA-TM-73223 A-6973) Avail NTIS HC A05/MF A01 CSCL 17G

Results of flight tests of the Strapdown Inertial Reference Unit (SIRU) navigation system are presented The fault tolerant SIRU navigation system features a redundant inertial sensor unit and dual computers System software provides for detection and isolation of inertial sensor failures and continued operation in the event of failures Flight test results include assessments of the system s navigational performance and fault tolerance Performance shortcomings are analyzed Author

**N78-18026#** Transportation Systems Center, Cambridge, Mass
**CHARACTERIZATION OF CURRENT TOWER CAB ENVIRONMENTS Interim Report, Jan - Mar 1977**
V J Hobbs D F Clapp P Rempfer D Devoe J Bellantoni, L Maddock J Raudseps, L Stevenson, J R Coonan, J Kuhn et al Nov 1977 207 p refs
(AD-A048306, DOT-TSC-FAA-77-19 FAA-EM-77-10) Avail NTIS HC A10/MF A01 CSCL 13/3

A description of the general tower cab environment is given in terms of (a) the evolution of the tower cab current cab classification and staffing levels and the basic flow of Air Traffic Control data relevant to cab operations (b) a breakdown of functions performed by tower cab personnel the basic equipment used to perform those functions and allocation of equipment and responsibilities to various controller positions and (c) current tower related systems and procedures including airspace surveillance surface surveillance, flight data handling and the role of the flight progress strip air/ground communications the data processing and display systems weather related systems, and current landing systems Author

**N78-18027#** Lincoln Lab , Mass Inst of Tech Lexington
**UPLINK COVERAGE MEASUREMENTS IN THE LOS ANGELES AREA FOR PASSIVE BCAS**
F Nagy Jr 7 Nov 1977 31 p
(Contracts DOT-FA77WAI-727 F19628-78-C-0002 FAA Proj 052-241-04)
(AD-A048288 ATC-81 FAA-RD-77-134) Avail NTIS HC A03/MF A01 CSCL 01/4

Uplink (1030 MHz) measurement results are presented based on data recorded by the Airborne Measurement Facility during normal landings and takeoffs at the LAX Van Nuys, and San Diego airports The data presented are relevant to current investigations of passive beacon-based collision avoidance systems and include (1) the interrogator environment as received, (2) its division between FAA and other interrogators (3) its dependence on aircraft height during landings and take-offs and (4) the availability of P2 pulses of sufficient strength for PRF (pulse repetition frequency) tracking The number of interrogators was found to increase with the aircraft height at the rate of 2 5 to 3 interrogators per 1000 ft Thus P2 pulse tracking appears to be feasible down to 2000 ft at LAX and lower at San Diego Author

**N78-18032#** IIT Research Inst, Annapolis Md
**THE IMPACT OF A PROPOSED ACTIVE BCAS ON ATCRBS PERFORMANCE IN THE WASHINGTON, D C, 1981 ENVIRONMENT Final Report**
Norman Theberge Sep 1977 48 p refs
(Contracts F19628-76-C-0017, DOT-FA70WAI-175)
(AD-A048589, ECAC-PR-77-037, FAA-RD-77-140) Avail NTIS HC A03/MF A01 CSCL 17/7

A computer model of the proposed active Beacon Collision Avoidance System (BCAS) was developed to investigate the impact of BCAS on the Air Traffic Control Radar Beacon System (ATCRBS) ground system Predictions were made for the early 1981 Washington D C, environment Two ground environments were simulated an all-ATCRBS environment and a 25%/75% Discrete Address Beacon System (DABS)/ATCRBS mix Airborne fruit rates and the effect of BCAS/DABS mode power programming on interference were also predicted Author (GRA)

**N78-18036#** Mitre Corp McLean, Va METREK
**CONCEPTS FOR ESTIMATING CAPACITY OF BASIC RUNWAY CONFIGURATIONS**
F A Amodeo A L Haines, and A N Sinha May 1977 50 p refs
(Contract DOT-FA70WA-2448)
(PB-274578/4 MTR-7115-Rev-1) Avail NTIS HC A03/MF A01 CSCL 01B

One method of evaluating the impact of changes in the governing longitudinal separation standards on final approach is through the estimation of runway capacity The arrival stream is analyzed with respect to the applicable longitudinal separation standards, ATC system performance and the interactions with departures, if any as governed by the appropriate ATC rules and procedures Concepts are developed for arrival only departure only arrival/departure dual-lane and intersecting runway configurations GRA

**N78-18037#** Mitre Corp, McLean, Va METREK Div
**BENEFITS OF MLS GUIDANCE FOR CURVED APPROACHES VOLUME 2 OPERATIONAL BENEFITS FOR NEW YORK AIRPORTS**
R R Iyer Jul 1975 52 p refs
(Contract DOT-FA70WA-2448)
(PB-274585/9, MTR-6951-Vol-2) Avail NTIS HC A04/MF A01 CSCL 01C

Projected benefits of curved approaches during marginal VFR and IFR weather conditions provided by implementing MLS at LaGuardia and Kennedy are investigated It is shown that the operational flexibility due to MLS contributes the following benefits increases in capacity at LGS during IFR and marginal VFR conditions reductions in airport noise exposure over populated areas around JKF and LGA, reductions in NASCOM delays at LGA and savings in operating costs for airlines by terminal route reductions GRA

**N78-18038#** Mitre Corp McLean Va METREK Div
**CONCEPTS FOR DETERMINATION OF LONGITUDINAL SEPARATION STANDARDS ON FINAL APPROACH**
A L Haines Oct 1975 44 p refs
(Contract DOT-FA70WA-2448)
(PB-274590/9 MTR-7047) Avail NTIS HC A03/MF A01 CSCL 01C

Definitions are developed with a view toward identifying the relationships between separation standards and the variables describing the final approach environment This provides a basis for systematic evaluation of changes in separation standards due to changes in the environment, particularly through Engineering and Development products Analytical relationships are developed primarily for IFR conditions represented by strict adherence to all applicable ATC rules and procedures For modeling purposes relationships are also developed for standards for VFR conditions represented by visual approaches from an IFR flight plan GRA

**N78-18040** Washington Univ Seattle
**APPLICATION OF SYSTEM IDENTIFICATION TO ANALYTIC ROTOR MODELING FROM SIMULATED AND WIND TUNNEL DYNAMIC TEST DATA Ph D Thesis**
Debashis Banerjee 1977 202 p
Avail Univ Microfilms Order No 77-28337

Aircraft state and parameter identification methods are introduced A simplified form of the Maximum Likelihood method is selected to extract analytical aeroelastic rotor models from simulated and dynamic wind tunnel tests results for accelerated cyclic pitch stirring excitation The goal is to determine the dynamic inflow characteristics for forward flight conditions from the blade flapping responses without direct inflow measurements Reverse flow effects are considered for high rotor advance ratios Two inflow models are studied, the first is based on an equivalent blade Lock number the second is based on a time delayed momentum inflow Basic rotor parameters are identified together with measurement bias values The effect of the theoretical dynamic inflow on the rotor eigenvalues is studied A relation between the accuracy of the identified parameters and the length of input data is established in simulation studies Dissert Abstr

**N78-18041*#** National Aeronautics and Space Administration Washington D C
**A NEW HELICOSTAT FROM SNIAS HELICOPTER DIVISION**
J Morisset Dec 1977 15 p refs Transl into ENGLISH from Air Cosmos (France) no 653, 8 Jan 1977 p 19-22 and 40 Trans by Scientific Translation Service, Santa Barbara, Calif
(Contract NASw-2791)
(NASA-TM-75063) Avail NTIS HC A02/MF A01 CSCL 01C

The Helicostat was described as a helicopter in which the vehicle weight is nullified by two balloons arranged in a catamaran fashion Development of such a vehicle is discussed and various uses for these helicopters are summarized Author

**N78-18042*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
**FLIGHT TESTS OF A RADIO-CONTROLLED AIRPLANE MODE WITH A FREE-WING, FREE-CANARD CONFIGURATION**
Shu W Gee 1978 13 p refs
(NASA-TM-72853 H-1008) Avail NTIS HC A02/MF A01 CSCL 01C

Flight characteristics controllability and potential operating problems were investigated in a radio-controlled airplane model in which the wing is so attached to the fuselage that it is free to pivot about a spanwise axis forward of its aerodynamic center and is subject only to aerodynamic pitching moments imposed by lift and drag forces and a control surface A simple technique of flying the test vehicle in formation with a pickup truck was used to obtain trim data The test vehicle was flown through a series of maneuvers designed to permit evaluation of certain characteristics by observation The free-wing free-canard concept was determined to be workable Stall/spin characteristics were considered to be excellent and no effect on longitudinal stability was observed when center of gravity changes were made Several problems were encountered during the early stages of flight testing such as aerodynamic lockup of the free canard and excessive control sensitivity Lack of onboard instrumentation precluded any conclusions about gust alleviation or ride qualities Author

**N78-18043*#** National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
**AEROMECHANICAL STABILITY OF HELICOPTERS WITH A BEARINGLESS MAIN ROTOR PART 1 EQUATIONS OF MOTION**
Dewey H Hodges Feb 1978 102 p refs Prepared in cooperation with Army Aviation Res and Develop Command Moffett Field Calif
(NASA-TM-78459 A-7301-Pt-1) Avail NTIS HC A06/MF A01 CSCL 01C

Equations of motion for a coupled rotor-body system were derived for the purpose of studying air and ground resonance characteristics of helicopters that have bearingless main rotors For the fuselage only four rigid body degrees of freedom are considered longitudinal and lateral translations pitch and roll The rotor is assumed to consist of three or more rigid blades Each blade is joined to the hub by means of a flexible beam segment (flexbeam or strap) Pitch change is accomplished by twisting the flexbeam with the pitch-control system, the characteristics of which are variable Thus, the analysis is capable of implicitly treating aeroelastic couplings generated by the flexbeam elastic deflections, the pitch-control system and the angular offsets of the blade and flexbeam The linearized equations are written in the nonrotating system retaining only the cyclic rotor modes thus, they comprise a system of homogeneous ordinary differential equations with constant coefficients All contributions to the linearized perturbation equations from inertia, gravity quasi-steady aerodynamics and the flexbeam equilibrium deflections are retained exactly Author

**N78-18044*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

**A FLIGHT EVALUATION OF A TRAILING ANEMOMETER FOR LOW-SPEED CALIBRATIONS OF AIRSPEED SYSTEMS ON RESEARCH AIRCRAFT**

*Bruce D Fisher, Bruce J Holmes and H Paul Stough III* Feb 1978 62 p refs

(NASA-TP-1135, L-11960) Avail NTIS HC A04/MF A01 CSCL 01C

Research airspeed systems on three low-speed general aviation airplanes were calibrated by the trailing anemometer method Each airplane was fitted with an NASA pitot-static pressure tube mounted on either a nose or wing boom The uncalibrated airspeed systems contained residual static-pressure position errors which were too large for high-accuracy flight research applications The trailing anemometer calibration was in agreement with the tower flyby calibration for the one aircraft for which the comparison was made The continuous deceleration technique for the trailing anemometer method offers reduced test time with no appreciable loss of accuracy for airspeed systems with pitot-static system lag characteristics similar to those described Author

**N78-18045*#** National Aeronautics and Space Administration Langley Research Center, Langley Station Va

**FUSELAGE STRUCTURE USING ADVANCED TECHNOLOGY METAL MATRIX FIBER REINFORCED COMPOSITES Patent Application**

Robert K Robinson (Boeing Commercial Airplane Co Seattle) and Harry M Tomlinson, inventors (to NASA) (Boeing Commercial Airplane Co, Seattle) Filed 16 Feb 1978 15 p Sponsored by NASA

(NASA-Case-LAR-11688-1 US-Patent-Appl-SN-878540) Avail NTIS HC A02/MF A01 CSCL 01C

A fuselage structure in which the skin is comprised of layers of a metal matrix fiber reinforced composite is described The plies of the composite material are built up so as to take advantage of the unidirectional properties of strength and stiffness of the composite material with alternate plies of material oriented at approximately 45 deg and approximately 315 deg to the fuselage longitudinal axis The stringers which run longitudinally and support the skin are also reinforced with layers of metal matrix fiber reinforced material oriented at approximately 0 deg relative to the fuselage longitudinal axis The metal matrix fiber reinforced composite used in the preferred embodiment is borsic aluminum Borsic aluminum is comprised of silicone coated boron fibers embedded in an aluminum matrix which results in a fuselage structure that is significantly lighter than a similar fuselage of titanium NASA

**N78-18046#** Advisory Group for Aerospace Research and Development Paris (France)

**FATIGUE DESIGN OF FIGHTERS GUIDELINES FOR OBTAINING AND MAINTAINING ADEQUATE FATIGUE PERFORMANCE OF TACTICAL AIRCRAFT**

Jan 1978 138 p refs

(AGARD-AG-231 ISBN-92-835-1271-5) Avail NTIS HC A07/MF A01

Guidelines are presented to establish recommended procedures for fatigue conscious design of aircraft with special reference to tactical aircraft Steps of the design process are outlined and for each step based on current knowledge those procedures most likely to provide adequate fatigue performance are given

**N78-18047#** National Aerospace Lab, Amsterdam (Netherlands)

**FATIGUE DESIGN OF FIGHTERS, GUIDELINES FOR OBTAINING AND MAINTAINING ADEQUATE FATIGUE PERFORMANCE OF TACTICAL AIRCRAFT GENERAL SURVEY**

J B deJonge *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 6-11 refs

Avail NTIS HC A07/MF A01

In the structural design process of a new aircraft, a number of successive stages can be defined Four successive phases are distinguished here, (a) The definition phase In this phase, the basic structural lay-out including the type of structure and materials to be used is determined (b) The development phase In this phase the detail design of the structure takes place (c) The prototype and production phase This phase is characterised by the assessment of the performance of the new aircraft and its certification (d) The service phase The aircraft has entered service and is being subjected to its actual operational environment The impact of fatigue on the structural design and the considerations with regard to the fatigue phenomenon in each of these successive phases are discussed Author

**N78-18048#** Air Force Systems Command, Wright-Patterson AFB, Ohio Structures Div

**THE DEVELOPMENT OF FATIGUE/CRACK GROWTH ANALYSIS LOADING SPECTRA**

J E Holpp and M A Landy *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 13-41 refs

Avail NTIS HC A07/MF A01

The processes involved in developing a realistic loading spectrum are described The purpose of developing a realistic loading spectrum is to define a stress-time history that is representative of those stresses encountered by a component during actual usage The discussion centers around developing load and stress spectrum for aircraft structural (airframe) components particularly fighter or strike aircraft The realism of the spectrum is determined by the accuracy of the input from the different disciplines and the degree of complexity that the analyst is willing or able to go to There are many external factors to be considered in the spectrum development process Among these are time and money considerations available data, degree of accuracy required, etc These factors may require the use of simpler less time consuming techniques than one would prefer to use for realism s sake The steps involved in the processes include (1) Mission profile definition (2) Loading environment (3) Loading conditions, (4) Structural loads analysis (5) Stress analysis and (6) Stress sequencing Author

**N78-18049#** Industrieanlagen-Betriebsgesellschaft m b H, Ottobrunn (West Germany)

**CALCULATION METHODS FOR FATIGUE LIFE AND CRACK PROPAGATION**

Walter Schutz *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 45-76 refs

Avail NTIS HC A07/MF A01

A number of more or less well known methods to calculate fatigue life in the crack initiation and crack propagation phases are discussed Each section is divided into two sub-sections

present status and potential improvements Methods are classified as present status when they are used widely in industry examined by systematical test programs or are simply outgrowths of older methods and no improvement can be expected for fundamental reasons They are classified as potential improvements when they offer some hope for improvement compared to the present status but this has not been conclusively proved Thus a method will be in the potential improvements section when it has not been thouroughly examined experimentally although it may have been around for many years Author

**N78-18050#** Industrieanlagen-Betriebsgesellschaft m b H Ottobrunn (West Germany)
**TESTS ON DETAILS AND COMPONENTS**
K Ahrensdorf *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 77-106 refs

Avail NTIS HC A07/MF A01

The fatigue life of critical components and/or the reaction of their structures to cracks must be determined to serve as a basis for fatigue life calculation and the final layout of fatigue-critical components Such fatigue tests are often combined with detailed stress analyses Also carried out are specimen tests to determine the crack propagation rates for the materials used and the crack growth in critical areas Specimen tests are employed to complement the component tests because even in this early phase, it is not only interesting to find out how the structure will react to a mission mix used for fatigue verification, but it is also necessary to investigate the influence of variations of mission mix These trade-off studies give information about the limitations in life associated with different usage A seemingly more severe load spectrum may yield a longer life Author

**N78-18051#** Royal Aircraft Establishment, Farnborough (England)
**CURRENT STANDARDS OF FATIGUE TEST ON STRIKE AIRCRAFT**
R D J Maxwell *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 107-116 refs

(AGARD-AR-92) Avail NTIS HC A07/MF A01

Many types of aircraft are operated by countries other than those in which the aircraft were designed and tested It is important, therefore that sufficient information on major tests is made available to enable the airworthiness authorities of all user countries to interpret the tests in terms of their own requirements and monitoring systems The discussion outlines in an advisory manner a list of the steps necessary to achieve the above objectives and to recommend those procedures based on current knowledge most likely to produce acceptable outputs at each step The presentation is divided into three sections (1) a brief statement of the objectives of a fatigue test and a list of the essential steps needed to achieve those objectives (2) a summary of the recommendations of the way in which each of the steps should be carried out and (3) a review of the background philosophy associated with the recommendations Author

**N78-18052#** National Aerospace Lab , Amsterdam (Netherlands)
**FATIGUE LOAD MONITORING**
J B DeJonge *In* AGARD Fatigue Design of Fighters Guidelines for Obtaining and Maintaining Adequate Fatigue Performance of Tactical Aircraft Jan 1978 p 117-134 refs

Avail NTIS HC A07/MF A01

For modern fighter aircraft with their usage versatility and desired long operational lives on the one hand and their finite fatigue endurance on the other, monitoring of operational load experience has become indispensable Monitored loads are used for re-assessing the service life under operational conditions and the inspection intervals for fail-safe structures which are based on crack growth rates in conjunction with loading severity Methods available for such re-assessment are discussed Various load monitoring techniques are described and general aspects of fatigue load monitoring are discussed Author

**N78-18053#** Army Aviation Engineering Flight Activity Edwards AFB, Calif
**AIRWORTHINESS EVALUATION NUH-1H HELICOPTER WITH GLOBAL POSITIONING SYSTEM Final Report**
Charles L Thomas and Tom P Benson May 1977 189 p refs
(AD-A047971 USAAEFA-76-13) Avail NTIS MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted a limited airworthiness flight evaluation of an NUH-1H helicopter in which a prototype global positioning system (GPS) was installed Flight tests were conducted at Edwards Air Force Base California, between 18 and 27 January 1977 Nine test flights were conducted for a total of 11 productive flight hours Testing was performed to determine the effect of GPS installation on vibration and pilot-induced oscillation (PIO) characteristics of the NUH-1H helicopter During this test, one deficiency and one shortcoming were noted The deficiency was insufficient aft longitudinal control margin in rearward flight The shortcoming was insufficient directional control margin in hover and low-speed flight The deficiency and the shortcoming were a result of the gross weight and center of gravity of the helicopter after installation of the GPS, although both were within normal UH-1H operating limits There was no significant effect on vibration characteristics or increase in PIO tendencies of the NUH-1H as a result of the GPS installation Author (GRA)

**N78-18054#** Boeing Vertol Co , Philadelphia, Pa
**LIMITATIONS OF THE CH-47 HELICOPTER IN PERFORMING TERRAIN FLYING WITH EXTERNAL LOADS Final Report, Jul 1976 - Apr 1977**
Irvin B Alansky, James M Davis and Theodore S Garnett, Jr Aug 1977 161 p refs
(Contract DAAJ02-76-C-0028)
(AD-A048580, D210-11225-1, USAAMRDL-TR-77-21) Avail NTIS HC A08/MF A01 CSCL 01/2

Quantitative limitations of the CH-47 helicopter performing terrain flying with external loads have been developed using a fully coupled total force and moment simulation math model of the helicopter and external load Load sway motion and susceptibility to pilot induced oscillations in night/instrument meteorological conditions were identified as the prime source of these limitations Masking considerations were determined for various external load configurations including an 8x8x20-foot MILVAN and a 155mm howitzer Incorporation of load stabilization (AAELSS) coupled with a shortened sling suspension or a Self-Hoisting Cargo Interface Device, offers the best potential for alleviating the limits identified, while providing improved masking requirements and reductions in pilot workload In addition, the levels of maneuverability possible with the present state-of-the-art visionic systems (including FLIR and NVG) were defined for terrain flying during night operations Author (GRA)

**N78-18055#** Grumman Aerospace Corp Bethpage, N Y
**FLIGHT QUALIFICATION OF TITANIUM F-14A AIRFRAME COMPONENTS MANUFACTURED BY HOT ISOSTATIC PRESSING (HIP) Final Report, 1 Nov 1975 - 31 Mar 1977**
R Witt Jun 1977 116 p refs
(Contract N00019-76-C-0143)
(AD-A048485) Avail NTIS HC A06/MF A01 CSCL 01/3

This program established that fuselage braces (Part No A51B21683) manufactured by the hot isostatic pressing (HIP) process can satisfy flight requirements for forged parts The HIP braces withstood 24 000 equivalent flight hours (four design lives) without failure The projected cost saving related to the utilization of the HIP process in manufacturing of these parts is in the range of 30 to 40% Ti-6Al-6V-2Sn titanium alloys consolidated by HIP exhibited excellent fracture toughness and elongation characteristics and obtained K sub ic and percent elongation values in the range of 69-74 ksi sq root of in and 15-16%, respectively Representative F sub tu and F sub ty values were approximately 3% below the current design specifications for forgings However these values can be increased by minor modifications in the oxygen content within allowable limits Mechanical properties exhibited isotropic characteristics

Reproducibility studies indicated that current tight tolerances for machined components may have to be relaxed to assure that all dimensions of hot isostatically pressed (HIP'd) parts meet design specifications Experimental welds on HIP and vacuum annealed materials met radiographic and ultrasonic acceptance criteria Utilization of the HIP process in manufacturing fatigue-critical airframe components will depend on availability of high-quality powders with certified purity standards to insure freedom from inclusions GRA

**N78-18056#** National Aerospace Lab Amsterdam (Netherlands) Scientific Services

**FLIGHT-PATH RECONSTRUCTION OF SYMMETRIC NONSTEADY FLIGHTS**

M VanDerWilt 17 May 1977 35 p refs

(NLR-TR-76133-U) Avail NTIS HC A03/MF A01

An essential part of the process of determining the aircraft performance from data of nonsteady flight tests is the so-called flight path reconstruction A flight path reconstruction with the square-root information formulation of the Kalman filter and smoother is described This estimation method is applied to a symmetric nonsteady flight Results of flight path reconstruction are obtained by processing simulated flight test measurements Author (ESA)

**N78-18057#** Dornier-System G m b H, Friedrichshafen (West Germany)

**IMPROVEMENT OF FLIGHT MEASURING DATA WITH A KALMAN FILTER [VERBESSERUNG DER FLUGMESSDATEN DURCH EIN KALMAN-FILTER]**

L Platzoeder Bonn DOKZENTBw 1977 104 p refs In GERMAN ENGLISH summary

(Contract T/RF-41/RF-410/51082)

(BMVg-FBWT-77-6) Avail NTIS HC A06/MF A01 DOKZENTBw DM 30

Improvement of Fiat G91-T3 flight test measuring data using a Kalman filter algorithm was studied The system equations and the Kalman filter equations are given and the regression analysis is presented Tests with the Kalman filter FORTRAN computer program listed in the appendix, are reported and results are discussed Both the filtering and the one channel smoothing of the measuring data produce an improvement in the regression analysis, but not nearly to the expected extent Indeed the filtering produces a distinct reduction of the measuring data noise But it is shown that the regression analysis is insensible to noise, as expected so that the improvement in the measuring data could not improve the results Tests with simulated data also show that the filter is very well qualified to filter out systematic errors In the flight test results this is also seen in the improvements of the multiple correlation coefficient To summarize studies with a Kalman-filter-algorithm show the technique to be a valuable tool in dynamic systems parameter identification Author (ESA)

**N78-18058#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Aerodynamik

**MODERN CONCEPTS FOR AERODYNAMIC ROTOR DESIGN**

H Koerner Sep 1977 87 p refs In GERMAN ENGLISH summary Presented at the Course of Hubschraubertech 1 Bundeswehrakad fuer Wehrverwaltung u Wehrtech Mannheim West Ger 29 Sep 1977

(DLR-IB-151-77/11) Avail NTIS HC A05/MF A01

As survey of new concepts for the improvement of the aerodynamic performance of rotors is given Improvements of the conventional hinged rotor are discussed especially new airfoil sections and modified blade planforms The new rotor concepts are considered together with aerodynamic problems in connection with new flight vehicles such as compound airplanes A short survey of the aerodynamic methods available for rotor design is presented Author (ESA)

**N78-18059#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Dynamik der Flugsysteme

**OPTIMAL LEVEL CONTROLS OF HIGH PERFORMANCE AIRCRAFT [OPTIMALE EBENE STEUERUNGEN VON HOCHLEISTUNGSFLUGZEUGEN]**

D Kraft G C Shau K H Well and E Berger 12 Jul 1977 53 p refs In GERMAN

(DLR-IB-552-77/20) Avail NTIS HC A04/MF A01

The application of computer programs for the analysis and synthesis of optimal aircraft designs to the problem of optimal controls design is dealt with The mathematical model of aircraft motion is described An equations system related to the linearized equations of motion was set up and the necessary optimality conditions formulated The approximation of aerodynamic and propulsion characteristics is discussed and an approximation by rational functions is proposed Two highly developed fast optimization algorithms are presented a multitarget and a collocation method Methods for determining estimated values are outlined Results of numerical calculations for time and fuel optimized trajectories of two high performance aircraft are presented ESA

**N78-18060#** Marconi Space and Defence Systems Ltd, Camberley (England)

**THE PHILOSOPHY ADOPTED FOR THE FLIGHT TESTING OF THE PANAVIA TORNADO AVIONICS SYSTEM IN HACK AIRCRAFT**

P H Morgan 1977 17 p Presented at the Symp on Data and Inform Process in Marine Navigation Systems Brunel Univ, Uxbridge Engl, 6 Sep 1977

Avail NTIS HC A02/MF A01

The philosophy and techniques adopted for the flight testing of the swing-wing Tornado aircraft digitally based self-contained all-weather NAV/ATTACK avionics system are presented The subsystems for navigation, displays, flight control, weapon aiming, computing and data transmission are described The development organization and development program system are described briefly The stage 3 flight trials program is detailed ESA

**N78-18061#** Westinghouse Defense and Electronic Systems Center Baltimore, Md

**F-4E AVIONICS UPDATE Final Report, 15 Jun. - 30 Sep 1976**

A F Wenk Aug 1977 48 p refs

(Contract F33615-76-C-1340)

(AD-A047949, AFAL-TR-77-91) Avail NTIS HC A03/MF A01 CSCL 19/5

This report covers the final phase of the previous F-4E Austere HUD Program AFAL-TR-76-190, dated December 1976 This report covers live aerial gun firing performance support that Westinghouse provided for the gunsight mechanization previously incorporated in test aircraft No 304 at AFFTC The report also covers SEAFAC support work and transformers delivered to SEAFAC Author (GRA)

**N78-18062#** Hughes Helicopters, Culver City, Calif Display Systems Lab

**LIQUID CRYSTAL AIRBORNE DISPLAY Final Technical Report, Mar 1973 - Dec 1976**

Richard N Winner, Michael N Ernstoff, and William R Byles Aug 1977 261 p refs

(Contract F33615-73-C-1221)

(AD-A048198 HAC-P76-527R HAC-Ref-C9383

AFAL-TR-77-18) Avail NTIS HC A12/MF A01 CSCL 14/2

A solid-state liquid crystal television display panel is described This display has been developed as a replacement for the cathode-ray tube in direct-view and head-up display applications for tactical aircraft Its key advantages are (1) high contrast in small and large areas, (2) gray shade capability under all levels of illumination including direct-sunlight (3) uniform high resolution over the entire display area (4) interface similar to CRT TV display and (5) low power, weight volume Cockpit installations have been designed for the display which permit viewing under

day and night conditions Measurements have confirmed that the display brightness and contrast remain superior to the CRT for all single-place cockpit viewing positions under anticipated in-flight illumination conditions The presentation of gray scale television images under direct sunlight illumination has been demonstrated The display is built using silicon LSI circuit technology to form the metal-oxide semiconductor addressing circuits which define a matrix of electrodes used to directly activate a liquid crystal film The present display is 2 in square and consists of 40 000 elements arranged in a 200 x 200 array Techniques have been successfully illustrated for increasing the size of the display by assembling a mosaic array of modules that are electrically interconnected GRA

N78-18033# Dynamics Research Corp Wilmington Mass
**DIGITAL AVIONICS INFORMATION SYSTEM (DAIS) MID-1980'S MAINTENANCE ANALYSIS Final Report, May 1975 - Oct 1976**
Andrew J Czuchry, John M Glasier, Herbert E Engel, H Anthony Baran (AFHRL, Wright-Patterson AFB, Ohio), Marjorie A Bristol, and Duncan L Dieterly (AFHRL, Wright-Patterson AFB Ohio) Brooks AFB Tex AFHRL Jul 1977 79 p refs
(Contract F33615-75-C-5218, AF Proj 2051)
(AD-A047886, AFHRL-TR-77-45) Avail NTIS HC A05/MF A01 CSCL 09/3

The fundamental objective of the Digital Avionics Information System (DAIS) Life Cycle Cost (LCC) Study is to provide the Air Force with an enhanced in-house capability to incorporate LCC considerations during all stages of the system acquisition process The purpose of this report is to describe the technical approach, results and conclusions obtained from a Maintenance Task Analysis (MTA) conducted on a mid-1980s DAIS conceptual design configuration to identify and quantify support maintenance task requirements This conceptual design configuration is one of two developed as bases for determining the maintenance support requirements of DAIS systems They are described in AFHRL-TR-76-59, Mid-1980s Digital Avionics Information System Conceptual Design Configuration The first is representative of an application of the DAIS principles of avionics integration to current avionics equipment The second represents an application of DAIS principles to equipment expected to be operational in the mid-1980s An MTA was conducted on the current DAIS conceptual design configuration, AFHRL-TR-76-71, Digital Avionics Information System (DAIS) Current Maintenance Task Analysis Its results provided a baseline for conducting the MTA reported here The approach taken was to identify major system design changes and innovative support system capabilities projected to be available in the mid-1980s timeframe along with major mechanization differences between the two conceptual designs GRA

N78-18034# Environmental Research Inst of Michigan, Ann Arbor Radar and Optics Div
**HOLOGRAPHIC COMBINERS FOR HEAD-UP DISPLAYS Final Report, 1 May 1976 - 31 Jan 1977**
W S Colburn and B J Chang Wright-Patterson AFB, Ohio AFAL Oct 1977 108 p refs
(Contract F33615-76-C-1182)
(AD-A047998, ERIM-122400-9-F, AFAL-TR-77-110) Avail NTIS HC A06/MF A01 CSCL 20/6

The use of holographic optical elements as combiners in Head-Up Displays (HUD) offers performance improvements in two respects because the holographic combiner has a high reflectivity over a narrow spectral region, it can make more efficient use of the light, and by forming the final element of the collimating lens, it can increase the field-of-view Both improvements were examined separately in an analytical and experimental investigation directed at evaluating holographic combiners in existing HUD systems Flat holographic combiners that can be substituted on a one-for-one replacement basis for the conventional combiner in an existing HUD were designed and fabricated The combiners were fabricated in dichromated gelatin, and were characterized by diffraction efficiencies in excess of 90% and angular bandwidths of 10 to 12 deg A computer analysis of curved holographic combiners in the A-10 HUD generated a design that shows promise for increasing the instantaneous field-of-view to 15 deg and the total field-of-view to 20 deg GRA

N78-18035# Draper (Charles Stark) Lab Inc Cambridge Mass
**PALEFAC Final Report, 1 Mar. 1975 - 31 May 1977**
H B Chalstrom, Jr Wright-Patterson AFB Ohio AFAL Sep 1977 24 p refs
(Contract F33615-75-C-1206, AF Proj 2052)
(AD-A048331, R-1087, AFAL-TR-77-167) Avail NTIS HC A02/MF A01 CSCL 09/2

This report describes the Palefac system which is part of the non-real-time support software of the Digital Avionics Information System (DAIS) of the Air Force Avionics Laboratory (AFAL) Palefac is a tool which aids in the development of real-time flight software for avionics embedded digital computers This report deals with three aspects of the relationship of Palefac to the DAIS program Author (GRA)

N78-18036* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**INTEGRATED GAS TURBINE ENGINE-NACELLE Patent**
Arthur P Adamson, Donald F Sargisson, and Charles L Stotler, Jr, inventors (to NASA) Issued 25 Oct 1977 9 p Filed 3 Nov 1975 Division of US Patent Appl SN-522108, filed 8 Nov 1974
(NASA-Case-LEW-12389-2, US-Patent-4 055,041, US-Patent-Appl-SN-628221, US-Patent-Class-60-226R US-Patent-Class-60-39 31, US-Patent-Class-244-53A, US-Patent-Class-244-54) Avail US Patent Office CSCL 21E

A nacelle for use with a gas turbine engine is presented An integral webbed structure resembling a spoked wheel for rigidly interconnecting the nacelle and engine, provides lightweight support The inner surface of the nacelle defines the outer limits of the engine motive fluid flow annulus while the outer surface of the nacelle defines a streamlined envelope for the engine Official Gazette of the U S Patent Office

N78-18037* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**VARIABLE MIXER PROPULSION CYCLE Patent**
Dan Joseph Rundell (GE, Cleveland), Donald Patrick McHugh (GE Cleveland), Tom Foster (GE, Cleveland), and Ralph Harold Brown inventors (to NASA) (GE, Cleveland) Issued 24 Jan 1978 10 p Filed 2 Jun 1975 Sponsored by NASA
(NASA-Case-LEW-12917-1, US-Patent-4,069,661, US-Patent-Appl-SN-583055 US-Patent-Class-60-204, US-Patent-Class-60-262) Avail US Patent Office CSCL 21E

A design technique method and apparatus are delineated for controlling the bypass gas stream pressure and varying the bypass ratio of a mixed flow gas turbine engine in order to achieve improved performance The disclosed embodiments each include a mixing device for combining the core and bypass gas streams The variable area mixing device permits the static pressures of the core and bypass streams to be balanced prior to mixing at widely varying bypass stream pressure levels The mixed flow gas turbine engine therefore operates efficiently over a wide range of bypass ratios and the dynamic pressure of the bypass stream is maintained at a level which will keep the engine inlet airflow matched to an optimum design level throughout a wide range of engine thrust settings Official Gazette of the U S Patent Office

N78-18038*# Pennsylvania State Univ University Park Dept of Mechanical Engineering
**INVESTIGATION OF THE UNSTEADY PRESSURE DISTRIBUTION ON THE BLADES OF AN AXIAL FLOW FAN Final Report, Sep 1973 - Sep 1977**
Robert E Henderson and Gary F Franke Mar 1978 138 p refs
(Grant NGR-39-009-275)
(NASA-CR-15571) Avail NTIS HC A07/MF A01 CSCL 21E

The unsteady response of a stator blade caused by the interaction of the stator with the wakes of an upstream rotor was investigated Unsteady pressure distributions were measured using a blade instrumented with a series miniature pressure transducers The influence of several geometrical and flow

parameters - rotor/stator spacing, stator solidity and stator incidence angle - were studied to determine the unsteady response of the stator to these parameters A major influence on the stator unsteady response is due to the stator solidity At high solidities the blade-to-blade interference has a larger contribution While the range of rotor/stator spacings investigated had a minor influence, the effect of stator incidence angle is significant The data indicate the existence of an optimum positive incidence which minimizes the unsteady response Author

**N78-18069#** General Electric Co , Cincinnati Ohio Aircraft Engine Group

**GE CORE ENGINE NOISE INVESTIGATION, LOW EMISSION ENGINES Final Report, Jun 1975 - Dec 1976**

R K Matta G T Sandusky and V L Doyle Feb 1977 286 p refs

(Contract DOT-FA75WA-3688)

(AD-A048590, FAA-RD-77-4) Avail NTIS HC A13/MF A01 CSCL 20/1

Investigations were conducted to determine the variables affecting source strength spectrum shape, and farfield directivity This investigation included scale model tests to evaluate the effects of exhaust nozzle geometry on radiation patterns of low frequency noise A full-scale combustor rig test was used to identify the controlling variables of combustor noise at the source Two engines tests were run to validate the findings from the scale model tests and add to the overall data base of core noise measurements The relationship between combustor source noise and emissions was studied and qualitative trends identified for advanced low emissions combustors Studies were made of the attenuation of high frequency turbine noise by downstream blade rows, the broadband noise generation by turbines, and the controlling parameters for turbine tone/jet stream interaction This included a turbine rig test in single and multistage configurations along with a unique data acquisition system Scale model tests were used to define the effect of the pertinent aero-acoustic parameters on turbine tone scattering by jet stream turbulence The results of these investigations were used to improve the component prediction techniques derived under the Core Engine Noise Control Program Author

**N78-18070*#** Pratt and Whitney Aircraft Group, West Palm Beach, Fla Government Products Div

**F-15/NONAXISYMMETRIC NOZZLE SYSTEM INTEGRATION STUDY SUPPORT PROGRAM Contractor Report, 24 Feb. 1977 - 30 Sep 1977**

H L Stevens Feb 1978 171 p refs

(Contract NAS3-20608)

(NASA-CR-135252, FR-9232) Avail NTIS HC A08/MF A01 CSCL 21E

Nozzle and cooling methods were defined and analyzed to provide a viable system for demonstration 2-D nozzle technology on the F-15 aircraft Two candidate cooling systems applied to each nozzle were evaluated The F-100 engine mount and case modifications requirements were analyzed and the actuation and control system requirements for two dimensional nozzles were defined Nozzle performance changes relative to the axisymmetric baseline nozzle were evaluated and performance and weight characteristics for axisymmetric reference configurations were estimated The infrared radiation characteristics of these nozzles installed on the F-100 engine were predicted A full scale development plan with associated costs to carry the F100 engine/two-dimensional (2-D) nozzle through flight tests was defined Author

**N78-18071#** Calspan Corp , Buffalo, N Y

**STUDIES OF HEAT TRANSFER TO GAS TURBINE COMPONENTS Final Report, Jun 1976 - Oct 1977**

Michael G Dunn and Frank J Stoddard Wright-Patterson AFB, Ohio AFAPL Oct 1977 54 p refs

(Contract F33615-76-C-2092)

(AD-A048551, CALSPAN-XE-5933-A-102 AFAPL-TR-77-66) Avail NTIS HC A04/MF A01 CSCL 21/5

A 180 sector of the first stage stationary inlet nozzle of the AiResearch TFE-731-2 engine was instrumented with thin-film heat-transfer gages and experiments were performed to obtain detailed heat-transfer rate distributions It is shown that the experimental apparatus can potentially be used to study total-pressure losses in cascades The experimental apparatus consists of a helium-driven shock tube as a short-duration source of high-temperature high-pressure gas driving a nozzle test-section device mounted near the exit of a primary shock-tunnel receiver tank The nozzle test-section device consists of a forward transition section with a circular opening facing the supersonic primary nozzle flow and with the external shape of a frustum of a cone Internal contouring is provided to transform the circular-section subsonic intake flow into one filling approximately a 180 annular segment having a geometry approximating that of the entrance to the turbine stator stage in a turbojet Detailed measurements of static pressure in the test section and heat-transfer rate on the stator sector have been obtained and are reported herein Author (GRA)

**N78-18072#** Sportavia-Puetzer G mbH and Co , K G (West Germany)

**EXPERIMENTAL DETERMINATION AND COMPARISON WITH THEORY OF THRUST, NOISE AND DRIVING WEIGHT OF PROPELLER DRIVES [EXPERIMENTELLE BESTIMMUNG UND VERGLEICH MIT DER THEORIE VON SCHUB, LAERM UND ANTRIEBSGEWICHT VON PROPELLERANTRIEBEN]**

H Oberdoerster, M Schliewa, H Schrecker, and M Weck Bonn DOKZENTBw 1977 78 p refs In GERMAN, ENGLISH summary

(Contract T/RF-41/RF-410/41110)

(BMVg-FBWT-77-16) Avail NTIS HC A05/MF A01, DOKZENTBw DM 30

Noise, static thrust and thrust in flight were experimentally determined for the quiet aircraft, Sportavia S5 Results were compared with those from the calculation method of Hamilton Standard for propeller thrust and Pilatus for propeller noise Prior conditions for the comparisons were established from comparison test flights for the gliding flight polar error, from measurement of the characteristics of the engine and from calibrations of the indicating instruments Weights of propeller and engine for predefined performance and engine speeds were recorded ESA

**N78-18073#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany) Inst fuer Luftstrahlantriebe

**INVESTIGATION OF THE JET WAKE DISCHARGE FLOW OF A HEAVILY LOADED CENTRIFUGAL COMPRESSOR IMPELLER M S. Thesis - Tech Hochschule Aachen**

Dietrich Eckardt 18 Jul 1977 227 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-466)

(DLR-FB-77-32) Avail NTIS HC A11/MF A01, DFVLR Cologne DM 91 20

The complex flow field in high performance centrifugal compressors was studied Newly developed measuring techniques for unsteady static and total pressures (based on semiconductor transducers) as well as flow directions (special hot-wire probe), and a digital data analysis system for fluctuating signals (sampling technique) were tested thoroughly The loss-affected mixing process of the distorted impeller discharge flow was investigated in detail, in the absolute and relative system, at impeller tip speeds up to 380 m/s A theoretical analysis proved good coincidence of the test results with the Dean-Senoo theory, which was extended to compressible flows Author (ESA)

**N78-18075*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif

**FLIGHT-DETERMINED STABILITY AND CONTROL COEFFICIENTS OF THE F-111A AIRPLANE**

Kenneth W Iliff Richard E Maine and Sandra Thornberry Steers Mar 1978 91 p refs

(NASA-TM-72851) Avail NTIS HC A05/MF A01 CSCL 01C

A complete set of linear stability and control derivatives of the F-111A airplane was determined with a modified maximum likelihood estimator The derivatives were determined at wing sweep angles of 26 deg, 35 deg, and 58 deg The flight conditions included a Mach number range of 0 63 to 1 43 and an angle

of attack range of 2 deg to 15 deg Maneuvers were performed at normal accelerations from 0 9g to 3 8g during steady turns to assess the aeroelastic effects on the stability and control characteristics The derivatives generally showed consistent trends and reasonable agreement with the wind tunnel estimates Significant Mach effects were observed for Mach numbers as low as 0 82 No large effects attributable to aeroelasticity were noted Author

**N78-18076*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards, Calif
**ANALYTICAL STUDY OF RIDE SMOOTHING BENEFITS OF CONTROL SYSTEM CONFIGURATIONS OPTIMIZED FOR PILOT HANDLING QUALITIES**
Bruce G Powers Feb 1978 60 p refs
(NASA-TP-1148, H-922) Avail NTIS HC A04/MF A01 CSCL 01C

An analytical study was conducted to evaluate the relative improvements in aircraft ride qualities that resulted from utilizing several control law configurations that were optimized for pilot handling qualities only The airplane configuration used was an executive jet transport in the approach configuration The control law configurations included the basic system, a rate feedback system, three command augmentation systems (rate command, attitude command, and rate command/attitude hold), and a control wheel steering system Both the longitudinal and lateral directional axes were evaluated A representative example of each control law configuration was optimized for pilot handling qualities on a fixed base simulator The root mean square airplane responses to turbulence were calculated, and predictions of ride quality ratings were computed by using three models available in the literature Author

**N78-18077#** Toronto Univ (Ontario) Inst for Aerospace Studies
**THE APPLICATION OF TECHNIQUES FOR PREDICTING STOL AIRCRAFT RESPONSE TO WIND SHEAR AND TURBULENCE DURING THE LANDING APPROACH**
L D Reid, A B Markov, and W O Graf Jun 1977 172 p refs
(UTIAS-215 CN-ISSN-0082-5255) Avail NTIS HC A08/MF A01

Techniques examined include an experimental approach which collects flow statistics at fixed points along the nominal flight path The correlations are then employed with a linear aircraft model to predict RMS response In the second technique studied, turbulence velocities are measured from which aerodynamic forces can be calculated using linear aerodynamics These measurements can be made by a moving probe in a boundary layer wind tunnel or by a properly instrumented aircraft in the field B L.P

**N78-18078#** Air Force Inst of Tech , Wright-Patterson AFB, Ohio School of Engineering
**THE EFFECTS OF EXTERNAL STORES ON THE FLUTTER OF A NON-UNIFORM CANTILEVER M S Thesis**
Van C Sherrer Dec 1977 105 p refs
(AD-A048360, AFIT-GAE/AA/77D-13) Avail NTIS HC A06/MF A01 CSCL 20/4

A computer study of the effects of external stores simulated by lumped masses was conducted with a finite element, cantilever, nonuniform wing model The NASTRAN (Level 16 0) computer program flutter format was used to obtain flutter speeds and frequencies Mass balancing with a single concentrated mass caused a reduction in flutter speed as the mass was moved chordwise toward the trailing edge and spanwise toward the wing tip Flutter speeds and frequencies of a 100 lb and a 200 lb store, simulated by two equal masses, were compared to an equivalent concentrated mass at the store center of gravity The stores consistently raised the flutter frequency over that of the single mass, but flutter speed results were not conclusive Author (GRA)

**N78-18080#** National Aerospace Lab , Amsterdam (Netherlands) Space Flight Div
**FLIGHT TEST OF STICK FORCE STABILITY IN ATTITUDE-STABILIZED AIRCRAFT**
H A Mooij and M F C VanGool 18 May 1977 7 p refs Presented at the AIAA 4th Atmospheric Flight Conf , Hollywood, Fla 8-10 Aug 1977
(NLR-MP-77015-U) Avail NTIS HC A02/MF A01

The need of artificially generated positive stick force stability for longitudinal flight control systems based on pitch-rate-command/attitude-hold (PRC/AH) has been investigated in two flight test programs using a Beechcraft Queen Air-80 and a Fokker F-28/Mk6000 The main conclusion, based on statistical analysis of performance measures and 'effort ratings' of 120 approaches, is that positive stick force stability reduces airspeed deviations from the reference speed at the cost of increased glide path deviations and increased pilot effort Only for relatively small levels of positive stick force stability was a modest reduction of airspeed deviation obtained, while glide path tracking and pilot effort were not significantly degraded as compared to the case of neutral stick force stability Author (ESA)

**N78-18081#** European Space Agency, Paris (France)
**DETERMINATION OF DYNAMIC CHARACTERISTICS FROM FLIGHT TEST DATA**
Martin Marchand Dec 1977 29 p refs Transl into ENGLISH of 'Ein Verfahren fuer die Bestimmung von dynamischen Flugeigenschaftskenngroessen aus Flugversuchsdaten', DFVLR, Brunswick Report DLR-FB-77-26, 20 Jun 1977 Original report in GERMAN previously announced as N78-14044 Original German report available from DFVLR, Cologne DM 13 20
(ESA-TT-434, DLR-FB-77-26) Avail NTIS HC A03/MF A01

An evaluation procedure for the determination of dynamic characteristics from flight test data was developed The procedure uses a gradient method for the evaluation of eigenvalues and a regression method for the calculation of eigenvectors The procedure was programmed in FORTRAN and successfully applied during a handling qualities assessment of a fighter aircraft The procedure is described and some results from both simulation and flight testing are presented Author (ESA)

**N78-18082** Virginia Univ , Charlottesville
**OPTIMAL AIRCRAFT SIMULATOR DEVELOPMENT BY ADAPTIVE RANDOM SEARCH OPTIMIZATION Ph.D Thesis**
Guy Otis Beale, Jr 1977 180 p
Avail Univ Microfilms Order No 77-28601

An Adaptive Random Search technique was developed for parameter optimization The result of the optimization process is a discrete time transfer function to be used as an integration operator in the simulation of closed loop nonlinear, dynamic systems The transfer function is optimized for the particular system being simulated The search for the optimum parameter set is guided by past successful parameter values A vector valued performance criterion is used with the optimization procedure This allows the consideration of several cost functions simultaneously For a particular simulation trial to be considered successful, no element of the performance vector may increase in value, and at least one element must decrease The optimization technique was applied to the simulation of aircraft motion in a vertical plane, as well as to a more general twelfth order aircraft model Dissert Abstr

**N78-18083*** National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
**FULL COLOR HYBRID DISPLAY FOR AIRCRAFT SIMULATORS *Patent***
Wendell D Chase inventor (to NASA) Issued 25 Oct 1977 11 p Filed 17 Oct 1975 Supersedes N76-10148 (14 - 01, p 0021)
(NASA-Case-ARC-10903-1 US-Patent-4,055 004 US-Patent-Appl-SN-623536 US-Patent-Class-35-12N, US-Patent-Class-358-104) Avail US Patent Office CSCL 14B

A full spectrum color monitor, connected to the camera and lens system of a television camera supported by a gantry frame over a terrain model simulating an aircraft landing zone, projects the monitor image onto a lens or screen visually accessible to a trainee in the simulator A digital computer produces a pattern

corresponding to the lights associated with the landing strip onto a monochromatic display and an optical system projects the calligraphic image onto the same lens so that it is superposed on the video representation of the landing field The optical system includes a four-color wheel which is rotated between the calligraphic display and the lens and an apparatus for synchronizing the generation of a calligraphic pattern with the color segments on the color wheel A servo feedback system responsive to the servo motors on the gantry frame produces an input to the computer so that the calligraphically generated signal corresponds in shape, size and location to the video signal Official Gazette of the U S Patent Office

**N78-18084*#** National Aeronautics and Space Administration Langley Research Center Langley Station, Va
**LASER VELOCIMETER SURVEY ABOUT A NACA 0012 WING AT LOW ANGLES OF ATTACK**
Danny R Hoad (Army Aviation Research and Development Command), James F Meyers, Warren H Young, Jr (Army Aviation Research and Development Command) and Timothy E Hepner (Army Aviation Research and Development Command) Jan 1978 155 p refs
(NASA-TM-74040) Avail NTIS HC A08/MF A01 CSCL 14B

An investigation was conducted in the Langley V/STOL tunnel with a laser velocimeter to obtain measurements of airflow velocities about a wing at low angles of attack The applicability of the laser velocimeter technique for this purpose in the V/STOL tunnel was demonstrated in this investigation with measurement precision bias calculated at -1 33 percent to 0 91 percent and a random uncertainty calculated at + or - 0 47 percent Free stream measurements were obtained with this device and compared with velocity calculations from pitot static probe data taken near the laser velocimeter measurement location The two measurements were in agreement to within 1 percent Velocity measurement results about the centerline at 0 6 degrees angle of attack were typically those expected At 4 75 degrees, the velocity measurements indicated that a short laminar separation bubble existed near the leading edge with an oscillating shear layer Author

**N78-18085*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
**DESIGN AND PERFORMANCE EVALUATION OF SLOTTED WALLS FOR TWO-DIMENSIONAL WIND TUNNELS**
Richard W Barnwell Feb 1978 33 p refs
(NASA-TM-78648) Avail NTIS HC A03/MF A01 CSCL 14B

A procedure for designing slotted walls for two dimensional wind tunnels is is presented The design objective is the minimization of blockage of streamline curvature or the reduction of both The slotted wall boundary condition is derived both for flow from the tunnel into the plenum and vice versa, and the procedure for evaluating wall interference is described A correlation of experimental data for the slotted wall boundary condition is given Results are given for several designs and evaluations of slotted wind tunnel walls Author

**N78-18086*#** Southampton Univ (England)
**THE 0 1m SUBSONIC CRYOGENIC TUNNEL AT THE UNIVERSITY OF SOUTHAMPTON**
M J Goodyer Jan 1978 43 p refs
(Grant NsG-7172)
(NASA-CR-145305) Avail NTIS HC A03/MF A01 CSCL 14B

The design and performance of a low speed one atmosphere cryogenic wind tunnel is described The tunnel is fan driven and operates over the temperature range 305K to 77K at Mach numbers up to 0 28 It is cooled by the injection and evaporation of liquid nitrogen in the circuit, and the usual test gas is nitrogen The tunnel has a square test section 0 1m across and was built to allow at low costs, the development of testing techniques and the development of instrumentation for use in cryogenic tunnels, and to exploit in general instrumentation work the unusuallly wide range of unit Reynolds number available in such tunnels The tunnel was first used in the development of surface flow visualization techniques for use at cryogenic temperatures Author

**N78-18087#** Appli-Mation, Inc , San Diego Calif
**AUTOMATED WEAPON SYSTEM TRAINER· EXPANDED ADAPTIVE MODULE FOR BASIC INSTRUMENT FLIGHT MANEUVERS Final Report, Jun 1974 - Jul 1976**
John P Charles and Robert M Johnson Orlando Fla Naval Training Equipment Center Aug 1977 204 p refs
(Contract N61339-74-C-0141)
(AD-A048498 AISR/376 NAVTRAEQUIPC-74-C-0141-1) Avail NTIS HC A10/MF A01 CSCL 05/9

Previous studies have demonstrated the conceptual and technical feasibility of automated and adaptive aviation simulator training This study was concerned with exploring the impact of operational syllabi and training requirements on these advanced techniques The Advanced Jet Instrument Training syllabus was *selected and analyzed A demonstration of the application of* automated and adaptive techniques to the syllabus was conducted utilizing the R and D simulator at the Naval Training Equipment Center Several new approaches to performance measurement, syllabus structuring and training control were developed to meet the syllabus requirement and training objectives The techniques and applications were successfully demonstrated Author (GRA)

**N78-18131*#** Fiber Science Inc , Gardena Calif
**COMPOSITE HUB/METAL BLADE COMPRESSOR ROTOR Contractor Report, Dec. 1974 - Oct. 1975**
Sam Yao Jan 1978 25 p
(Contract NAS3-18926)
(NASA-CR-135343) Avail NTIS HC A02/MF A01 CSCL 11D

A low cost compressor rotor was designed and fabricated for a small jet engine The rotor hub and blade keepers were compression molded with graphite epoxy Each pair of metallic blades was held in the hub by a keeper All keepers were locked in the hub with circumferential windings Feasibility of fabrication was demonstrated in this program Author

**N78-18138#** SRI International Corp , Menlo Park, Calif
**EXPLORATORY DEVELOPMENT OF CONDUCTIVE COATING MATERIALS Final Report, 15 Mar 1976 - 15 Mar 1977**
S R Morrison, M Landstrass, and D B Parkinson Wright-Patterson AFB, Ohio AFML Jun 1977 60 p refs
(Contract F33615-76-C-5072)
(AD-A048253, AFML-TR-77-90) Avail NTIS HC A04/MF A01 CSCL 11/3

The object of this study is the development of a conductive white coating (paint) primarily for use on aircraft radomes Two problems are addressed First, in order to maintain a low pigment volume concentration (PVC) so the coating will have good erosion resistance, we have examined ways of inducing the pigment to flocculate in a chain or snowflake structure This structure is needed to maintain interparticle contacts, and thus high conductance while permitting a low PVC The most effective way found to induce chain flocculation was with an applied electric field With the flocs thus formed, they were cemented into permanent units with a SiCl4 treatment The second problem examined was the preparation of a white pigment with a stable *conductance showing resistance to oxidation It is pointed out* that more work on this latter problem is needed before a completely satisfactory paint is developed GRA

**N78-18158#** National Bureau of Standards Washington D C
**STUDIES OF THE FLASH FIRE POTENTIAL OF AIRCRAFT CABIN INTERIOR MATERIALS Final Report, Aug 1975 - Sep 1976**
Michael J Manka Henry Pierce and Clayton Huggett Dec 1977 35 p refs Sponsored in part by the National Aviation Facilities Experimental Center (NAFEC) Atlantic City N J
(Contract DOT-FA67NF-AP-21)
(AD-A048475 NA-77-180 FAA-RD-77-47) Avail NTIS HC A03/MF A01 CSCL 13/12

A minimum energy principle was proposed to characterize the flash fire behavior of the complex mixture of fuels derived from the pyrolysis of organic materials This principle states that

a flash fire is possible when the potential combustion energy content of the pyrolyzate air mixture exceeds approximately 425 cal/L A variety of experiments was performed to provide support for the minimum energy principle The results were in general agreement with predictions but the accuracy of the measurements was not good enough to permit detailed conclusions Oxidative pyrolysis plays a significant role in the formation of the fuel-air mixture in the flash fire cell Particulates contribute to the creation of flash fire conditions but they present a difficult measurement problem Author

**N78-18188#** Naval Air Development Center Warminster, Pa Air Vehicle Technology Dept

**ACCELERATED LABORATORY CORROSION TEST FOR MATERIALS AND FINISHES USED IN NAVAL AIRCRAFT Progress Report**

S J Ketcham 14 Sep 1977 12 p refs
(AD-A048059 NADC-77252-30) Avail NTIS HC A02/MF A01 CSCL 14/2

An accelerated laboratory corrosion test has been developed to screen materials and finishes for use on naval aircraft Sulfur dioxide is introduced at periodic intervals into a conventional salt fog chamber to simulate conditions produced by the carrier stack gas/marine environment Procedures for conducting the test are described Author (GRA)

**N78-18226#** Army Mobility Equipment Research and Development Center Fort Belvoir, Va

**COMPARISON TESTS ON THE 100-GPM ELECTROKINETIC FUEL DECONTAMINATOR AND A 100-GPM MILITARY STANDARD FILTER/SEPARATOR Final Technical Report**

William R Williams Sep 1977 35 p
(AD-A048655 MERADCOM-2220) Avail NTIS HC A03/MF A01 CSCL 21/4

This report covers identical tests performed on the 100-GPM Electrokinetic Fuel Decontaminator and a 100-GPM Military Standard Filter/Separator for the purpose of comparing performances Performance is based upon the ability to remove emulsified water from fuel Test fuels were turbine fuel JP-5 and diesel fuel No 2 Water is injected into the fuel upstream of a centrifugal pump out of the test vessel in concentrations of 0 5, 2, 5, and 10% The effluent, pressure-drop readings are also taken The effluent fuel from each test vessel is measured for water concentration using a turbidimeter Tests are performed at ambient temperatures and low temperatures Results are correlated, and the performances of the two test vessels are compared Conclusions are as follows (a) The Electrokinetic Fuel Decontaminator demonstrates improved overall efficiency in removing water from turbine fuel and diesel fuel over the currently used Military Standard Filter/Separator (b) The Electronkinetic Fuel Decontaminator demonstrates a lower overall pressure drop than the Military Standard Filter/Separator (c) The power consumption of the Electrokinetic Fuel Decontaminator is primarily dependent on the amount of water present and, to a lesser extent, on temperature (d) The power consumption for decontaminating diesel fuel is approximately three times as great as that for decontaminating turbine fuel (e) The current necessary to remove 1 gallon of water from turbine fuel is approximately 1 ampere for diesel fuel, the current is approximately 3 amperes Author (GRA)

**N78-18264#** Institute for Telecommunication Sciences Boulder, Colo

**OBJECTIVE MEASUREMENT OF VOICE CHANNEL INTELLIGIBILITY Final Report**

K J Gamauf and W J Hartman Oct 1977 76 p refs Sponsored in part by Army
(Contract DOT-FA74WAI-448)
(AD-A048611, FAA-RD-77-153) Avail NTIS HC A05/MF A01 CSCL 17/2

Following the results of a feasibility study an objective intelligibility measure is developed using a large data base consisting of 8-50 word phonetically balanced word groups with twelve different kinds of distortion Justification for the use of this particluar measure is included with mathematical derivations and physical interpretations A discussion of the feasibility of a hardware implementation of the software developed here is also included Author

**N78-18272#** R and D Associates, Marina Del Rey Calif

**AIRCRAFT RESPONSE EFFECT ON E-FIELD MEASUREMENTS**

Gerard Schlegel 9 Mar 1977 82 p refs
(Contract DNA001-77-C-0012)
(AD-A047986 AD-E300042 RDA-TR-140801-008 DNA-4279T) Avail NTIS HC A05/MF A01 CSCL 20/3

This report describes the effect of the aircraft response on the measurement of E-fields In investigating this effect the effective height data developed by the Boeing Corporation for a l-m blade antenna on a C-130 aircraft was utilized Difficulties in using this data are discussed and calculated phase functions to correspond to the amplitude data are presented Calculated antenna open circuit voltages are then presented for different free field variations and polarizations Author (GRA)

**N78-18289#** National Aerospace Lab , Amsterdam (Netherlands) Scientific Services

**DETERMINATION OF ANTENNA RADIATION PATTERNS, RADAR CROSS SECTIONS AND JAM-TO-SIGNAL RATIOS BY FLIGHT TESTS**

O B M Pietersen G J Alders, and R B A Wasch 14 Sep 1976 13 p Presented at the Symp on Flight Test Tech of the AGARD Flight Mech Panel, Porz-Wahn West Ger , 11-14 Oct 1976
(NLR-MP-76023-U) Avail NTIS HC A02/MF A01

A flight test data acquisition and processing method aimed at the determination of radiation patterns of airborne equipment is discussed The data acquisition procedure and the data processing and presentation schemes used, are discussed ESA

**N78-18290#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Flugfunk und Mikrowellen

**THE GEOMETRICAL THEORY OF DIFFRACTION - A METHOD FOR THE SOLUTION OF ELECTROMAGNETIC BOUNDARY VALUE PROBLEMS OF COMPLICATED STRUCTURES IN THE HIGH FREQUENCY CASE**

A Schrott [1977] 250 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-435)
Avail NTIS HC A11/MF A01

Determination of the radiation characteristic of antennas on complicated structures such as satellites and aircraft, and the scattering at these structures in the high frequency case with the aid of the geometrical theory of diffraction is dealt with The complicated structures are divided into canonical forms which can be analyzed by rigorous asymptotic methods The most important canonical problems like the diffraction at an edge are treated extensively The diffraction coefficients for the computation of the diffracted field are presented Ray tracing is carried out for several structures The computation of the field at caustics with the aid of equivalent edge currents or correction factors respectively is discussed in detail The field of application and the accuracy of the geometrical theory of diffraction is demonstrated with numerous computational examples Author (ESA)

**N78-18291#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Flugfunk und Mikrowellen

**THE INTEGRAL EQUATION METHOD - A COMPUTATIONAL METHOD FOR DIFFRACTED AND SCATTERED FIELDS OF COMPLICATED STRUCTURES**

V Stein [1977] 214 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT-436)
Avail NTIS HC A10/MF A01

Determination of the radiation and scattering behavior of complicated structures with the aid of the integral equation method is dealt with These structures may be complicated isolated radiators or shapes like helicopters or satellites which are excited by an electromagnetic wave The real structure is substituted by a mathematical model for the solution of the electric and magnetic field integral equations by means of the method of moments In

order to reduce the computer storage requirements special procedures such as the numerical Green function are used The combination of both integral equations for the investigation of special problems like the resonance case is discussed in some detail The field of application and the accuracy of the integral equation method are demonstrated with numerous computational examples Author (ESA)

**N78-18319#** *Norden Norwalk, Conn*
**STANDARD ELECTRONIC MODULE RADAR COST ANALYSIS Final Report, 1 Jun - 30 Nov 1976**
R Hoefle R Archbald, and R Lipeles Jul 1977 111 p refs (Contract F33615-76-C-1306)
(AD-A048207 Rept-1266-R-0007 AFAL-TR-77-26) Avail NTIS HC A06/MF A01 CSCL 17/9

The standard electronic module radar (SEMR) is a redesigned AN/APN-59b weather, navigation beacon radar system using standard electronic modules wherever possible Two configurations of SEMR have been developed to permit use in C-130 and C-135 or in C-141 aircraft Both configurations include built-in test equipment (BITE) to provide fault detection and isolation to 4 to 6 modules Author (GRA)

**N78-18321#** Westinghouse Electric Corp Baltimore, Md
**MODULAR PACKAGING APPROACHES Final Report, 1 Mar - 30 Sep. 1976**
W W Staley Jul 1977 129 p refs
(Contract F33615-75-C-1269)
(AD-A048205 Rept-77-0043 AFAL-TR-76-61-Vol-2) Avail NTIS HC A07/MF A01 CSCL 09/3

The objective of this study is to investigate the feasibility practicality and implementation of standard electronic modules SEM for avionics Tradeoff studies are used to provide quantitative SEM formats The broad spectrum of considerations necessary to characterize standard packaging for a wide class of avionics applications are investigated In depth quantification is placed primarily on digital signal processing and to a lesser degree on analog circuitry The work is performed in four tasks whereby Task 1 evaluates current and past industry and DOD module programs, Task 2 studies present technology and technological trends for determination of the standard avionics modules, Task 3 is a compilation of industry and DOD data concerning standard module information and concepts, and Task 4 is the detailed development and evaluation of the proposed 'Westinghouse SEM' including the construction of demonstration hardware The efforts of Tasks 1, 2, and 3 are described in the previous issued interim Report AFAL-TR-76-61, Volume 1 This Final Report describes the details of the study performed on Task 4 with the conclusions made and recommendations for future work Author (GRA)

**N78-18377#** Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)
**SEPARATION PROBLEMS ENCOUNTERED BY AIRCRAFT DESIGNERS CSS DIV. DES ETUDES AVANCEES. [LES PROBLEMES DE DECOLLEMENTS POSES A L'AVIONNEUR]**
Pierre Perrier *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 11 p refs In FRENCH
Avail NTIS HC A11/MF A01

The different ways in which flow separation presents problems to aircraft manufacturers in the design and performance prediction of civil and military aircraft are distinguished The means used to resolve these problems are reviewed from an analytical and experimental viewpoint Areas of research which show promise for reducing the adverse effects of quasi- and quasi-steady and unsteady separation are explored A R H

**N78-18381*#** *National Aeronautics and Space Administration* Ames Research Center, Moffett Field Calif
**INTRODUCTION TO UNSTEADY ASPECTS OF SEPARATION IN SUBSONIC AND TRANSONIC FLOW**
W J McCroskey *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 8 p refs

Avail NTIS HC A11/MF A01 CSCL 20D

Almost any flow that separates will have some degree of unsteadiness In some cases the fluctuations will be almost complete stochastic, in others it will be highly organized and in still others, it will be a combination of random and periodic components Some peculiar unsteady phenomena are reviewed and several classes of flow problems are discussed Flow visualization and pressure measurements are used to explore external flows past fluff bodies unsteady separation on slender bodies and internal flows A R H

**N78-18382#** Royal Aircraft Establishment Bedford (England)
**PREDICTION OF THE SEVERITY OF BUFFETING**
D G Mabey *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 30 p refs

Avail NTIS HC A11/MF A01

The nature of buffeting, and buffeting criteria for fighter and transport aircraft are examined Flow fields about unswept wings, swept wings, and slender wings are discussed Although the onset of flow separations (the buffet boundary) can be predicted by a combination of boundary layer methods and potential flow theory, adequate theoretical methods are not yet available to predict the aerodynamic excitation after separation The prediction of the severity of aircraft buffeting will continue to depend on model tests in wind tunnels Three types of model tests are (1) ordinary wind tunnel models used to measure unsteady wing-root strain in the first bending mode, (2) ordinary wind tunnel models used to measure the unsteady pressure across the appropriate surface, and (3) aeroelastic models used to measure unsteady responses The importance of using wind tunnels with low levels of flow unsteadiness is emphasized Alternative methods of determining buffeting onset are discussed A R H

**N78-18383*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**SOME UNSTEADY SEPARATION PROBLEMS FOR SLENDER BODIES**
W J McCroskey *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 11 p refs

Avail NTIS HC A11/MF A01 CSCL 20D

The development of reliable prediction techniques for engineering purposes requires a fundamental and detailed understanding of the unsteady flow fields on wings and rotating blades Some of the peculiar features of unsteady separated flows that are not simple analogs or extensions of quasi-steady flows are discussed These include the unsteady Kutta-Joukowski condition dynamic stall on oscillating airfoils (with applications to helicopter rotor blades) and unsteady shock wave-boundary layer interaction Author

**N78-18384#** Royal Aircraft Establishment Farnborough (England) Dept of Aerodynamics
**INVISCID FLUID MODELS, BASED ON ROLLED-UP VORTEX SHEETS, FOR THREE-DIMENSIONAL SEPARATION AT HIGH REYNOLDS NUMBER**
J H B Smith *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 27 p refs

Avail NTIS HC A11/MF A01

The inviscid fluid models which have been used to represent flows with three dimensional separations of vortex type are introduced and described Their strengths and weaknesses are discussed and suggestions are made for improvements A selection of results for a wide range of problems is presented The difficulties which arise in trying to extend these models to represent separation from highly swept separation lines on smooth bodies are explored and a view is given of the present position and developments in the immediate future Author

**N78-18387*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**PREDICTION OF UNSTEADY SEPARATED FLOWS ON OSCILLATING AIRFOILS**
W J McCroskey *In* AGARD Three Dimensional and Unsteady Separation at High Reynolds Numbers Feb 1978 8 p refs

Avail NTIS HC A11/MF A01 CSCL 20D

Calculating the flow around an airfoil undergoing dynamic stall is a task which has not yet been accomplished at high Reynolds numbers although several approximate analytical methods have been proposed The most promising of those methods seems to be either a combination of the discrete potential vortex and thin boundary layer approaches or a significantly improved version of the strong viscous-inviscid interaction approach The former may prove to be superior for low speed high amplitude flows, but the latter seems likely to be more suitable for airfoils that operate under supercritical transonic flow conditions and for cases that do not penetrate deeply into stall At the present time, the engineer who is faced with the need to predict the aerodynamic forces and moments on oscillating airfoils would be better advised to turn to one of the empirical correlation techniques or perhaps to utilize more than one method and average the results In any event these methods permit the essential features of dynamic stall to be described, even though further improvements are highly desirable Future efforts will probably see more use made of the two-dimensional theoretical analyses, while experiments can be expected to play the major role in assessing the importance of the three-dimensional effects that are likely to be encountered in practice Author

**N78-18408#** European Space Agency, Paris (France)
**THE USE OF PYRANOMETERS IN AIRCRAFT**
Hans P Fimpel Dec 1977 54 p refs Transl into ENGLISH of 'Die Verwendung von Pyranometern in Flugzeugen' DFVLR Oberpfaffenhofen, West Ger Report DLR-FB-77-24 3 Jun 1977 Original report in GERMAN previously announced as N78-14379 Original German report available from DFVLR, Cologne DM 18 50
(ESA-TT-433, DLR-FB-77-24) Avail NTIS HC A04/MF A01

The Moll-Gorczynski-Solarimeter and the Eppley-Pyranometer Model PSP were investigated in order to find out whether they can be used for measurements onboard aircraft The influence of temperature and pressure on the sensitivity, the dependence of the inclination, and the heating through high air-velocities were studied in laboratory and ground-based measurements Measurements with an aircraft showed that the influence of quick variations of the air temperature can be easily corrected Author (ESA)

**N78-18441#** Abex Corp , Oxnard, Calif
**RELIABILITY, IMPROVEMENT WARRANTY (RIW) MID CONTRACT EVALUATION Report, Apr 1973 - Aug 1977**
Oscar Markowitz 15 Oct 1977 138 p refs
(Contract N00383-73-C-3318)
(AD-A048244, ASO-TEE-2-77) Avail NTIS HC A07/MF A01 CSCL 15/5

RIW (Reliability Improvement Warranty) is considered by DOD (Department of Defense) as being in a trial phase during which the philosophies techniques and applications could be wrung out The Abex RIW contract, about which this report deals, innovated features of no exclusions, support, as well as early timing in the sequence of the life of an item Thus, the report on this Abex RIW contract is meaningful in terms of evaluating RIW results against other most likely results should an otherwise normal support mode have been selected rather than RIW The pre-contract history is provided as well as the main conditions and terms of the RIW contract itself Each area of interest (Program, Administration Engineering Logistics and Economics) is reviewed and quantified from data developed for the RIW contract purposes as well as data from other Navy sources obtained for evaluation purposes Throughout the report results obtained within the Abex contract are compared against non-RIW alternatives as well as other experiences obtained with other equivalent engine driven hydraulic pumps supported without benefits of RIW Conclusions to date can be made that the RIW goals anticipated were more than met and the RIW contract has, in fact, resulted in a most cost effective support alternative available to the Navy Additionally, the RIW alternative has provided superlative support to the fleet within a Navy investment considerably less than other comparative units used in other front line Navy aircraft The report provides considerable supportative detail and analysis to back up the above conclusions Author (GRA)

**N78-18459*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
**DEVELOPMENT AND APPLICATION OF AN OPTIMIZATION PROCEDURE FOR FLUTTER SUPPRESSION USING THE AERODYNAMIC ENERGY CONCEPT**
E Nissim (Technion - Israel Inst of Tech ) and I Abel Feb 1978 39 p refs
(NASA-TP-1137, L-11909) Avail NTIS HC A03/MF A01 CSCL 20K

An optimization procedure is developed based on the responses of a system to continuous gust inputs The procedure uses control law transfer functions which have been partially determined by using the relaxed aerodynamic energy approach The optimization procedure yields a flutter suppression system which minimizes control surface activity in a gust environment The procedure is applied to wing flutter of a drone aircraft to demonstrate a 44 percent increase in the basic wing flutter dynamic pressure It is shown that a trailing edge control system suppresses the flutter instability over a wide range of subsonic Mach numbers and flight altitudes Results of this study confirm the effectiveness of the relaxed energy approach Author

**N78-18548#** Federal Energy Administration, Washington D C Office of Conservation and Environment
**FEDERAL POLICY OPTIONS TO EFFECT FUEL CONSERVATION IN THE AIR INDUSTRY**
Robert L Bowles *In* Union Coll Effects of Energy Constraints on Transportation Systems Dec 1977 p 399-408

Avail NTIS HC A24/MF A01

Federal policies which may have potential for reducing petroleum consumption within the transportation sector are presented Airlines consume nearly 10 percent of the transportation energy and constitute a considerable portion of the operating cost Federal policies discussed include (1) Fuel Allocation and Price Control, (2) Taxation, (3) Air Carrier Regulation, (4) Aviation System Regulation and (5) Federal Expenditures and Investment Author

**N78-18549#** Bureau of Economic Analysis, Washington, D C
**MEASURING THE IMPACT ON SCHEDULED AIR LINES OPERATIONS OF RESTRICTIONS IN FUEL AVAILABILITY**
J C Constanz *In* Union Coll Effects of Energy Constraints on Transportation Systems Dec 1977 p 409-416

Avail NTIS HC A24/MF A01

Airline and aircraft manufacturers' fuel conservation efforts are presented A description was given of how since 1973 passengers flown per gallon of fuel used have increased by 19 percent The airline reduced the average number of flights flown each day to conserve fuel and to take advantage of more efficient aircraft which carry more passengers per flight Use of computerized flight plans (optimum routes altitudes and speeds) reduced the use of fuel to a considerable extent Use of flight simulators and fewer engines during taxiing reduced the consumption of petroleum Author

**N78-18595#** Environmental Protection Agency, Ann Arbor Mich Standards Development and Support Branch
**AIRCRAFT EMISSION FACTORS**
Robert G Pace Mar 1977 29 p refs
(PB-275067/7 AC-77-03) Avail NTIS HC A03/MF A01 CSCL 13B

Updated aircraft engine emission factors and a sample of the calculation methodology used in obtaining these numbers

are presented Modal emission factors were calculated for a number of gas turbine and piston aircraft engines Emission factors per aircraft per landing take-off cycle were calculated for representative aircraft engine combinations Included were commercial jet transports business jets turboprops and general aviation piston aircraft GRA

**N78-18797*#** Aerospace Corp , El Segundo, Calif Advanced Programs Div
**FAULT-TOLERANT SOFTWARE FOR AIRCRAFT CONTROL SYSTEMS Final Report, Oct. 1966 - Oct 1977**
1 Feb 1978 82 p refs
(Contract NAS1-14644)
(NASA-CR-145298, ATR-78(7640)-1) Avail NTIS HC A05/MF A01 CSCL 09B

Concepts for software to implement real time aircraft control systems on a centralized digital computer were discussed A fault tolerant software structure employing functionally redundant routines with concurrent error detection was proposed for critical control functions involving safety of flight and landing A degraded recovery block concept was devised to allow collocation of critical and noncritical software modules within the same control structure The additional computer resources required to implement the proposed software structure for a representative set of aircraft control functions were discussed It was estimated that approximately 30 percent more memory space is required to implement the total set of control functions A reliability model for the fault tolerant software was described and parametric estimates of failure rate were made Author

**N78-18823*#** National Aeronautics and Space Administration Langley Research Center Langley Station, Va
**EIGENVALUE/EIGENVECTOR ASSIGNMENT USING OUTPUT FEEDBACK**
S Srinathkumar Feb 1978 32 p refs
(NASA-TP-1118, L-11869) Avail NTIS HC A03/MF A01 CSCL 09B

The problem of eigenvalue assignment in a linear time-invariant system using output feedback is considered New sufficient conditions are derived to assign an almost arbitrary set of minimum (n,m + r - 1) distinct eigenvalues where n, m, and r are the number of states, inputs and outputs, respectively These conditions precisely identify the class of systems where such an assignment is impossible The synthesis technique also highlights the freedom in selection of closed-loop eigenvectors under output feedback The utility of eigenvalue/eigenvector assignment in transient response shaping is illustrated by the design of a controller for the lateral dynamics of an aircraft Author

**N78-18873*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
**CONCORDE NOISE-INDUCED BUILDING VIBRATIONS JOHN F KENNEDY INTERNATIONAL AIRPORT**
W H Mayes, R DeLoach, D G Stephens, J M Cawthorn, H K Holmes, R B Lewis B G Holliday, and D W Ward Jan 1978 38 p refs
(NASA-TM-78660, Rept-1) Avail NTIS HC A03/MF A01 CSCL 20A

The outdoor and indoor noise levels resulting from aircraft flyovers and certain nonaircraft events were recorded at six home sites along with the associated vibration levels in the walls, windows, and floors of these test homes Limited subjective tests conducted to examine the human detection and annoyance thresholds for building vibration and rattle caused by aircraft noise showed that both vibration and rattle were detected subjectively in several houses for some operations of both the Concorde and subsonic aircraft Preliminary results indicate that the relationship between window vibration and aircraft noise is (1) linear, with vibration levels being accurately predicted from OASPL levels measured near the window (2) consistent from flyover to flyover for a given aircraft type under approach conditions (3) no different for Concorde than for other conventional jet transports (in the case of window vibrations induced under approach power conditions) and (4) relatively high levels of window vibration measured during Concorde operations are due more to higher OASPL levels than to unique Concorde source characteristics Author

**N78-18874*#** DyTec Engineering, Inc Huntington Beach, Calif
**INVESTIGATION OF GROUND REFLECTION AND IMPEDANCE FROM FLYOVER NOISE MEASUREMENTS Final Report**
Robert L Chapkis and Alan H Marsh Feb 1978 142 p refs
(Contract NAS1-14797)
(NASA-CR-145302 DyTec-R-7708) Avail NTIS HC A07/MF A01 CSCL 20A

An extensive series of flyover noise tests was conducted for the primary purpose of studying meteorological effects on propagation of aircraft noise The test airplane a DC 9-10, flew several level-flight passes at various heights over a taxiway Two microphone stations were located under the flight path A total of 37 runs was selected for analysis and processed to obtain a consistant set of 1/3 octave band sound pressure levels at half-second intervals The goal of the present study was to use the flyover noise data to deduce acoustical reflection coefficients and hence acoustical impedances Author

**N78-18878#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany) Inst fuer Turbulenzforschung
**ACOUSTIC INTERFERENCE EFFECTS AND THE ROLE OF HELMHOLTZ NUMBER IN AERODYNAMIC NOISE**
H V Fuchs 1977 30 p refs Presented at the Symp on Turbulence, Berlin 1-5 Aug 1977
(DLR-IB-257-77/11) Avail NTIS HC A03/MF A01

Recent coherence measurements in the near and far fields of both cold-air model jets and real jet engine flows show a strong axisymmetric structure in both the turbulent flow and the acoustic wave field radiated at small angles to the jet axis Coherent source phenomena occur at the relevant Strouhal numbers around the spectral peaks in the turbulent and acoustic pressure fields and persist at high Reynolds and Mach numbers Empirical scaling laws common in aerodynamic noise were frequently based on merely a typical density, velocity, and length of the mean flow as the characteristic parameters Such a simple dependence emerges from a dimensional analysis of Lighthill-Curle-type source integrals by assuming a small-scale eddy structure of the turbulence For these scaling laws to be strictly valid the scale lc of the individual turbulent sources must be small compared to the acoustic wave length radiated In cases where the coherently radiating sources are found to be not acoustically compact, scaling laws should incorporate, additionally, at least one of the following parameters acoustic compactness ratio, turbulence coherence ratio, and Helmholtz number Author (ESA)

**N78-19042*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
**TWO-DIMENSIONAL OSCILLATING AIRFOIL TEST APPARATUS**
Frank L Gibson, Andrew J Hocker Jr , and Dennis S Matsuhiro *In* NASA Goddard Res Center The 11th Aerospace Mech Symp Apr 1977 p 171-178

Avail NTIS HC A11/MF A01 CSCL 14B

A two-dimensional oscillating airfoil test apparatus is presented as a method of measuring unsteady aerodynamic forces on an airfoil or rotor blade section The oscillating airfoil test rig, which was built for use in NASA Ames Research Center's 11x11-foot Transonic Wind Tunnel (speed range M = 0 4 - 1 4) allows determination of unsteady loadings and detailed pressure distributions on representative airfoil sections undergoing simulated pitching and flapping motions The design details of the motion generating system and supporting structure are presented Author

**N78-19047** Northwestern Univ , Evanston Ill
**GENESIS N + 1 THE ORIGINS OF THE TURBO-JET REVOLUTION Ph.D Thesis**
Edward W Constant II 1977 554 p
Avail Univ Microfilms Order No 77-32291

The derivation of radical airframe and gas turbine component performance assumptions from advances in theoretical aerodynamics was examined in the invention of the turbo-jet engine To facilitate comprehension of the complex elements and interrelations central to the turbo-jet revolution an ideal typical model for technolgoical change similar to that of Thomas Kuhn s for science was proposed In addition to portraying the direct impact of advances in scientific theory on technological change, the model also attempts to portray the relation of scientific method especially the ideal of technological testability to such change Furthermore the model describes the critical importance of technological systems interface constraints on changes in any one system or sub-system Dissert Abstr

**N78-19048*#** National Aeronautics and Space Administration, Washington D C
**EFFECT OF PERTURBED FLOW ON THE TRANSITION FROM THE SUPERSONIC LAMINAR BOUNDARY LAYER TO THE TURBULENT**
A M Kharitonov Jan 1978 18 p refs Transl into ENGLISH from the book 'Aeromekhanika Moscow Nauka Press, 1976 p 153-164 Original language document was A77-30570 Transl by Sci Transl Serv Santa Barbara, Calif
(NASA-TM-75196) Avail NTIS HC A02/MF A01 CSCL 01A

Results of experimental studies on the effect of various factors on the transition of a supersonic boundary layer are discussed It is shown that in supersonic wind tunnels a significant effect on the transition of the boundary layer on a model is exerted by the scale of acoustic perturbations which is proportional to the boundary layer displacement thickness of the working section Experimental data obtained over a wide range of variation of flow parameters in aerodynamically similar test installations with different dimensions of the working section are generalized by means of a correlation parameter based on the displacement thickness Author

**N78-19049*#** Boeing Commercial Airplane Co Seattle Wash
**TEST DATA REPORT, LOW SPEED WIND TUNNEL TESTS OF A FULL SCALE LIFT/CRUISE-FAN INLET, WITH ENGINE, AT HIGH ANGLES OF ATTACK**
W M Shain Jan 1978 165 p
(Contract NAS2-9640)
(NASA-CR-152055 T6-6145) Avail NTIS HC A08/MF A01 CSCL 01A

A low speed wind tunnel test of a fixed lip inlet with engine was performed The inlet was close coupled to a Hamilton Standard 1 4 meter variable pitch fan driven by a lycoming T55-L-11A engine Tests were conducted with various combinations of inlet angle of attack freestream velocities and fan airflows Data were recorded to define the inlet airflow separation boundaries performance characteristics, and fan blade stresses The test model installation instrumentation test data reduction and final data are described Author

**N78-19050*#** Burroughs Corp Paoli Pa
**NUMERICAL AERODYNAMIC SIMULATION FACILITY PRELIMINARY STUDY EXTENSION EXECUTIVE SUMMARY Final Report**
Feb 1978 11 p
(Contract NAS2-9456)
(NASA-CR-152106) Avail NTIS HC A02/MF A01 CSCL 01A

An optimized functional design of key elements of the Numerical Aerodynamic Simulation Facility was investigated The following tasks were performed and are discussed (1) develop optimize, and describe the functional description of the custom hardware (2) delineate trade-off areas between performance, reliability availability serviceability, and programmability (3) develop metrics and models for validation of the candidate system's performance (4) conduct a functional simulation of the system design (5) perform a reliability analysis of the system design and (6) develop the software specifications to include a user level high level programming language a correspondence between the programming language and instruction set, and outline the operating system requirements Author

**N78-19051*#** Burroughs Corp Paoli Pa
**NUMERICAL AERODYNAMIC SIMULATION FACILITY PRELIMINARY STUDY EXTENSION Final Report**
Feb 1978 273 p
(Contract NAS2-9456)
(NASA-CR-152107) Avail NTIS HC A12/MF A01 CSCL 01A

The production of an optimized design of key elements of the candidate facility was the primary objective of this report This was accomplished by effort in the following tasks (1) to further develop optimize and describe the function description of the custom hardware (2) to delineate trade off areas between performance reliability availability, serviceability and programmability (3) to develop metrics and models for validation of the candidate systems performance (4) to conduct a functional simulation of the system design (5) to perform a reliability analysis of the system design and (6) to develop the software specifications to include a user level high level programming language a correspondence between the programming language and instruction set and outline the operation system requirements Author

**N78-19052*#** Control Data Corp , St Paul, Minn Research and Advanced Design Lab
**PRELIMINARY STUDY FOR A NUMERICAL AERODYNAMIC SIMULATION FACILITY PHASE 1· EXTENSION**
N R Lincoln Feb 1978 434 p refs
(Contract NAS2-9457)
(NASA-CR-152108) Avail NTIS HC A19/MF A01 CSCL 01A

Functional requirements and preliminary design data were identified for use in the design of all system components and in the construction of a facility to perform aerodynamic simulation for airframe design A skeleton structure of specifications for the flow model processor and monitor, the operating system, and the language and its compiler is presented A R H

**N78-19053*#** National Aeronautics and Space Administration, Washington, D C
**TRANSONIC FLOW PAST AN AIRFOIL WITH CONDENSATION**
B Schmidt Mar 1978 21 p refs Transl into ENGLISH from Acta Mechanica (Austria), v 2, 1966 p 194-208 Transl by Sci Transl Serv , Santa Barbara, Calif
(Contract NASw-2791)
(NASA-TM-75201) Avail NTIS HC A02/MF A01 CSCL 01A

In connection with investigations conducted to determine the influence of water vapor on experiments in wind tunnels, the question arose as to what changes due to vapor condensation might be expected in airfoil measurements Density measurements on circular-arc airfoils aided by an interferometer in choked tunnels with parallel walls show that increasing humidity produces increasing changes in the flow field The flow becomes nonstationary at high humidity At the airfoil however, the influence of the condensation is only felt, inasmuch as the shock bounding the local supersonic region moves upstream with increasing humidity while its intensity decreases The density distribution upstream of the shock remains unchanged Even if the flow becomes nonstationary in the vicinity of the airfoil no changes occur at the airfoil Author

**N78-19054#** National Aerospace Lab , Tokyo (Japan)
**CALCULATION OF THE LIFT OF PARTIALLY-STALLED WINGS**
Bradford H Wick Apr 1977 13 p refs
(NAL-TR-498T) Avail NTIS HC A02/MF A01

Methods of calculating the lift and the spanwise distributions of the lift of thin sweptback wings with partially stalled flow were presented and evaluated The evaluation was made by comparing the calculated and measured results for a number of

wings It was concluded that the methods provide a reasonably accurate means of calculating the lift and its spanwise distribution Author

**N78-19055*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif
**AN ANNULAR WING Patent Application**
Harold J Walker, inventor (to NASA) Filed 24 Feb 1978 21 p
(NASA-Case-FRC-11007-1, US-Patent-Appl-SN-880725) Avail NTIS HC A02/MF A01 CSCL 01A

An annular wing is described for the purpose of supporting an aircraft in flight without the use of directional stabilizer surfaces The wing comprises an annular body of substantially uniform symmetrical configuration characterized by an annular positive lifting surface and a chord line The wing is highly maneuverable, simple in concept, economic to fabricate and characterized by stable horizontal flight properties at subsonic speeds NASA

**N78-19056*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
**THE ROLE OF TIME-HISTORY EFFECTS IN THE FORMULATION OF THE AERODYNAMICS OF AIRCRAFT DYNAMICS**
Murray Tobak and Lewis B Schiff Mar 1978 12 p refs Proposed for Presentation at the AGARD Symp on Dyn , Athens, Greece, 22-24 May 1978
(NASA-TM-78471, A-7328) Avail NTIS HC A02/MF A01 CSCL 01A

The scope of any aerodynamic formulation proposing to embrace a range of possible maneuvers is shown to be determined principally by the extent to which the aerodynamic indicial response is allowed to depend on the past motion Starting from the linearized formulation in which the indicial response is independent of the past motion, two successively more comprehensive statements about the dependence on the past motion are assigned to the indicial response (1) dependence only on the recent past and (2) dependence additionally on a characteristic feature of the distant past The first enables the rational introduction of nonlinear effects and accommodates a description of the rate dependent aerodynamic phenomena characteristic of airfoils in low speed dynamic stall, the second permits a description of the double valued aerodynamic behavior characteristic of certain kinds of aircraft stall An aerodynamic formulation based on the second statement, automatically embracing the first, may be sufficiently comprehensive to include a large part of the aircraft s possible maneuvers The results suggest a favorable conclusion regarding the role of dynamic stability experiments in flight dynamics studies Author

**N78-19058*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**WATER-TUNNEL EXPERIMENTS ON AN OSCILLATING AIRFOIL AT RE EQUALS 21,000**
Kenneth W McAlister and Lawrence W Carr Mar 1978 84 p refs
(NASA-TM-78446 A-7232) Avail NTIS HC A05/MF A01 CSCL 01A

Flow visualization experiments were performed in a water tunnel on a modified NACA 0012 airfoil undergoing large amplitude harmonic oscillations in pitch Hydrogen bubbles were used to (1) create a conveniently striated and well preserved set of inviscid flow markers, and (2) to expose the succession of events occurring within the viscous domain during the onset of dynamic stall Unsteady effects were shown to have an important influence on the progression of flow reversal along the airfoil surface prior to stall A region of reversed flow underlying a free shear layer was found to momentarily exist over the entire upper surface without any appreciable disturbance of the viscous-inviscid boundary A flow protuberance was observed to develop near the leading edge while minor vortices evolve from an expanding instability of the free shear layer over the rear portion of the airfoil The complete breakdown of this shear layer culminates in the successive formation of two dominant vortices Author

**N78-19059*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va
**DYNAMIC WIND-TUNNEL TESTS OF AN AEROMECHANICAL GUST-ALLEVIATION SYSTEM USING SEVERAL DIFFERENT COMBINATIONS OF CONTROL SURFACES**
Eric C Stewart and Robert V Doggett, Jr Mar 1978 37 p refs
(NASA-TM-78638, L-11918) Avail NTIS HC A03/MF A01 CSCL 01A

Some experimental results are presented from wind tunnel studies of a dynamic model equipped with an aeromechanical gust alleviation system for reducing the normal acceleration response of light airplanes The gust alleviation system consists of two auxiliary aerodynamic surfaces that deflect the wing flaps through mechanical linkages when a gust is encountered to maintain nearly constant airplane lift The gust alleviation system was implemented on a 1/6-scale rod mounted, free flying model that is geometrically and dynamically representative of small four place, high wing, single engine light airplanes The effects of flaps with different spans, two size of auxiliary aerodynamic surfaces plain and double hinged flaps, and a flap elevator interconnection were studied The model test results are presented in terms of predicted root mean square response of the full scale airplane to atmospheric turbulence The results show that the gust alleviation system reduces the root mean square normal acceleration response by 30 percent in comparison with the response in the flaps locked condition Small reductions in pitch-rate response were also obtained It is believed that substantially larger reductions in normal acceleration can be achieved by reducing the rather high levels of mechanical friction which were extant in the alleviation system of the present model Author

**N78-19061#** Massachusetts Inst of Tech Cambridge Fluid Dynamics Research Lab
**A LIFTING SURFACE THEORY FOR WINGS EXPERIENCING LEADING-EDGE SEPARATION Final Report, 1 Jan 1975 - 30 Jun 1977**
Thomas K Matoi and Sheila E Widnall 30 Jun 1977 148 p refs
(Contract N00014-75-C-0257)
(AD-A048439 ONR-CR215-230-3F) Avail NTIS HC A07/MF A01 CSCL 20/4

This report describes a nonlinear lifting surface theory for a wing with leading-edge vortices in a steady incompressible flow A numerical scheme has been developed from this theory and initial runs have been made for the delta wing and arrow wing planforms A general procedure for other planforms is also described The present formulation is the result of an extensive modification of the work of Nangia and Hancock in which a model of the leading-edge vortex is added to a vorticity representation of the wing and wake This lifting surface theory program is based on the kernel function formulation in that the vorticity distribution is described by continuous functions with unknown coefficients The vortex location is similarly described by functions with unknown coefficients These unknowns are found by satisfying the downwash condition and the no-force condition on the leading-edge vortex representation Due to the nonlinear nature of the boundary conditions with respect to the vortex position, the solution is obtained from an iterative scheme based on Newton's method Results for the delta wing and arrow wing are presented and compared with experiment and other theories GRA

**N78-19062#** Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering
**AN EXPERIMENTAL INVESTIGATION OF STEADY ASYMMETRIC VORTEX SHEDDING FROM A SLENDER BODY OF REVOLUTION AT HIGH ANGLES OF ATTACK M S Thesis**
Robert Rudolph Turelli Dec 1977 64 p refs
(AF Proj 1366)
(AD-A048370, AFIT/GAE/AA/77D-15) Avail NTIS HC A04/MF A01 CSCL 21/4

An experimental investigation of the effects of Mach number and Reynolds number on the side forces induced on a slender

body of revolution at high angles of attack was conducted The tests were carried out in the Air Force Flight Dynamics Laboratory's Trisonic Gasdynamic Facility GRA

**N78-19064#** Aerospace Corp El Segundo, Calif Aerophysics Lab
**LINEARIZED NEWTONIAN AERODYNAMICS OF SLENDER INFLATED CONES Interim Report**
John W Ellinwood 5 Dec 1977 37 p
(Contract F04701-77-C-0078)
(AD-A048695 TR-0078(3940-02)-1 SAMSO-TR-77-218) Avail NTIS HC A03/MF A01 CSCL 16/3

Bionic vehicles covered with unsupported cloth are predicted to experience skin displacement from aerodynamic pressure at small angle of attack The resulting shape aerodynamic force, and moment perturbations are predicted as functions of given axial tension and internal pressurization A tension parameter is identified that varies inversely as dynamic pressure It is concluded that the inflatable loses its shape dramatically unless this tension parameter is least of order one, and that this useful boundary cannot be appreciably extended by increasing pressurization, unless the internal pressure is at least an order of magnitude larger than external pressures Author (GRA)

**N78-19065#** McDonnell-Douglas Astronautics Co , Huntington Beach, Calif
**AERODYNAMIC COMPUTER CODE FOR COMPUTING PRESSURE LOADING ON COMPLETE MISSILE FOR STRUCTURAL ANALYSIS Final Report, 1 Jun 1976 - 31 Dec 1977**
Kenneth K Wang Jan 1978 215 p refs
(AD-A048840 MDC-G7215) Avail NTIS MF A01 CSCL 01/1

Aerodynamic computer code for calculating the pressure distribution on missile or its components e g , body and wings and to interpolate by surface fit at locations as specified for structural analysis using the NASTRAN computer code Author (GRA)

**N78-19067#** Beech Aircraft Corp , Wichita Kans
**GUIDED DROGUE FLIGHT TEST REPORT Final Report, Nov 1976 - Nov 1977**
J A Ellsworth, W R Fox D E Lovendahl and J E Moore 6 Sep 1977 43 p refs
(Contract N00019-76-C-0555)
(AD-A049164, E-23027) Avail NTIS HC A03/MF A01 CSCL 01/2

An experimental maneuverable aerial refueling drogue was designed fabricated, and flight tested The drogue was trailed from the wing tip of a CC-137 tanker Tests were conducted from 200 to 300 KEAS The drogue exhibited stable trail, and maneuvering commands resulted in drogue displacements similar to predictions Author (GRA)

**N78-19068#** Arizona Univ , Tucson Dept of Aerospace and Mechanical Engineering
**UNSTEADY TRANSONIC FLOW COMPUTATIONS**
A R Seebass Sep 1977 35 p refs Presented at the AGARD Fluid Dyn Panel Symp on Unsteady Aerodynamics Ottawa 26-28 Sep 1977
(Contract N00014-76-C-0182)
(AD-A049188) Avail NTIS HC A03/MF A01 CSCL 20/4

The effects of unsteady modes of motion on two-dimensional transonic flows are investigated Numerical algorithms that treat shock waves as moving discontinuities are described for nonlinear and time-linearized perturbation flows Results for transonic flow past an NACA 64A006 airfoil experiencing harmonic motions in one of several modes are presented Author (GRA)

**N78-19069#** Air Force Inst of Tech , Wright-Patterson AFB, Ohio School of Engineering
**AN AERODYNAMIC INVESTIGATION OF A FORWARD SWEPT WING M.S. Thesis**
Kenneth Lewis Sims Dec 1977 115 p refs
(AD-A048898 AFIT/GAE/AA/77D-14) Avail NTIS HC A06/MF A01 CSCL 20/4

This study consisted of modeling and wind tunnel testing of a high speed subsonic low aspect ratio, forward swept wing with an advanced supercritical airfoil section for the purpose of determining its lift, drag, and pitching moment characteristics as compared to a similar aft swept wing Tests were conducted at Mach numbers of 0 63 to 0 93 in the Air Force Flight Dynamics Laboratory s Trisonic Gasdynamic Facility located at Wright-Patterson Air Force Base, Ohio Two wing configurations forward and aft swept, were tested and compared to computer predictions provided by the Unified Subsonic-Supersonic Program (Woodward s Version B) The results indicated that the forward swept wing was capable of higher useable angles of attack while maintaining a lower drag coefficient for angles of attack below eight degrees Wind tunnel test results are presented in graphical and tabular form for use in future design studies of similar aerodynamic configurations Author (GRA)

**N78-19070#** Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering
**DOUBLET LATTICE AERODYNAMIC PREDICTIONS FOR AN OSCILLATING F-5 WING WITH STORES M S Thesis**
Daniel L Parker Dec 1977 99 p refs
(AD-A048968, AFIT/GAE/AA/77D-10) Avail NTIS HC A05/MF A01 CSCL 20/4

The Doublet Lattice Method with the Method of Images was used to predict Unsteady Aerodynamic Coefficients and Pressures on a Model F-5 Wing with various store configurations, oscillating in subsonic flow Various finite element lattice configurations were tested to obtain numerical convergence and indicate the optimum modelling technique Test conditions included Mach numbers of 6 8, 9 and 95 At each Mach number oscillation frequencies of 0 20 Hz, and 45 Hz were considered Convergence studies confirmed the utility and accuracy of Multhopp or sinusoidal lattice distributions Steady state pressure predictions compared favorably to those obtained by Woodward s Method Predictions showed significant increases in aerodynamic forces caused by adding tip stores to the wing Author (GRA)

**N78-19071#** Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
**MAGNUS EFFECTS ON BALLISTIC TRAJECTORIES M S. Thesis**
James D Schneider Dec 1977 118 p refs
(AD-A048966 AFIT/GA/AA/77D-8) Avail NTIS HC A06/MF A01 CSCL 19/4

The effect of Magnus coefficients projectile spin rate, and pitching motion on lateral displacement of a ballistic trajectory is investigated by use of a six degree of freedom simulation The coefficients had no significant effect Increased spin rate extends the projectile impact point both down range and cross range Oscillations induced by rate motion increased the lateral deviation but oscillations induced by an initial displacement did not Author (GRA)

**N78-19072#** Martin Marietta Corp Baltimore, Md
**BOUNDARY LAYER OVER SPINNING BLUNT-BODY OF REVOLUTION AT INCIDENCE INCLUDING MAGNUS FORCES**
K C Wang 1977 56 p refs
(Contract F49620-76-C-0004)
(AD-A049199, AFOSR-77-1306TR) Avail NTIS HC A04/MF A01 CSCL 20/4

An incompressible laminar flow over a spinning blunt-body at incidence is investigated The approach follows strictly the three-dimensional boundary layer theory, and the lack of initial profiles is readily resolved The rule of the dependence zone is satisfied with the Krause scheme and complete numerical solutions are obtained for an ellipsoid of revolution at 6 deg incidences and two different spin rates Spinning causes asymmetry which in turn, introduces the Magnus force The asymmetry is most pronounced in crossflow but is also noticeable in the skin-friction and displacement thickness of the meridional

flow A variety of crossflow profiles are determined as are the streamline patterns in the cross- and meridional-planes which are especially useful in visualizing the flow structure Detailed distribution of skin frictions displacement thicknesses and centrifugal pressure are presented A new derivation of the total displacement thickness is given and a negative displacement thickness is found physically meaningful The Magnus forces due to the crossflow skin friction and the centrifugal pressure are determined, these two forces partly compensate each other At lower spin rate the frictional force is larger resulting in a positive Magnus force At high spin rate, the opposite is obtained At high incidence (30 deg), the leeside separated region associated with an open separation is found not amenable to a classical boundary layer treatment The present boundary layer calculations could be carried out in the longitudinal direction only up to the beginning of an open separation Since an open separation moves forward with increasing incidence the calculable area, therefore, decreases Author (GRA)

**N78-19073#** North Carolina State Univ Raleigh Dept of Mechanical and Aerospace Engineering
**LIFT HYSTERESIS OF AN OSCILLATING SLENDER ELLIPSE Interim Report**
W Donald Johnson and J C Williams III 30 Sep 1977 45 p refs
(Grants DAHC04-75-G-0007 DA-ARO(D)-31-124-72-G134) (AD-A049343, ARO-10157 7-E) Avail NTIS HC A03/MF A01 CSCL 20/4

A theoretical investigation has been made to determine the variation of lift with time on a slender elliptic cylinder oscillating in pitch The development of the unsteady two-dimensional laminar boundary layer over the surfaces of the pitching ellipse is calculated and the periodic variation of lift is determined by matching the rate at which boundary layer developed vorticity is shed into the wake with the time rate of change of circulation about the ellipse The effects of mean angle-of-attack and oscillation frequencies on lift hysteresis loops are determined It is shown that the hysteresis loops change direction for mean angles of attack greater than that corresponding to maximum steady state lift Author (GRA)

**N78-19074#** Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div
**STATIC STABILITY OF VEHICLES WHICH USE THE LIFTING FORCE OF AIRFOILS**
V I Koroley 27 Jul 1977 20 p ref Transl into ENGLISH from Sudostr i Morskiye Sooruzheniya (USSR), no 2, 1966 p 45-55
(AD-A049069, FTD-ID(RS)T-1239-77) Avail NTIS HC A02/MF A01 CSCL 20/4

In designing rapid transportation facilities which use the lifting force of airfoils near a solid or liquid screen one important problem is that of providing stable motion of sufficient duration In the present article we discuss the problem of static stability in vehicles which have two airfoils - a leading and a trailing (tandem system) - separated by a certain distance determined by the length of the cabin body GRA

**N78-19075#** Princeton Univ, N J Dept of Aerospace and Mechanical Sciences
**AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE HOVERING AND FORWARD FLIGHT CHARACTERISTICS OF THE AEROCRANE HYBRID HEAVY LIFT VEHICLE Final Report**
W F Putman and H C Curtiss, Jr Sep 1977 135 p refs (Contract N62269-76-C-0464)
(AD-A049084, AMS-TR-1351, NADC-76201-30) Avail NTIS HC A07/MF A01 CSCL 01/3

Results of an analytical and experimental investigation of an AEROCRANE hybrid heavy lift vehicle are discussed The experimental program involved free-flight investigations of the trim and dynamic stability characteristics of the AEROCRANE in hovering and forward flight using a Froude-scaled model The effects of a simple feedback system on the dynamic stability of the model and the ability of a remote pilot to control the model are discussed Analytical predictions of the model characteristics showed very good agreement with the experimental data Author (GRA)

**N78-19076#** Naval Postgraduate School, Monterey, Calif
**LASTOP: A COMPUTER CODE FOR LASER TURRETS OPTIMIZATION OF SMALL PERTURBATION TURRETS IN SUBSONIC OR SUPERSONIC FLOW Final Report, 1976 - 1977**
Garret N Vanderplaats and Allen E Fuhs 20 Dec 1977 240 p refs
(AD-A049272, NPS-69-77-004) Avail NTIS MF A01 CSCL 01/1

A program has been developed which calculates optical path length and phase distortion arising from the density field surrounding a laser turret Further the program finds the optimum turret shape yielding minimum phase distortion The aerodynamic model is briefly described, however the optimization and control codes are thoroughly presented Sample data input and sample output are given The program is listed The material is presented in detail so that this report constitutes a user s manual Author (GRA)

**N78-19077#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div
**A WING IN AN UNSTEADY GAS FLOW, PART 1**
S M Belotserkovskiy B K Skripach, and V G Tabachnikov 8 Sep 1977 517 p Transl into ENGLISH of the book 'Krylo v Nestatsionarnom Potoke Gaza" Moscow, Izd Nauka 1971 p 1-767 3 Vol
(AD-A048999 FTD-ID(RS)T-1543-77-Pt-1) Avail NTIS HC A22/MF A01 CSCL 01/3

Contents Aerodynamic Coefficients, Formulation of the Problem of the Unsteady Motion of Wing, Basic Formula for the Potential of the Disturbed Velocities, Common Properties of Linear Unsteady Problems, and Similarity Parameters Duhamel Integral, Theorem of Momentum and Rational Method of Solution of Linear Unsteady Problems, Reciprocity Theorem and Its Corollaries Experimental Determination of Unsteady Aerodynamic Wing Characteristics, Low Speeds (Incompressible Medium M = 0), The Velocity Field of Oblique Horseshoe Vortex in an Incompressible Medium Method of the Calculation of Aerodynamic Wing Characteristics with the Harmonic Dependences of the Kinematic Parameters on Time, and Method of the Calculation of Aerodynamic Wing Characteristics with the Arbitrary Dependences of the Kinematic Parameters on Time GRA

**N78-19078#** Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div
**A WING IN AN UNSTEADY GAS FLOW, PART 2**
S M Belotserkovskiy, B K Skripach, and V G Tabachnikov 8 Sep 1977 497 p Transl into ENGLISH of the book Krylo v Nestatsionarnom Potoke Gaza Moscow, Izd, Nauka 1971 p 1-767 3 Vol
(AD-A049000 FTD-ID(RS)T-1534-77-Pt-2) Avail NTIS HC A21/MF A01 CSCL 01/3

Contents Method of the Calculation of Apparent Additional Masses of Wings of Arbitrary Planform, Some Point Solutions Calculation of the Unsteady Wing Characteristics of Arbitrary Planform High Subsonic Speeds (0 - M - 1), Method of the Calculation of the Coefficients of Aerodynamic Derivatives The Velocity Field of Unsteady Discrete Vortex in a Compresses Medium, Method of the Calculation of Aerodynamic Wing Characteristics with Arbitrary Time Dependences, Some Known Solutions Calculation of the Unsteady Wing Characteristics of Arbitrary Planform, Supersonic Speeds (M = 2) Numerical Method of the Calculation of Aerodynamic Wing Characteristics, with Harmonic Time Disturbances Numerical Method of the Calculation of Aerodynamic Wing Characteristics with Arbitrary Time Dependences, and Some Exact Solutions for Wings with Supersonic Edges with Harmonic Time Dependences GRA

**N78-19079#** Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div
**A WING IN AN UNSTEADY GAS FLOW, PART 3**

S M Belotserkovskiy, B K Skripach, and V G Tabachnikov 8 Sep 1977 384 p refs Transl into ENGLISH of the book 'Krylo v Nestatsionarnom Potoke Gaza" Moscow Izd Nauka 1971 p 1-767 3 Vol
(AD-A049001 FTD-ID(RS)T-1543-77-Pt-3) Avail NTIS HC A17/MF A01 CSCL 01/3

*Contents* Some Precise Solutions for Wings with Supersonic Edges with Arbitrary Time Dependences Procedure of Calculation of the Aerodynamic Wing Characteristics of Arbitrary Planform Practical Applications Special Features of the Practical Use of Duhamel Integral in Tasks of Aerodynamics Approximation Method Coefficients of the Aerodynamic Derivative and of Apparent Additional Masses Some Common Properties of Unsteady Effect of Planform, Numbers M and p* on the Aerodynamic Derivatives of Wings and Effect of Planform, the Mach Numbers and Laws of Motion for Transient Functions GRA

**N78-19080#** Hebrew Univ, Jerusalem (Israel)
**THE DYNAMICS OF NON SPHERICAL PARTICLES Final Technical Report, 1 Mar 1975 - 1 Jun. 1977**
Isaiah Gallily Jun 1977 75 p refs
(Grant DA-ERO-75-G-021 DA Proj 2M0-6110-B-53B)
(AD-A047144) Avail NTIS HC A04/MF A01 CSCL 04/1

In this paper the aerodynamic translational mobility of nonspherical was experimentally determined for Knudsen numbers of up to 0 2 The particles were glass cylinders, which represent asbestos fibers and ice needles, and cubes, which represent the primary constituents of metal oxide aggregates The method of determination and the apparatus used were based on a stereophotography of the trajectories of the particles in still air and a photogrammetric measurement of the (three) dimensions of the particles in a scanning electron microscope The results for cylinders, compared with continuous fluid theoretical values of the coefficients, show a reasonable *correspondence with expectation which even improved when the* blunt edge effect of the particles was taken into consideration However, in the case of cylinders having diameters above 1 micrometer the experimentally determined coefficients were higher by about 50% than the continuous fluid calculated ones whereas in the case of cylinders of diameters less than 0 5 micrometers the determined coefficients were smaller than the calculated values The resistance coefficients of cubes showed similar tendencies The deposition of cylindrical particles in still air was studied in a specially constructed sedimentation cell in this cell, a method for the size distribution analysis of these particles was tried GRA

**N78-19081#** Transportation Research Board, Washington, D C
**IMPLEMENTATION PLAN FOR AN AIR TRANSPORTATION RESEARCH INFORMATION SERVICE Final Report**
Sep 1977 137 p
(Contract DOT-FA77WA-3872)
(AD-A049301, FAA-EM-77-14) Avail NTIS HC A07/MF A01 CSCL 01/2

An air transportation research information service (ATRIS) that would provide the user community with abstracts of documents and resumes of research projects that relate to the air transport field was presented The potential user community for ATRIS services and products was discussed, recommendations were made for specific types of interactions between ATRIS and the user community Input scope was presented in terms of twenty one subject areas and sixteen types of information Output scope was presented in terms of announcement bulletins, special bibliographies, and batch mode and on line retrieval services The report includes an implementation plan for the first three years of ATRIS development and operations The plan contains specific proposals for input/output operations in each year cost estimates for the proposed operations, and funding strategies for meeting the cost requirements through support from sponsors, institutional supports and user charges Author

**N78-19082*#** Washington Univ, St Louis, Mo Dept of Civil Engineering
**BENEFIT-COST EVALUATION OF AN INTRA-REGIONAL AIR SERVICE IN THE BAY AREA Technical Report, 1 Jan - 31 Dec 1977**
Lonnie E Haefner 28 Dec 1977 285 p refs
(Grant NsG-2170)
(NASA-CR-152084) Avail NTIS HC A13/MF A01 CSCL 05C 05C

Utilization of an iterative statistical model is presented to evaluate combinations of commuter airport sites and surface transportation facilities in confunction with service by a given commuter aircraft type in light of Bay Area regional growth alternatives and peak and off-peak regional travel patterns The model evaluates such transportation options with respect to criteria of airline profitability, public acceptance, and public and private nonuser costs It incorporates information modal split, peak and off-peak use of the air commuter fleet, terminal and airport cost, development costs and uses of land in proximity to the airport sites regional population shifts and induced zonal shifts in travel demand The model is multimodal in its analytical capability and performs exhaustive sensitivity analysis Author

**N78-19084#** Boeing Vertol Co Philadelphia Pa
**CRASHWORTHY TROOP SEAT TESTING PROGRAM Final Report, May 1974 - Dec 1976**
M J Reilly Nov 1977 206 p refs
(Contract DAAJ02-74-C-0036 DA Proj 1L2-62209-AH-76)
(AD-A048975 D210-11169-1, USAAMRDL-TR-77-13) Avail NTIS HC A10/MF A01 CSCL 01/3

Crashworthy troop seat designs developed under a previous contract were reviewed and design refinements were made Component testing was planned and tests were performed Malfunctioning components were redesigned and were retested satisfactorily A new tubular-strut energy attenuator was developed to replace the rolling helical-wire energy attenuator which did not function properly Crashworthy troop seats fabricated under a previous contract were modified, with new components developed during component testing Additional seats were fabricated for static testing in various crash impact attitudes A total of six static tests including two retests required as a result of minor failures, were performed by Dynamic Science as a subcontractor Analysis of the test results showed that the forward- and aft-facing seat configurations were highly successful in meeting the test objectives in all attitudes, with the exception of the lateral loading Eleven dynamic tests were performed by FAA-Civil Aeromedical Institute in three series of tests GRA

**N78-19085#** Naval Ship Research and Development Center, Bethesda, Md
**NAVAL EMERGENCY AIR CARGO DELIVERY SYSTEM (NEACDS) FEASIBILITY TESTS AND EVALUATION Final Report, Oct. 1973 - May 1977**
Russell H Putnam Maurice J Zubkoff, Fred A Myers, and Thomas E Wheatley Dec 1977 94 p refs
(AD-A048988, DTNSRDC-77-0117) Avail NTIS HC A05/MF A01 CSCL 01/3

The Naval Emergency Air Cargo Delivery System (NEACDS) is designed to provide an emergency delivery capability to resupply priority items to ships at sea from fixed wing aircraft via airdrop The major objective of the project has been to establish the feasibility of this concept with the added provisions of (1) not putting a man or boat in the water during retrieval up through sea state 4 and (2) using commonly available off-the-shelf materials The basic naval problems solved were waterproofing, shock mitigation, load flotation, and retrieval at sea Coordinating procedures for ship-aircraft operations and communications were *developed The feasibility of NEACDS has been demonstrated* and a limited capability is available for use This report summarizes the program of static drops, range airdrops and fleet drops for the NEACDS GRA

**N78-19086#** National Transportation Safety Board, Washington, D C Bureau of Accident Investigation
**AIRCRAFT ACCIDENT REPORT. KNOB HILL, INC., CESSNA-421, N999MB, NOGALES, ARIZONA, 22 JANUARY 1977**
27 Oct 1977 33 p

(NTISUB/C/104-011, NTSB-AAR-77-11) Avail NTIS HC A03/MF A01 Paper copy also available on subscription, North American Continent price $35 00/year all others write for quote CSCL 01B

Radar contact with the aircraft was acquired north of Nogales at 9,000 ft The controller advised the pilot to turn immediately because of a mountain peak, but radar contact was lost The aircraft was destroyed and both occupants were killed The National Transportation Safety Board determines that the probable cause of the accident was the controllers' issuance of an improper departure clearance climb restriction, and altitude clearance The controllers lack of knowledge and noncompliance with standard ATC procedures placed the aircraft in proximity to high terrain GRA

**N78-19087#** National Transportation Safety Board Washington, D C Bureau of Accident Investigation

**AIRCRAFT ACCIDENT REPORT. TEXAS INTERNATIONAL AIRLINES, INC, DOUGLAS DC-9-14, N9104, STAPLETON INTERNATIONAL AIRPORT, DENVER, COLORADO, 16 NOVEMBER 1976**

27 Oct 1977 50 p

(NTISUB/C/104-010 NTSB-AAR-77-10) Avail NTIS HC A03/MF A01, Paper copy also available on subscription North American Continent price $35 00/year, all others write for quote CSCL 01B

On November 16, 1976 a McDonnell Douglas DC-9-14, crashed after rejecting a takeoff from runway 8 right at Stapleton International Airport, Denver, Colorado The takeoff was rejected when the stall warning stick shaker activated after the aircraft had rotated for takeoff The aircraft overran the runway, traversed drainage ditches, struck approach light stanchions, and stopped Eighty-one passengers and five crewmembers evacuated the aircraft, 14 persons were injured The National Transportation Safety Board determines that the probable cause of this accident was a malfunction of the stall warning system for undetermined reasons which resulted in a false stall warning and an unsuccessful attempt to reject the takeoff after the aircraft had accelerated beyond refusal and rotation speeds GRA

**N78-19088#** National Aviation Facilities Experimental Center, Atlantic City N J

**HIGH-ALTITUDE AREA NAVIGATION (RNAV) ENROUTE SIMULATION Final Report, Mar - Aug 1976**

Francis M Willett, Jr and Mark R Taylor Dec 1977 85 p refs

(FAA Proj 044-326-080)

(AD-A049315, FAA-NA-77-4 FAA-RD-77-128) Avail NTIS HC A05/MF A01 CSCL 17/7

A four-part dynamic simulation using two systems of navigation area navigation (RNAV) and very high frequency omnidirectional radio range (VOR), was conducted to (1) validate the results derived from fast-time simulation tests of RNAV and Jet-VOR route structures through real-time simulation tests, (2) determine whether benefits resulted from the application of RNAV in the high-altitude enroute environment, and (3) establish the impact that the number of potential aircraft conflict situations has on the ATC system and system user Simulations were conducted in a fast-time mode, without controller intervention, for an area encompassed by five high altitude Chicago Air Route Traffic Control Center sectors and for a single selected sector of the five Real-time simulations, with controller intervention, were conducted for both the five- and one-sector configurations Test results showed a significant reduction in controller workload in the RNAV system compared to the VOR system for both sector configurations Comparison of the fast-time potential conflict data with real-time controller workload and system performance measures did not show any correlation between the two sets of data Author

**N78-19089#** National Aviation Facilities Experimental Center, Atlantic City, N J

**DERIVATION OF GROUNDSPEED INFORMATION FROM AIRBORNE DISTANCE MEASURING EQUIPMENT DME INTERROGATORS Final Report, Oct. 1975 - Sep 1976**

John Gallagher, William Lynn and Robert H Pursel Nov 1977 55 p

(FAA Proj 073-320-100)

(AD-A049277, FAA-NA-77-28, FAA-RD-77-135) Avail NTIS HC A04/MF A01 CSCL 01/4

Laboratory and flight tests were conducted to investigate the derivation of aircraft groundspeed from the range rate pulse information obtained from ARINC 568 distance measuring equipment (DME) interrogators Initial tests determined the limitation of the range rate pulse output from the two interrogators tested Subsequent effort was directed toward digital filtering techniques to improve accuracy and response time of the DME-derived groundspeed Best results were obtained with either accelerometer complementation or Kalman filtering with velocity and acceleration observations Both techniques achieved standard deviations of about 3 knots when compared to inertial navigation system groundspeed Author

**N78-19090#** Lincoln Lab, Mass Inst of Tech, Lexington

**A HARDWARE IMPLEMENTATION OF THE ATCRBS REPLY PROCESSOR USED IN DABS**

R G Nelson and J H Nuckols 19 Sep 1977 58 p refs

(Contracts DOT-FA-72WAI-621 F196228-76-C-0002

FAA Proj 034-241-012)

(AD-A047622/6 ATC-78, FAA-RD-77-92) Avail NTIS HC A04/MF A01 CSCL 17/7

A special-purpose digital hardware processor which implements the ATCRBS reply processing algorithms designed for use in the Discrete Address Beacon System (DABS) was developed and used in two DABS-related programs A detailed functional description of this processor and its implementation is reported It could serve as the ATCRBS reply processor for a beacon collison avoidance system with minor modifications Author

**N78-19094*#** McDonnell-Douglas Corp St Louis, Mo

**CONCEPTUAL DESIGN STUDY OF A HARRIER V/STOL RESEARCH AIRCRAFT**

Waldemar E Bode Roger L Berger Glen A Elmore and Thomas R Lacey Feb 1978 293 p

(Contract NAS2-9748)

(NASA-CR-152086) Avail NTIS HC A13/MF A01 CSCL 01C

MCAIR recently completed a conceptual design study to define modification approaches to, and derive planning prices for the conversion of a two place Harrier to a V/STOL control display and guidance research aircraft Control concepts such as rate damping attitude stabilization velocity command, and cockpit controllers are to be demonstrated Display formats will also be investigated and landing navigation and guidance systems flight tested The rear cockpit is modified such that it can be quickly adapted to faithfully simulate the controls, displays and handling qualities of a Type A or Type B V/STOL The safety pilot always has take command capability The modifications studied fall into two categories basic modifications and optional modifications Technical descriptions of the basic modifications and of the optional modifications are presented The modification plan and schedule as well as the test plan and schedule are presented The failure mode and effects analysis, aircraft performance aircraft weight, and aircraft support are discussed Author

**N78-19095#** Royal Aircraft Establishment, Farnborough (England)

**ICING ON HELICOPTERS**

Karl Wagner Jul 1977 15 p Transl into ENGLISH from Flug-Rev Int (West Ger), v 9 1971 p 31-34

(RAE-Trans-1911, BR60629) Avail NTIS HC A02/MF A01

Some of the problems peculiar to helicopters were discussed Emphasis was placed on the vulnerability of the rotor A simple hypothesis for a safety criterion for the rotor was presented Three encounters were cited, two which seemed to confirm the hypothesis and one which did not The discrepancy was explained by distinguishing between icing due to large drops of supercooled rain and icing due to small drops of very fine drizzle or fog The mechanisms of icing at these two conditions were briefly discussed Author

**N78-19096*#** Rockwell International Corp, Los Angeles, Calif
**STUDY OF HYPERSONIC PROPULSION/AIRFRAME INTEGRATION TECHNOLOGY Final Report**
William R Hartill Thomas P Goebel, and Verle V VanCamp Jan 1978 97 p refs
(Contract NAS1-14859)
(NASA-CR-145321 NA-78-24) Avail NTIS HC A05/MF A01 CSCL 01C

An assessment is done of current and potential ground facilities, and analysis and flight test techniques for establishing a hypersonic propulsion/airframe integration technology base A Mach 6 cruise prototype aircraft incorporating integrated Scramjet engines was considered the baseline configuration, and the assessment focused on the aerodynamic and configuration aspects of the integration technology The study describes the key technology milestones that must be met to permit a decision on development of a prototype vehicle, and defines risk levels for these milestones Capabilities and limitations of analysis techniques, current and potential ground test facilities, and flight test techniques are described in terms of the milestones and risk levels Author

**N78-19097#** General Dynamics/Convair San Diego, Calif
**DEVELOPMENT OF THERMOPLASTIC COMPOSITE AIRCRAFT STRUCTURAL ELEMENTS Final Report, Jun 1975 - Dec. 1976**
R C Goad May 1977 72 p refs
(Contract N62269-75-C-0386)
(AD-A048468, NADC-77187-30) Avail NTIS HC A04/MF A01 CSCL 11/9

This work accomplished the design, fabrication, and testing of structural panels of representative thermoplastic construction suitable for use in the forward fuselage areas of advanced CTOL and V/STOL carrier-based Naval aircraft Author (GRA)

**N78-19098#** Hughes Aircraft Co, Culver City, Calif Display Systems Lab
**DEVELOPMENT OF A PROGRAMMABLE PANEL Final Report, 15 Jun 1975 - 15 Jul 1976**
G Wolfson Aug 1977 31 p refs
(Contract N62269-75-R-0372)
(AD-A048469, HAC-P77-383 HAC-REF-D4443, NADC-77264-30) Avail NTIS HC A03/MF A01 CSCL 14/2

A programmable control panel utilizing a liquid crystal alphanumeric display with four lines of twenty characters each was designed and fabricated The panel features ten pushbuttons with the liquid crystal display providing two lines of four characters each as a programmable pushbutton legend This panel was designed to demonstrate liquid crystal alphanumeric display technology as applied to advanced integrated controls and displays for future Navy avionics systems Author (GRA)

**N78-19099*#** Naval Postgraduate School, Monterey, Calif
**PROCEEDINGS OF THE NAVY/NASA VSTOL FLYING QUALITIES**
C J Mazza (NADC, Warminster, Pa), D M Layton, and L V Schmidt Aug 1977 550 p refs Proc held at Monterey, Calif, 26-28 Apr 1977, sponsored by NADC and NASA
(NASA-CR-155810, AD-A047961) Avail NTIS HC A23/MF A01 CSCL 01C

Flying qualities of V/STOL aircraft used in Navy operations are reviewed Topics discussed include aircraft development and flight testing, flight controls and displays, and seaborne launch and recovery interface

**N78-19100*#** National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
**A COMPARISON OF V/STOL HANDLING REQUIREMENTS WITH THE VAK-191B**
Seth B Anderson *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 3-20

Avail NTIS HC A23/MF A01 CSCL 01C

The two available V/STOL criteria references were compared with flight measurements obtained on the VAK-191B along with the pilot's comments relative to the aircraft meeting the specifications Differences in the specifications themselves were also noted Handling qualities requirements for shipboard operation were emphasized Author

**N78-19101*#** McDonnell Aircraft Co St Louis, Mo
**MIL-F-83300, VIEW FROM AN AIRCRAFT DESIGNER**
T R Lacey *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 21-52 refs

Avail NTIS HC A23/MF A01 CSCL 01C

The MIL-F-83300 V/STOL Flying Qualities Specification is reviewed from three aspects (1) its effectiveness as a guide to the attainment of well balanced V/STOL aircraft design, (2) the relevance of its requirements to the successful emergence of the Harrier and (3) its relative merits and deficiencies when compared to the AGARD V/STOL Handling Criteria Suggested changes for making it a more useful tool for the V/STOL aircraft designer are presented Author

**N78-19102*#** Grumman Aerospace Corp, Bethpage, N Y
**V/STOL HOVER STABILITY IMPACT ON HOVER CONTROL TASK**
A B Whitaker, C P Kelly, R B Wittman and R P Martorella *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 53-70 ref

Avail NTIS HC A23/MF A01 CSCL 01C

Longitudinal static stability requirements for V/STOL aircraft are discussed in terms of vertical landing on a small ship at night response of the aircraft to air turbulence, and hovering flight The increased pilot workload encountered under these flight conditions is considered Results of a flight simulation study performed to evaluate a specific hover control task two control systems - attitude rate command and translational velocity command and the pilots performance with and without turbulence are reported It is concluded that the translational velocity command system provides the control requirements for good spot hovering capability and reduced pilot workload J M S

**N78-19103*#** Aeroplane and Armament Experimental Establishment, Boscombe Down (England)
**V/STOL FLYING QUALITIES REQUIREMENTS IN THE UK**
John R Williams *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 71-92 refs

Avail NTIS HC A23/MF A01 CSCL 01C

Acceptance and suitability testing is discussed in relation to providing a numerical basis for quantitative assessments and, together with measured aircraft characteristics, the formulation of flying qualities requirements and design criteria for V/STOL aircraft Harrier handling qualities during short takeoff and semi-jetborne flight are assessed with emphasis on longitudinal stability maneuverability and pilot compensation Flight safety is also considered A restriction of the short takeoff nozzle angle to a maximum of 50 deg instead of the 60 deg specified by the flight manual is proposed Results of flight tests and pilot ratings for various configurations and the two techniques indicate that the proposed technique improved significantly the handling qualities of the outboard stores configuration during short takeoffs J M S

**N78-19104*#** Naval Air Systems Command, Washington D C
**REVIEW OF US NAVY VSTOL HANDLING QUALITIES REQUIREMENTS**
Dale E Hutchings *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 93-110

Avail NTIS HC A23/MF A01 CSCL 01C

Handling qualities requirements for V/STOL operations from small ships are considered in terms of the ship operating environment Turbulence wind over the deck, ship motion, visibility and severe weather and sea conditions are among the factors discussed J M S

**N78-19105*#** Calspan Corp , Buffalo, N Y
**CAPABILITIES OF THE NAVY VARIABLE STABILITY X-22A FOR V/STOL FLYING QUALITIES R AND D**
Edwin W Aiken John L Beilman, J Victor Lebacqz, and John W Clark, Jr (NADC Warminster, Pa ) *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 111-138 refs
Avail NTIS HC A23/MF A01 CSCL 01C

The X-22A V/STOL Flight Research Facility which provides in-flight simulation capability applicable to hover, low speed, and transition flight investigation of fixed wing V/STOL flying is described The variable stability system the guidance and display equipment the data acquisition and processing system, and the ground simulator are included Research programs involving the STOL flying qualities for landing approach the control system display and guidance requirements for VTOL aircraft instrument approach and landing, and the expansion of the adverse weather operation capabilities of the Navy's VTOL aircraft are briefly summarized J M S

**N78-19106*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**A PILOTED SIMULATION OF V/STOL LANDINGS ABOARD A NON-AVIATION SHIP**
Ronald M Gerdes *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 139-158 refs
Avail NTIS HC A23/MF A01 CSCL 01C

A lift fan simulation program was conducted to examine V/STOL handling qualities and operational problems to find solutions to high pilot workload problem areas and to simulate terminal guidance and control of a landing on a nonaviation ship Piloting aids evaluated include an advanced attitude control system, a decoupled flight path control system, and an integrated head-up display Results are discussed from a pilot's point of view with emphasis on reduction of pilot workload during V/STOL aircraft recoveries at sea J M S

**N78-19107*#** Royal Aircraft Establishment, Bedford (England)
**THE STO DECK LAUNCH PROBLEM**
O P Nicholas *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 159-176

Avail NTIS HC A23/MF A01 CSCL 01C

Harrier aircraft launch performance is assessed Ship pitching motion, deck-end speed target launch speed margin, and minimum sea clearance are among the factors considered Avoidance of a bow-down catapult launch is emphasized J M S

**N78-19108*#** Naval Air Test Center, Patuxent River, Md
**SHIPBOARD TESTING OF THE AV-8A HARRIER**
A M Rossetti and J E Iles *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 177-200
Avail NTIS HC A23/MF A01 CSCL 01C

Minimum end airspeed flying qualities and performance optimum STO trim settings and effects of mistrim on STO flying qualities are discussed along with dynamic interface (STO, VTO, VL), approach and VL flying qualities, and effects of inboard tanks in combination with outboard stores The reaction control system center of gravity aircraft loading nozzle angle, and airspeed are considered The influence of pilot workload on the optimum trim setting and the post launch flying qualities are included J M S

**N78-19109*#** Vought Corp Dallas Tex
**ANALYSIS OF THE INFLUENCE OF THE OGE/IGE TRANSITION ON VAK-191B FLYING QUALITIES IN HOVER**
Robert L Fortenbaugh *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 201-236 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Single axis pitch and roll frequency response data were taken with the VAK-191B control system in the VTOL mode This mode has proportional attitude command in each axis Therefore while the pitch axis input command was oscillated, the roll control system attempted to hold wings level and, similarly, while the roll axis input command was oscillated, the pitch control system attempted to maintain a reference attitude The yaw axis of the pedestal was locked for these tests because the aircraft yaw control system is rate command in all modes and would allow aircraft heading to drift in the presence of yaw moment disturbances Analysis of the roll response data which produced quantification of the in ground effect (IGE) propulsion-induced roll angle effect on the aircraft and subsequent analysis of the influence of this effect on roll flying qualities are described Validity of the analytical flying qualities results and the IGE and out of ground effect roll models is established by comparison with VAK-191B operational limitations and pilot comments on the aircraft s handling characteristics A similar analysis of the pitch response data was made and figures summarizing these results are included Author

**N78-19110*#** National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
**PILOT CENTERED REQUIREMENTS IN CONTROL/DISPLAY DESIGN**
Ronald A Hess *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 237-258 refs
Avail NTIS HC A23/MF A01 CSCL 01C

A method developed for predicting pilot opinion ratings for particular vehicles and tasks using optimal control pilot model is described and an outline of a flight director design procedure based upon the optimal control pilot model is given Longitudinal and lateral control of a helicopter in hover and in a -6 deg constant ground speed-command landing approach are considered Emphasis is placed on display design for optimum V/STOL control J M S

**N78-19111*#** Systems Technology Inc Hawthorne, Calif
**SURVEY OF PILOTING FACTORS IN V/STOL AIRCRAFT WITH IMPLICATIONS FOR FLIGHT CONTROL SYSTEM DESIGN**
Robert F Ringland and Samuel J Craig *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 269-292 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Flight control system design factors involved for pilot workload relief are identified Major contributors to pilot workload include configuration management and control and aircraft stability and response qualities A digital fly by wire stability augmentation, configuration management, and configuration control system is suggested for reduction of pilot workload during takeoff, hovering, and approach J M S

**N78-19112*#** McDonnell Aircraft Co , St Louis, Mo
**RATIONALE FOR SELECTION OF A FLIGHT CONTROL SYSTEM FOR LIFT CRUISE FAN V/STOL AIRCRAFT**
Roman K Konsewicz *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 293-342

(GP77-0375-28) Avail NTIS HC A23/MF A01 CSCL 01C

Various features of the lift cruise fan V/STOL concept are briefly reviewed The ability to operate from small ships in adverse weather low visibility, and rough sea conditions is emphasized as is the need for a highly capable flexible and reliable flight control system A three channel control by wire digital flight control system is suggested The requirement for automatic flight control, the advantage of control by wire implementation, the preference for a digital computer and the need for three channel redundancy are among the factors discussed J M S

**N78-19113*#** Boeing Military Airplane Development Seattle Wash
**PRELIMINARY DESIGN OF A FLIGHT CONTROL SYSTEM FOR A V/STOL AIRPLANE WITH GEARED VARIABLE PITCH FANS**
Philip Gotleib *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 343-362

Avail NTIS HC A23/MF A01 CSCL 01C

A flight control system designed for an aircraft powered by three variable pitch fans, interconnected by shafts to provide lifting system redundancy is considered for application to a Navy Type A V/STOL aircraft with similar configurational features The differences and similarities in the applications are discussed with emphasis on a design approach for safety in the event of failures in the propulsion and flight control systems Differences in flying qualities and system design criteria are considered

Author

**N78-19114*#** Honeywell, Inc., Minneapolis, Minn Avionics Div

**ELECTRONICS PLUS FLUIDICS FOR V/STOL FLIGHT CONTROL**

Russell C Hendrick *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flight Qualities Aug 1977 p 363-386

Avail NTIS HC A23/MF A01 CSCL 01C

The redundant digital fly by wire flight control system coupled with a fluidic system, which uses hydraulic pressure as its signal transmission means to provide pilot and feedback sensor control of airframe forcing functions is considered for application to the V/STOL aircraft A potential fluidics system is introduced and anticipated performance, weight and reliability is discussed Integration with the redundant electronic channels is explored, with the safety and mission reliability of alternate configurations estimated

Author

**N78-19115*#** Boeing Vertol Co., Philadelphia Pa

**THE HELICOPTER/SHIP DYNAMIC-INTERFACE PROBLEM A NEW APPROACH**

Theodore S Garnett Jr and James M Davis *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 387-406

Avail NTIS HC A23/MF A01 CSCL 01C

A wind tunnel test was conducted in the Boeing Vertol low speed V/STOL tunnel to assess aerodynamic wake turbulence behind the superstructure of a 1/50-scale FF1052-class U S Navy frigate Dynamic velocity data were measured at a sufficient number of locations in the separated wake to define major areas of turbulence affecting helicopter operations aboard ship The results are to be applied in piloted flight simulation work aimed at solving ship/helicopter dynamic-interface problems The testing accomplished to map the turbulent wake is documented and results are presented

Author

**N78-19116*#** Naval Postgraduate School, Monterey Calif

**A SUMMARY OF SHIP DECK MOTION DYNAMICS AS APPLIED TO VSTOL AIRCRAFT**

A E Baitis *In its* Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 407-460 refs

Avail NTIS HC A23/MF A01 CSCL 01C

Ship deck motions are considered in terms of the landing/takeoff of V/STOL aircraft from small ships Fluctuations in the air turbulence shed by the ship's superstructures, wind direction and velocity, and wind turbulence loads on the aircraft are among the factors discussed Roll stabilization using antiroll tanks, fins, and rudders is covered

J M S

**N78-19117*#** Center for Naval Analyses, Washington, D C

**SEAKEEPING CONSIDERATIONS IN THE EMPLOYMENT OF V/STOL ON NAVAL SHIPS**

S R Olson *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 461-476 refs

Avail NTIS HC A23/MF A01 CSCL 01C

Compatibility of Naval ships as V/STOL support platforms and the ship motions that V/STOL aircraft must endure are discussed A methodology which evaluates the impact of motion criteria such as the maximum ship motion allowable during V/STOL landing/launch is presented Emphasis is given to design alternatives that reduce ship motion

J M S

**N78-19118*#** Naval Air Systems Command, Washington, D C Launch/Recovery Branch

**REQUIREMENTS FOR VLA SYSTEMS**

Noel S Flynn *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 477-494

Avail NTIS HC A23/MF A01 CSCL 01C

The effectiveness of visual landing aid (VLA) systems during the approach and landing flight phase of V/STOL aircraft is examined Baseline requirements for VLA systems are determined

J M S

**N78-19119*#** Naval Ocean Systems Center, San Diego Calif

**VTOL/HELICOPTER APPROACH AND LANDING GUIDANCE SENSORS FOR NAVY SHIP APPLICATIONS**

S K Miyashiro and F E Morris *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 495-514

Avail NTIS HC A23/MF A01 CSCL 01C

Approach and landing guidance sensors essential to recover V/STOL aircraft and helicopter on ships are described Alternative techniques which feature different operating frequencies from microwave to optical-infrared, different geometric techniques of position fixing by range and angle measurements from a single point or points on a short baseline available at the landing platform typically forty feet wide are included Other factors discussed include ceiling/visibility requirements, in-close accuracy, safety and pilot acceptance, and compatibility with air traffic control and landing systems

J M S

**N78-19120*#** Naval Air Systems Command, Washington, D C Advanced Aircraft Development and Systems Objectives Office

**NAVTOLAND AND FLYING QUALITIES**

Thomas S Momiyama *In* Naval Postgraduate School Proc of the Navy/NASA VSTOL Flying Qualities Aug 1977 p 515-546 refs

Avail NTIS HC A23/MF A01 CSCL 01C

The V/STOL operational capability is reviewed with emphasis on pilot workload and all-weather landing guidance systems A research and development program to correlate and integrate the development of all systems and techniques involved in enabling the pilot to fly V/STOL aircraft onto ships and tactical sites is described Aircraft design parameters that affect its control in the vertical takeoff and landing flight regimes are emphasized Topics considered include (1) integrated flight controls and displays (2) low speed sensor, (3) air traffic control approach and landing guidance systems (4) visual landing aids, (5) ground effect induced thrust variation problems, and (6) handling qualities

J M S

**N78-19121#** McDonnell Aircraft Co., St Louis, Mo

**GENERALIZED PROCEDURES FOR TRACKING CRACK GROWTH IN FIGHTER AIRCRAFT Final Technical Report, 15 Sep 1975 - 15 Oct. 1976**

G S Parker Jan 1977 178 p refs

(Contract F33615-75-C-3136, AF Proj 1367)

(AD-A048847, AFFDL-TR-76-133) Avail NTIS HC A09/MF A01 CSCL 11/6

This study is composed of three major parts, (1) effects of usage parameters on crack growth (2) development of generalized procedures, and (3) implementation of the tracking program During the development of generalized procedures, crack growth trends and alternate methods of tracking were established *In addition the recorded data requirements have been evaluated* The effort regarding implementation of a tracking program consisted of an evaluation of logistics and the identification of technical difficulties and potentially significant costs

Author (GRA)

**N78-19122#** Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Engineering

**DESIGN AND EVALUATION OF A SIDE FORCE GENERATOR MODIFICATION FOR THE XBQM-1 REMOTELY PILOTED VEHICLE**

Glenn R Leimbach Dec 1977 136 p refs
(AD-A048901 AFIT/GAE/AA/77D-7) Avail NTIS HC A07/MF A01 CSCL 01/3

Wingtip and fuselage mounted side force generator (SFG) surfaces were designed and installed on the XBQM-106 remotely piloted vehicle (RPV) to enhance its lateral terminal response characteristics These surfaces were sized and positioned in an attempt to keep the net rolling and yawing moments about the CG unchanged when the aircraft was side slipping The FLEXSTAB digital computer system in conjunction with traditional hand calculated method was used to evaluate the RPV's stability, control, and time response characteristics The time history responses to rudder, aileron rudder/aileron, and wind gust inputs were generated and plotted by the FLEXSTAB program From these plots it was determined that the SFG modification increased the yaw rate response 10 6% while decreasing the roll rate 10 7% and the side slip angle response 25 1% The dutch roll damping was increased 4% and the DR period decreased 8% The roll mode time to half amplitude increased 16 7% and the spiral stability increased for the modified vehicle The longitudinal stability suffered a slight decrease due to the SFG
Author (GRA)

**N78-19123#** Air Force Inst of Tech, Wright-Patterson AFB, Ohio School of Engineering
**A FEASIBILITY STUDY OF A MANUAL BOMB RELEASE WHILE IN A TURN M S Thesis**
Joel Dana Walton Dec 1977 123 p refs
(AD-A048882, AFIT/GAE/AA/77D-17) Avail NTIS HC A06/MF A01 CSCL 15/7

This study attempts to determine if a pilot can manually release a bomb while in a turn The nonlinear equations describing the geometry, fire control law, aircraft equations of motion, flight controls and pilot model are developed These equations are linearized so that a frequency response analysis can be conducted for perturbations about a nominal trajectory The system response is evaluated using wind gust inputs and lateral stick inputs and plotting the resulting system perturbations over a given frequency range
Author (GRA)

**N78-19124#** Hughes Helicopters Culver City, Calif
**ADVANCED TECHNOLOGY HELICOPTER LANDING GEAR Final Report, Apr. 1975 - Apr 1977**
Ralph E Goodall Oct 1977 150 p refs
(Contract DAAJ02-75-C-0028)
(AD-A048891, HH-77-41, USAAMRDL-TR-77-27) Avail NTIS HC A07/MF A01 CSCL 01/3

This report covers the work performed on the advanced helicopter landing gear program by Hughes Helicopters The objectives of the program were to design, fabricate, and test a wheel-type advanced main landing gear concept possessing high-energy-absorbing characteristics for helicopters in the 15,000-pound class These objectives were achieved by formulating design criteria through a data search, choosing the most cost-effective composite material and through a design analysis, selecting the most promising landing gear concept This concept used graphite epoxy as a structural material to fabricate the trailing arm of the main landing gear of the Hughes YAH-64 helicopter by wet-filament winding (WFW) The graphite arm was successfully tested demonstrating the practicality of employing composite structures in the construction of high-energy-attenuating landing gear components The program showed that the graphite trailing arm was 11 percent lighter than the baseline steel arm The weight of the baseline landing gear could be reduced by maximizing the use of composites 7 percent by using existing WFW equipment, and 26 percent by developing and using a toroid winding machine
Author (GRA)

**N78-19125#** Kearney (A T) and Co, Inc Chicago, Ill Caywood-Schiller Div
**THE MISSION TRADE-OFF METHODOLOGY (MTOM) MODEL. MODEL DESCRIPTION Final Report**
W J Strauss, N D Bailey, and M W Kasper Dec 1977 126 p refs
(Contract F33615-74-C-5141)
(AD-A049318 JTCG/AS-76-S-001) Avail NTIS HC A07/MF A01 CSCL 01/3

Presented are the results assumptions and rationale of a model to evaluate the relative cost-effectiveness of proposed aircraft modifications for survivability enhancement Two primary questions are addressed how effective are the proposed modifications in a mission context and what are the important factors contributing to the improvement To answer these questions, the MTOM model was developed Parametric variations are presented and analyzed
Author (GRA)

**N78-19126#** Advisory Group for Aerospace Research and Development, Paris (France)
**ROTORCRAFT DESIGN**
Jan 1978 342 p refs Proceedings of the Flight Mechanics Panel Symp, Moffett Field, Calif, 16-19 May 1977
(AGARD-CP-233 ISBN-92-835-1272-3) Avail NTIS HC A15/MF A01

Military and civilian rotorcraft designers are provided with exchanges concerning common problems and grounds for civil/military cooperation Sessions included military requirements and new rotorcraft systems, civil operations and new helicopter designs, and research vehicles Rotor wind tunnel and flight research are also reviewed, and opportunities for coordinating military and civil requirements and specifications are discussed

**N78-19127#** Army Aviation Systems Command, St Louis, Mo
**PROJECTED NEEDS OF US ARMY AVIATION**
Story C Stevens *In* AGARD Rotorcraft Design Jan 1978 22 p refs
Avail NTIS HC A15/MF A01

The projected needs of U S Army air mobility as they are seen today within the U S Army Aviation Systems Command are reviewed The U S Army's envisioned future aviation requirements are discussed and their relation to research and development needs is summarized Special emphasis is given to those aspects of the military requirements which seem to offer the best opportunities for coordination with civil developments Both the short term needs, as exemplified by the currently developing systems and the long term requirements, which may be represented by conceptual studies only, are addressed
Author

**N78-19128#** Bundesministerium der Verteidigung, Bonn (West Germany)
**GERMAN ARMY HELICOPTER DEVELOPMENT AND PROSPECTS FOR THE FUTURE**
K W Mack and H Jakob *In* AGARD Rotorcraft Design Jan 1978 22 p
Avail NTIS HC A15/MF A01

The present German army helicopter development is concentrated on a light antitank helicopter (ATH) and a liasion-and-observation helicopter (LOH) based on the civilian BO 105 helicopter of Messerschmitt-Bolkow-Blohm The outstanding characteristics of these two systems is a high degree of commonality that is promising considerable advantages for cost effectiveness maintenance, overhaul and other logistic aspects Guidelines for the future German military helicopter development are among others night- and bad-weather capability, increased maneuverability, improved survivability and crashworthiness, improved maintenance, overhaul and repair, reduction of the number of types, and consideration of standardization and interoperability requirements
Author

**N78-19129#** Canadian Forces Base, Shearwater (Nova Scotia)
**CANADIAN NAVY EXPERIENCE WITH SMALL SHIP HELICOPTER OPERATIONS**
N H J Browne *In* AGARD Rotorcraft Design Jan 1978 4 p
Avail NTIS HC A15/MF A01

A short summary is presented of the development of the Canadian Navy's approach and solution to operating medium

size helicopters from small ships in the North Atlantic This is followed by a general description of the Helicopter Hauldown Rapid Securing Device - the main item of equipment which enabled successful open sea operations with the available equipment An overview of the operating capabilities of the Destroyer/Helicopter system, the lessons learned from its development and a subjective assessment of future helicopter requirements for the Canadian Navy are also offered Author

**N78-19130#** Ministry of Defence, London (England) Directorate of Naval Air Warfare
**BRITISH MILITARY HELICOPTER PROGRAMMES**
J D W Husband *In* AGARD Rotorcraft Design Jan 1978 7 p
Avail NTIS HC A15/MF A01

The range of helicopters in current use within the UK armed services is described and the broad requirements for the future are examined It is recognized that, because of the spiralling cost of development of new helicopters, every effort will have to be made to reduce the through life costs by improving the life, reliability and maintainability of components Survivability, both in crash resistance and in reduced vulnerability to hostile fire are of particular importance in the battlefield environment, while increased speed and endurance are sought in naval helicopters Author

**N78-19131#** Army Aviation Systems Command, St Louis, Mo Research, Development and Engineering Directorate
**THE US ARMY UTTAS AND AAH PROGRAMS**
Ronald F Gormont and Robert A Wolfe *In* AGARD Rotorcraft Design Jan 1978 18 p refs

Avail NTIS HC A15/MF A01

The U S Army s latest developed utility and attack helicopters with contracts recently awarded to Sikorsky Aircraft for the utility tactical transport aircraft system (UTTAS) and Hughes Aircraft for the advanced attack helicopter (AAH) are addressed A brief history into the background of the Army's requirement for a UTTAS and AAH is provided along with a history of the development, a general description of the aircraft with intended missions, planned activities significant capabilities, and potential alternate uses of the resulting designs The capabilities and potential alternate uses consider the implication of the stringent military requirements in adapting the UTTAS and AAH to other nonmilitary or noncombat missions Both development programs have concentrated efforts on reliability and maintainability characteristics which provide enhanced operational capability on the modern day battlefield at an affordable cost Author

**N78-19132#** Department of the Navy, Washington D C
**US NAVY/MARINE CORPS ROTARY WING REQUIREMENTS**
J A Purtell *In* AGARD Rotorcraft Design Jan 1978 4 p

Avail NTIS HC A15/MF A01

Points addressed include how rotorcraft fit into a Navy committed to a future VTOL force, current helicopter developments in Naval aviation with emphasis upon characteristics and capabilities of CH-53E Super Stallion LAMPS MK III, and the AH-1T improved Sea Cobra, and finally, what current trends are underway in navalized helicopters to applications Author

**N78-19133#** British Airways Helicopters Ltd Horley (England)
**BRITISH AIRWAYS HELICOPTER OPERATIONS**
J A Cameron *In* AGARD Rotorcraft Design Jan 1978 4 p

Avail NTIS HC A15/MF A01

The helicopter's role in civil aviation in the United Kingdom is assessed The main operation considered is a helicopter passenger service from Penzance on Britain s south west coast to the Isles of Scily A comparison is made between fixed wing aircraft and rotary wing aircraft in regard to operating costs and flight time reduction Other aspects of operations economics are examined, including helicopter design, fleet maintenance and overhaul life B L P

**N78-19134#** Squadron 330/B-Wing Banak AFB, Laksalv (Norway)
**AIR-SEA RESCUE OPERATIONS SEARCH AND RESCUE EXPERIENCE**
Tore Skaar *In* AGARD Rotorcraft Design Jan 1978 8 p

Avail NTIS HC A15/MF A01

The 330th squadron operates Sea King helicopters for air-sea rescue missions all along the Norwegian coast The operational environment is one of the most demanding in the world The shortcomings of the present generation of helicopters are discussed, the most serious being the lack of in flight icing protection of the rotor systems Author

**N78-19135#** KLM North Sea Helicopters, Amsterdam (Netherlands)
**SOME ASPECTS OF OFFSHORE OPERATIONS IN THE NETHERLANDS**
R J VanDerHarten *In* AGARD Rotorcraft Design Jan 1978 7 p refs
Avail NTIS HC A15/MF A01

The sound film Bridging the Troubled Waters' (Sikorsky Aircraft), which gives a general impression of helicopter operations between mainland and naval destinations, is summarized Problems which had to be solved in order to realize the required services on a 24-hour basis are reviewed One of these problems was the certification of helicopter weather minima for IFR-flight This involved the development and evaluation of instrument procedures and the proper choice of instruments and panel layout the navigational aids and the communication system Special attention was paid to the radar system which provides not only weather detection but is also used during the approach to the targets at sea, as well as to the recent evaluation of an integrated pilot display system which has a great potential for very low weather minima without the use of automatic guidance Author

**N78-19136#** Hughes Helicopters, Culver City, Calif
**COMBINED MILITARY AND COMMERCIAL APPLICATION OF LIGHT HELICOPTERS**
E E Cohen, K B Amer, and R E Moore *In* AGARD Rotorcraft Design Jan 1978 21 p
Avail NTIS HC A15/MF A01

An overview is presented of light helicopters of less than 4000 pounds gross weight used by both military and commercial aviation Hughes Helicopters background in light helicopters the design considerations and criteria used in the development of these helicopters and the Army's entry into light helicopter development are considered as well Some conjecture is offered on the design considerations and criteria which might be used to develop a next generation lightweight multipurpose helicopter which could be used suitably by both military and commercial aviation Author

**N78-19137#** Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
**LONG TERM EXPERIENCE WITH A HINGELESS/COMPOSITE ROTOR**
G Reichert and E Weiland *In* AGARD Rotorcraft Design Jan 1978 14 p refs
Avail NTIS HC A15/MF A01

The Messerschmitt-Bolkow-Blohm Company has gained good experience with its light helicopter MBB - BO 105, which is engaged in civilian as well as in military operations Up to now, more than 300 BO 105 helicopters have been delivered to customers and some 250,000 hours of flight time have been accumulated The first helicopters have about 5,000 flight hours This experience is especially valuable because the BO 105 is the first production helicopter with a hingeless rotor and fiberglass rotorblades which has been able to prove its ability in practical operation consistently over a long period of time The broad spectrum of operation and experience includes the following types of missions in civilian operation utility, executive, rescue police offshore, lighthouse supply as well as LOH, scout and antitank-missions in military operation Besides the problems resulting from this broad field of operations, which are typical for many light helicopters, additional questions associated with the new

technology were specially considered for example the changed handling characteristics and the different loading situation of the hingeless rotor and the behavior of the fatigue loaded fiberglass blades Author

**N78-19138#** Textron Bell Helicopter Ft Worth Tex
**THE BELL MODEL 222**
James R Garrison *In* AGARD Rotorcraft Design Jan 1978 16 p
Avail NTIS HC A15/MF A01

The design objectives, features and performance of the recently developed Bell Model 222 helicopter are described The Model 222 was designed to meet the needs of the worldwide commercial market Primary design objectives were safety, efficiency reduced cost of ownership, and superior handling qualities From the test results, the Model 222 is a fuel conservative, productive aircraft with excellent flying qualities The 222 far exceeds the FAA requirements for fail-safe design and crashworthiness Redundancy, 8g seats crash resistant fuel tanks and real twin-engine safety are examples The latter refers to the fact that for any altitude at which the helicopter can hover OGE, it can continue to cruise if one engine fails Author

**N78-19139#** Sikorsky Aircraft, Stratford, Conn
**THE SIKORSKY S-76 PROGRAM**
R F Donovan *In* AGARD Rotorcraft Design Jan 1978 14 p

Avail NTIS HC A15/MF A01

The Sikorsky S-76 helicopter was designed for the commercial market in general, and in particular was designed to serve the off-shore oil market and meet its requirements to carry 12 passengers and a crew of two on a 400 nautical mile radius mission with flotation equipment Author

**N78-19140#** Societe Nationale Industrielle Aerospatiale Paris (France)
**THE AS 350 LIGHT HELICOPTER**
Rene Mouille *In* AGARD Rotorcraft Design Jan 1978 18 p

Avail NTIS HC A15/MF A01

The AS-350 was designed especially for civil operators, with cost effectiveness a major concern Overall architectural design reduced the number of engine components resulting in a lightweight (4200 lb), single-engined helicopter capable of carrying a crew of six M V

**N78-19141#** Dornier-Werke G m b H Friedrichshafen (West Germany)
**TETHERED RPV-ROTORCRAFT**
G Kannamueller and W Goeller *In* AGARD Rotorcraft Design Jan 1978 7 p
Avail NTIS HC A15/MF A01

A tethered rotor platform was designed for the stabilization of transmitters and receivers of electromagnetic waves at an adequate altitude over a ground control station for military and civil purposes The complete system consisted of rotor platform, tethering cable, and ground control station Apart from the transmission of command and information data the tethering cable was also used for the power supply Tethered rotor platforms were used primarily in the military field for electronic warfare, fire control communication and surveillance of battlefield, sea surface and air space Author

**N78-19142*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
**EVALUATION OF THE TILT ROTOR CONCEPT THE XV-15'S ROLE**
James H Brown Jr H Kipling Edenborough (Textron Bell Helicopter Fort Worth, Tex ) and Kenneth G Wernicke *In* AGARD Rotorcraft Design Jan 1978 9 p Prepared in cooperation with Army Air Mobility Res and Develop Lab , Moffett Field Calif
Avail NTIS HC A15/MF A01 CSCL 01C

The need for an aircraft combining the efficient vertical takeoff and landing capability of a helicopter with the efficient high speed characteristics of a fixed wing turboprop is examined The ability of the tilt rotor concept to fill this requirement and examples as to its potential usefulness in both military and civil missions are discussed Author

**N78-19143#** Army Air Mobility Research and Development Lab , Fort Eustis, Va
**THE ADVANCING BLADE CONCEPT (ABC) ROTOR PROGRAM**
Harvey R Young and Duane R Simon *In* AGARD Rotorcraft Design Jan 1978 23 p refs

Avail NTIS HC A15/MF A01

The advancing blade concept, a coaxial counterrotating hingeless helicopter rotor system, was flight tested Flight results in a basic helicopter configuration confirmed several important advantages of the concept and identified some shortcomings The background and current status of the program are presented, and rotor and test aircraft features are briefly described Author

**N78-19144*#** National Aeronautics and Space Administration Langley Research Center, Langley Station Va
**THE ROTOR SYSTEMS RESEARCH AIRCRAFT A NEW STEP IN THE TECHNOLOGY AND ROTOR SYSTEM VERIFICATION CYCLE**
Robert J Houston, Julian L Jenkins, Jr , and John L Shipley (Army Air Mobility Res and Develop Lab Hampton, Va ) *In* AGARD Rotorcraft Design Jan 1978 24 p refs

Avail NTIS HC A15/MF A01 CSCL 01C

Rotor systems research aircraft vehicles, (RSRA), were developed specifically to provide the capabilities necessary for the effective and efficient in-flight test and verification of promising new rotor concepts and supporting technology developments The capabilities of the RSRA aircraft for potential research programs are discussed Author

**N78-19145#** National Aeronautical Establishment, Ottawa (Ontario)
**THE NAE AIRBORNE V/STOL SIMULATOR**
S R M Sinclair, W E B Roderick and K Lum *In* AGARD Rotorcraft Design Jan 1978 12 p refs

Avail NTIS HC A15/MF A01

Specialized facilities for investigating the problems associated with high-lift low-speed flight were established The airborne simulator's four major areas of systems development are discussed installation of an electrohydraulic actuator system to interface with the basic helicopter controls development and integration of a hybrid computing system, implementation of a model-following autopilot, and development of a broadband motion sensing system A short description of each of these systems is given Author

**N78-19146#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Flugmechanik
**DFVLR ROTORCRAFT RESEARCH**
B Gmelin, H J Langer, and P Hamel *In* AGARD Rotorcraft Design Jan 1978 17 p refs

Avail NTIS HC A15/MF A01

Selected activities in the field of rotorcraft research and development are presented and discussed helicopter wind tunnel test stands active vibration control, crew escape systems and helicopter system identification Author

**N78-19147#** Westland Helicopters Ltd , Yeovil (England)
**RESEARCH REQUIREMENTS FOR THE IMPROVEMENT OF HELICOPTER OPERATIONS**
Martin V Lowson *In* AGARD Rotorcraft Design Jan 1978 13 p refs
Avail NTIS HC A15/MF A01

Principal difficulties in helicopter performance engineering were studied Problems in the areas of noise both external and internal and ice formation were examined Reduction of rotor speed as a noise control method was suggested, and ice formation was attributed to meteorological uncertainties Author

**N78-19148#** Office National d Etudes et de Recherches Aerospatiales, Paris (France)
**ONERA AERODYNAMIC RESEARCH WORK ON HELICOPTERS**
Jean-Jacques Philippe and Claude Armand *In* AGARD Rotorcraft Design Jan 1978 19 p refs

Avail NTIS HC A15/MF A01

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

**N78-19149#** Westland Helicopters Ltd Yeovil (England)
**WESTLAND WISP**
M J Breward *In* AGARD Rotorcraft Design Jan 1978 14 p ref
Avail NTIS HC A15/MF A01

Feasibility studies for a surveillance and target acquisition system led to a proposal for a remotely piloted helicopter with co-axial twin rotors having symmetry about the rotor axis One project which has proceeded into hardware status and which has commenced flight trials carries a trainable television camera and gyro based automatic stabilization equipment It is operable by two persons one of which performs all piloting functions Author

**N78-19150#** Societe Nationale Industrielle Aerospatiale, La Courneuve (France)
**TECHNICAL AND FINANCIAL FALL-OUT ON ARMED FORCES FROM COMMERCIAL AND EXPORT HELICOPTER PROGRAMMES**
Andre L Renaud *In* AGARD Rotorcraft Design Jan 1978 4 p
Avail NTIS HC A15/MF A01

An attempt was made to highlight the drawbacks for industry, and advantages for armed forces, when launching a helicopter program as a private venture The drawbacks for the industry lie in the investments, the lack of operational and technical specifications, and of official crew s judgement on the aircraft The advantages for military operators were the deferred and lower non-recurring cost outlay if a helicopter was developed as a private venture Author

**N78-19151#** Boeing Vertol Co , Philadelphia, Pa
**CIVIL AND MILITARY DESIGN REQUIREMENTS AND THEIR INFLUENCE ON THE PRODUCT**
David G Harding and John P Walsh *In* AGARD Rotorcraft Design Jan 1978 9 p refs

Avail NTIS HC A15/MF A01

Differences in airworthiness requirements were found to cause substantial cost increases particularly for civil application of military helicopters The effects of these differences are discussed by examing the civil certification programs of various military helicopters Author

**N78-19156*#** National Aeronautics and Space Administration, Washington, D C
**LOW CYCLE FATIGUE IN TURBINES**
M Brun Mar 1978 23 p refs Transl into ENGLISH from Fatigue Oligocyclique dans les Turbomachines Mecanique Materiaux Elec (France), no 323-324, Nov -Dec 1976 p 42-50 Transl by Kanner (Leo) Associates, Redwoood City, Calif
(Contract NASw-2790)
(NASA-TM-75264) Avail NTIS HC A02/MF A01 CSCL 21E

Behavior of certain components at low-cycle fatigue is a parameter related to the conditions of use of turbines, to the technology of engine production and to the precision of its regulation The laboratory takes this into account using data from sophisticated tests and rigorous analyses The production plan includes careful examination of possible causes of premature rupture This parameter has motivated the metallurgy industry to develop new materials and new technology Author

**N78-19157*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**PREDICTED INLET GAS TEMPERATURES FOR TUNGSTEN FIBER REINFORCED SUPERALLOY TURBINE BLADES**
Edward A Winsa Leonard J Westfall, and Donald W Petrasek 1978 23 p refs Presented at 2d Intern Conf on Composite Materials, Toronto, Canada 16-20 Apr 1978 sponsored by Am Inst of Mining, Metallurgical and Petroleum Engineers
(NASA-TM-73842) Avail NTIS HC A02/MF A01 CSCL 21E

Tungsten fiber reinforced superalloy composite (TFRS) impingement cooled turbine blade inlet gas temperatures were calculated taking into account material spanwise strength, thermal conductivity material oxidation resistance, fiber-matrix interaction, and coolant flow Measured values of TFRS thermal conductivities are presented Calculations indicate that blades made of 30 volume percent fiber content TFRS having a 12,000 N-m/kg stress-to-density ratio while operating at 40 atmospheres and a 0 06 coolant flow ratio could permit a turbine blade inlet gas temperature of over 1900K This is more than 150K greater than similar superalloy blades Author

**N78-19158*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**HIGH TEMPERATURE ENVIRONMENTAL EFFECTS ON METALS**
S J Grisaffe, C E Lowell and C A Stearns 1977 19 p refs Presented at 24th Sagamore Army Materials Res Conf Risk and Failure Analysis for Reliability Bolton Landing, N Y, 22-26 Aug 1977
(NASA-TM-73878) Avail NTIS HC A02/MF A01 CSCL 21E

The gas turbine engine was used as an example to predict high temperature environmental attack on metals Environmental attack in a gas turbine engine derives from high temperature, combustion products of the air and fuel burned and impurities Of all the modes of attack associated with impurity effects, hot corrosion was the most complicated mechanistically Solutions to the hot corrosion problem were sought semi-empirically in (1) improved alloys or ceramics (2) protective surface coating, (3) use of additives to the engine environment, and (4) air/fuel cleanup to eliminate harmful impurities J C S

**N78-19159*#** National Aeronautics and Space Administration, Washington, D C
**APPROXIMATE DYNAMIC MODEL OF A TURBOJET ENGINE**
O A Artemov Mar 1978 9 p refs Transl into ENGLISH from Samoletostr Tekh Vozdush Flota (USSR), no 40, 1976 p 34-37 Original language document announced as A77-32705 Transl by Kanner (Leo) Associates, Redwood City Calif
(NASA-TM-75263) Avail NTIS HC A02/MF A01 CSCL 21E

An approximate dynamic nonlinear model of a turbojet engine is elaborated on as a tool in studying the aircraft control loop, with the turbojet engine treated as an actuating component Approximate relationships linking the basic engine parameters and shaft speed are derived to simplify the problem, and to aid in constructing an approximate nonlinear dynamic model of turbojet engine performance useful for predicting aircraft motion Author

**N78-19162#** Naval Air Propulsion Test Center Trenton, N J Propulsion Technology and Project Engineering Dept
**EFFECT OF FUEL BOUND NITROGEN ON OXIDES OF NITROGEN EMISSION FROM A GAS TURBINE ENGINE**
**Interim Report**

Anthony F Klarman and Anthony J Rollo Dec 1977 33 p refs
(ZF57571004)
(AD-A048382 NAPC-PE-1) Avail NTIS HC A03/MF A01 CSCL 21/4

Fuels of varying nitrogen content were tested in a T63-A-5A engine to measure their effects on exhaust gas emissions Five test fuels varying in fuel bound nitrogen content from 3 microgram (nitrogen)/g (fuel) to 902 microgram (nitrogen)/g (fuel) were evaluated The nitrogen content in the fuel was adjusted by mixing a JP-5 type fuel derived from shale oil (902 microgram (nitrogen)/g (fuel)) and regular petroleum JP-5 fuel (3 microgram (nitrogen)/g (fuel)) Nitrogen content of the fuel had no effect on engine performance The carbon monoxide and unburned hydrocarbon emissions were equivalent for all the fuels included in the test program For the engine power ratings tested, the oxides of nitrogen emissions increased with increasing nitrogen content of the test fuel The conversion efficiency of fuel bound nitrogen to oxides of nitrogen appears to be independent of the nitrogen content of the fuel Difficulties in measuring small changes in oxides of nitrogen level resulting from low nitrogen content fuels (50 microgram nitrogen/g (fuel) or less) caused the conversion efficiency to be very variable The conversion efficiency for fuels with a nitrogen content of 250 microgram (nitrogen)/g (fuel) or greater was approximately 45 percent Author (GRA)

**N78-19163#** AiResearch Mfg Co, Phoenix Ariz
**FABRICATION AND TEST OF A FLUIDIC FUEL-CONTROL AND BLEED-AIR-LOAD-CONTROL SYSTEM FOR GAS TURBINE ENGINES Final Report, 25 Jul 1976 - 31 Aug 1977**
T S Thurston Dec 1977 41 p
(Contract DAAG39-76-C-0129)
(AD-A049039, AiResearch-41-1803A, HDL-CR-77-129-1) Avail NTIS HC A03/MF A01 CSCL 13/7

This program has produced a production fluidic fuel-control and bleed-air-load-control system which consists of a fuel control, a load valve and a temperature sensor Three sets of hardware were produced for use in a follow-on program This hardware will be subjected to acceptance tests on the Air Research Model GTCP 85-180 gas turbine engine The production system improved the steady-state performance over that demonstrated on the prototype control produced under the previous program The fluidic circuits were designed to perform within specification limits when operated at altitude as well as high and low temperature conditions Designs and drawings were modified wherever necessary to facilitate production The system underwent engine and fuel bench testing to confirm design improvement and performance As part of this testing a 50-hour endurance bench test of the fuel control was performed This test as well as the engine tests conducted identified minor problems with the fuel metering valve and the speed sensor which were easily corrected The appropriate design changes were incorporated into the production configuration The production fluidic fuel-control and bleed-air-load-control system performed satisfactorily meeting the program and engine requirements and is therefore recommended for follow-on program testing Author (GRA)

**N78-19164#** Bolt, Beranek, and Newman, Inc, Canoga Park, Calif
**SENSITIVITY OF AIRCRAFT RUNUP/COMMUNITY NOISE PREDICTIONS TO EXCESS GROUND ATTENUATION**
Thomas C Dunderdale Dec 1977 28 p refs
(Contract F33615-76-C-0528)
(AD-A049067 AMRL-TR-77-76) Avail NTIS HC A03/MF A01 CSCL 01/3

This study examines the sensitivity of aircraft ground runup noise predictions to the accuracy of excess ground attenuation algorithms presently used in NOISEMAP Day/Night Level (DNL) noise exposure contours were computed for one hour of single engine military power ground runup activity by F-4, C-131 and C-5 aircraft These aircraft were chosen since they have straight jet low bypass ratio fan and high bypass ratio fan engines The propagation algorithms studied were no excess ground attenuation, standard NOISEMAP excess attenuation, and NOISEMAP excess attenuation plus and minus one standard deviation of the field test data used to develop the present NOISEMAP algorithm This study clearly substantiates the need for further field measurements planned by AMRL in 1977 and 1978 to refine or modify the ground propagation algorithm and establish confidence in its accuracy GRA

**N78-19165#** Northrop Corp, Hawthorne Calif Structural Dynamics Research Dept
**A NON-GAUSSIAN GUST MODEL FOR AIRCRAFT RESPONSE ANALYSIS**
W S Pi and C Hwang 8 Feb 1978 36 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Jul 1978
(NOR-76-223) Avail NTIS HC A03/MF A01

The non-Gaussian model was created through a zero-memory transformation of a Gaussian process Single or multiple transformation parameters were used to control the severity and other statistical characteristics of the non-Gaussian process The composite nature of gust patches of various intensity was accounted for through the accumulative statistics Methods to predict the aircraft response statistics to the non-Gaussian gust model were developed by approximating the response integral as its Riemann sum Application of the probabilistic theory indicates that the statistical properties of response can be expressed in multifold integral forms and its moments can be expressed in explicit forms The response of Northrop F-5A aircraft subject to the non-Gaussian gust was formulated and the response statistics presented Author

**N78-19166*#** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif
**A PORTABLE DEVICE PARTICULARLY SUITED FOR USE IN STARTING AIR-START UNITS FOR AIRCRAFT Patent Application**
William R Rosier and George C Volk, inventors (to NASA) Filed 9 Mar 1978 15 p
(Contract NAS4-2272)
(NASA-Case-FRC-10113-1, US-Patent-Appl-SN-885066) Avail NTIS HC A02/MF A01 CSCL 01E

The invention is embodied in a device including (1) a DC circuit having a pair of terminal plugs, each plug being characterized by a first, second, and third terminal, (2) a pair of manually operable switches for connecting the first terminal of each of the plugs to the positive side of a voltage source, (3) a circuit lead connecting the second terminal of each plug to the negative side of said source (4) a pair of electrical cables adapted to connect the first and second terminals of each plug to an air-start unit, (5) means for connecting each of the cables between the first terminal of one plug and the third terminal of the other plug of the pair, and (6) a second pair of manually operable switches for selectively connecting the third terminal of each plug of the pair to the negative side of the voltage source whereby electrical continuity of each cable of the pair may be examined prior to being connected to an air-start unit NASA

**N78-19167#** Naval Air Engineering Center Lakehurst, N J Test Dept
**EVALUATION OF THE CVN 68/CVN 69 LAUNCHING SYSTEM Final Report, 16 Aug 1970 - 31 Mar 1976**
Michael A Manganello 28 Dec 1977 75 p refs
(AD-A049044 NAEC-94-1140) Avail NTIS HC A04/MF A01 CSCL 13/10

This report presents the final evaluation of the Integrated Catapult Control Station and associated catapult equipment for the CVN 68/CVN 69 launching system Evaluation testing was conducted on the TC13 Mod 1 catapult site The report delineates the deficiencies and discrepancies found in the CVN 68/CVN 69 launching system Implementation of the recommended changes to the deficient items would greatly improve operations and increase the reliability and maintainability of the catapults aboard the CVN 68/CVN 69 and later carriers with these innovations incorporated Author (GRA)

**N78-19168#** Air Force Inst of Tech, Wright-Patterson AFB, Ohio School of Engineering

**ANALYSIS AND DESIGN OF A COOLED SUPERCRITICAL AIRFOIL TEST MODEL M S Thesis**
Ray Glenn Pope, Jr Dec 1977 101 p refs
(AD-A048895, AFIT/GAE/AA/77D-11) Avail NTIS HC A06/MF A01 CSCL 20/4

A wind tunnel test model of a supercritical airfoil was designed to investigate the wall cooling effect on subsonic boundary layer stability A DSMA 523 airfoil section was employed The model was designed to have surface temperature instrumentation and a liquid nitrogen cooling system Heat transfer, aerodynamic loads and stresses, and instrumentation were analyzed for the proposed test conditions A computer program was developed to analyze the forced, convective heat transfer over a two-dimensional body with a constant wall temperature The program utilized an integral method to compute local Santon numbers Local heat flux and total heat flow were predicted for a Mach number of 0 7, Reynolds numbers of 0 923 x 10 to the 6th power and 1 673 x 10 to the 6th power and cooling ratios from 1 000 to 0 824 The stress analysis consisted of applying beam bending theory, along with some simplifying assumptions to the model Construction drawings and specified test conditions for Mach numbers of 0 3, 0 5 and 0 7 are included The proposed tests are to be conducted in the subsonic test section of the Trisonic Test Facility at Wright-Patterson AFB, Ohio Author (GRA)

**N78-19169#** Air Force Human Resources Lab , Brooks AFB, Tex
**DISPLAY AND SPEECH DEVICES FOR SIMULATOR INSTRUCTOR/OPERATOR STATION APPLICATIONS Final Report, Jun 1975 - Jun 1976**
Noel F Schwartz Dec 1977 18 p refs
(AD-A049247, AFHRL-TR-77-50) Avail NTIS HC A02/MF A01 CSCL 05/9

The Air Force Human Resources Laboratory (AFHRL) has the responsibility for research and development of advanced simulation techniques including more efficient and more effective Instructor Operator Stations (IOS) which would possibly use newly developed display devices and techniques and speech response/recognition devices This review was undertaken to become better acquainted with the state of the art of hardware devices which could be used for the IOS s of advanced aircraft training simulators and to provide some guidance in these devices to designers, specifiers and users of IOS's Attention focused mainly on display devices and speech response/recognition devices A survey of technical literature concerning display devices, and speech synthesis and speech recognition devices was accomplished and contacts were established with a number of manufacturers and developers of these devices to determine the latest developments and potential applications Also, literature was searched for R and D related to the application of such devices Some of the merits and shortcomings of a number of display devices (i e , cathode ray tubes (CRT) and alternative but similar devices) are discussed and descriptions of their operation are included Speech interaction with computers is also discussed in a similar manner It is concluded that new display devices will not significantly impact the general design or utilization of the IOS Advancement of speech recognition could have a significant impact, but development beyond present capabilities does not appear imminent Author (GRA)

**N78-19170#** Gulf and Western Applied Science Labs Waltham, Mass
**SENSORY MECHANISM MODELING Interim Report, 26 Jan 1976 - 20 Jul 1977**
Joshua Borah, Laurence R Young and Renwick E Curry Oct 1977 40 p refs
(Contract F33615-76-C-0039)
(AD-A049278, AFHRL-TR-77-70) Avail NTIS HC A03/MF A01 CSCL 06/16

The purpose of this study was to model human motion and orientation sensing mechanisms so that simulator motion cueing systems can be designed to take full advantage of the characteristics of these sensory mechanisms Individual models for vestibular, visual, tactile and proprioceptive sensors have been either adapted from previous modeling work or formulated from available psychophysical and neurophysiological data A literature search was conducted to help identify material in the area of mechanoreceptor systems and the resulting bibliography is included A composite model structure has been proposed, using a Kalman filter blending technique to integrate information from the different sensory modalities into a single estimate of state The Kalman filter represents the presumed function of neural central processing The model has been implemented in the form of a digital computer program, and promising preliminary results, in qualitative agreement with known responses, have been obtained using only vestibular model components Ongoing work is directed at exercising the nonvestibular modalities, performing thorough validation and exercise of the entire model, and extending the model where possible GRA

**N78-19208#** Air Force Inst of Tech , Wright-Patterson AFB, Ohio School of Engineering
**A GENERAL STUDY OF HYBRID COMPOSITE LAMINATES M.S. Thesis**
George D Brooks Dec 1977 65 p refs
(AD-A048364, AFIT/GAE/AA/77D-2) Avail NTIS HC A04/MF A01 CSCL 11/4

This thesis is a general study of hybrid composite laminates that includes application of a three dimensional stress analysis approximation technique based on equilibrium considerations and free edge effects Thermal residual stresses and effects of replacing lamina in a composite laminate with lamina composed of hybrid material were investigated Two types of 48 ply hybrid composite laminates were tested under tensile and flexure loading Results achieved experimentally for the moduli of elasticity were compared with values predicted by laminated plate theory and laminated beam theory Thermal residual stresses proved to be significant and worthy of due consideration in stress analysis of test specimens Hybridization, as studied appeared to have little effect on the overall properties of a laminate Hybrid composite laminates obey classical laminate theory and can, in certain ply configurations develop considerable free edge effect stresses Author (GRA)

**N78-19325*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**JET AIRCRAFT HYDROCARBON FUELS TECHNOLOGY**
John P Longwell, ed 1978 64 p Workshop held at Cleveland, Ohio, 7-9 Jun 1977
(NASA-CP-2033, E-9457) Avail NTIS HC A04/MF A01 CSCL 21D

A broad specification, referee fuel was proposed for research and development This fuel has a lower, closely specified hydrogen content and higher final boiling point and freezing point than ASTM Jet A The workshop recommended various priority items for fuel research and development Key items include prediction of tradeoffs among fuel refining distribution, and aircraft operating costs, combustor liner temperature and emissions studies, and practical simulator investigations of the effect of high freezing point and low thermal stability fuels on aircraft fuel systems Author

**N78-19326*#** Gordian Associates, Inc , New York
**COMPUTER MODEL FOR REFINERY OPERATIONS WITH EMPHASIS ON JET FUEL PRODUCTION. VOLUME 2: DATA AND TECHNICAL BASES Final Report**
Daniel N Dunbar and Barry G Tunnah 21 Feb 1978 55 p refs
(Contract NAS3-20620)
(NASA-CR-135334, Rept-1099-1) Avail NTIS HC A04/MF A01 CSCL 21D

The FORTRAN computing program predicts the flow streams and material, energy, and economic balances of a typical petroleum refinery, with particular emphasis on production of aviation turbine fuel of varying end point and hydrogen content specifications The program has provision for shale oil and coal oil in addition to petroleum crudes A case study feature permits dependent cases to be run for parametric or optimization studies by input of only the variables which are changed from the base case The report has sufficient detail for the information of most readers Author

**N78-19362#** Hughes Aircraft Co Fullerton, Calif Ground Systems Group

**HIGH RESOLUTION, HIGH BRIGHTNESS COLOR TELEVISION PROJECTOR: ANALYSIS, INVESTIGATIONS, DESIGN, PERFORMANCE OF BASELINE PROJECTOR Final Report, Jul. 1976 - Mar. 1977**

P C Baron, E R Charles, D E Sprotbery, and D B Jorgensen Sep 1977 134 p ref

(Contract F33615-76-C-0040, AF Proj 6114)

(AD-A049279, AFHRL-TR-77-33(1)) Avail NTIS HC A07/MF A01 CSCL 14/2

This study addressed the problem of establishing the feasibility of, and defining, a high performance color television projector to be used in optically mosaicked, computer image generator (CIG) driven wide-field-of-view simulators Based on verbal briefing, reviewing documentation and a visit to the Advanced Simulator for Pilot Training (ASPT) at Williams AFB, the RFP requirements were interpreted, refined and prioritized The survey task reviewed the extant state-of-the-art in display technology for techniques which held promise of meeting the RFP requirements Based on this task, it was concluded that only the liquid crystal light valve (LCLV) technology had a chance to do so, however, its performance needed to be upgraded significantly from the then current state A systematic investigation of all components contributing to projector operation was therefore undertaken The lamp, illumination system, polarizing beamsplitter, dichroics, LCLVs, CRT, deflection system projection lens and screen were all subjected to a systematic test/analysis cycle, and improvements were made as required Samples were obtained, tested and analyzed, breadboards were built and tested, and detailed studies were conducted Subcontract studies were let, to investigate the dichroics and the projection lens The latter was a major effort by Kollmorgen Corp Tradeoffs were generated relating brightness to color purity/range, light falloff to pilot head motion, and resolution to CRT spot size and projection lens cost Components were then selected (or specified) to result in an RFP-compliant system which yielded minimum overall risk The projector was defined in detail GRA

**N78-19517#** Honeywell, Inc , Hopkins, Minn Defense Systems Div

**HYDRAULIC CONSTANT RECOIL PROGRAM Final Report, 28 Jun. 1974 - 30 Apr 1977**

Robert Gartner 18 Nov 1977 125 p

(Contract DAAA09-74-C-2077)

(AD-A049313 HONEYWELL-47212) Avail NTIS HC A06/MF A01 CSCL 13/7

The design, development and testing of a test prototype hydraulic servo recoil system that reduces the recoil forces of the 20mm M197 gatling gun to near-constant levels is described The system concept, system implementation and engineering, preflight and flight test on board an AH-1G helicopter are summarized Preliminary conclusions are that the vibrations in the helicopter resulting from gun firing are virtually eliminated Author (GRA)

**N78-19553** Purdue Univ , Lafayette, Ind

**ANALYSIS OF SINGLE AND DOUBLE COVERAGE AIRCRAFT MULTISPECTRAL SCANNER ARRAYS FOR POSITIONAL DATA Ph.D Thesis**

Max Michael Ethridge 1977 317 p

Avail Univ Microfilms Order No 77-30073

The development of an analytical model for the restitution of multiply scanned multispectral scanner (MSS) digital data arrays was investigated A brief discussion concerning the potential mapping applications of aircraft MSS digital data was followed by a description of six geometric restitution techniques The six techniques, which include collinearity, piecewise polynomials, weighted mean, moving averages, meshwise linear interpolation, and Gauss-Markov models, were each used to restitute four strips of actual aircraft MSS digital data An analysis of the results obtained from considerable experimentation with the recently proposed Gauss-Markov model was also presented The restitution results from the six techniques provide input for a statistically based analysis involving analysis of variance and Newman-Keuls techniques By considering the results of the statistical analysis together with subjective factors the three most suitable techniques were found Dissert Abstr

**N78-19713*** Alden Electronic and Impulse Recording Equipment Co , Washington, D C

**AVIATION WEATHER SERVICE REQUIREMENTS, 1980 - 1990**

Newton A Lieurance *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 18-26

Avail NTIS HC A15/MF A01 CSCL 04B

Future aviation weather needs are discussed Priority weather requirements and deficiencies existing for weather observations and forecast services in terminal areas are presented Needs in en route operations up to 30 km are addressed with emphasis on turbulence, presence of suspended ice and water particles, SST to supersonic speeds, solar radiation, ozone and sonic booms Some conclusions are drawn and recommendations are presented G Y

**N78-19714*** National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala

**OVERVIEW OF NASA/MARSHALL SPACE FLIGHT CENTER'S PROGRAM ON KNOWLEDGE OF ATMOSPHERIC PROCESSES**

Dennis W Camp *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 28-40 refs

Avail NTIS HC A15/MF A01 CSCL 04A

The Marshall Space Flight Center (MSFC) is charged with the responsibility to enhance aviation safety through improving understanding of various atmospheric phenomena A brief discussion is presented concerning the tasks and work being accomplished by MSFC The tasks are defined as follows (1) to determine and define the turbulence and steady wind environments induced by buildings, towers hills, trees, etc , (2) to identify, develop, and apply natural environment technology for the reconstruction and/or simulation of the natural environment for aircraft accident investigation and hazard identification, (3) to develop basic information about free atmosphere perturbations, (4) to develop and apply fog modification mathematical models to assess candidate fog modification schemes and to develop appropriate instrumentation to aquire basic data about fog To accomplish these tasks MSFC has developed a program involving field data acquisition, wind tunnel studies, theoretical studies, data analysis and flight simulation studies Author

**N78-19715*** National Oceanic and Atmospheric Administration, Rockville Md

**AN OVERVIEW OF AVIATION WEATHER SERVICES**

John W Connolly *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 41-48

Avail NTIS HC A15/MF A01 CSCL 04B

Safety of flight is the first concern of the aviation weather service, the economics of air transportation is a second major interest Weather is a significant causal factor impacting on the efficiency of air transportation A discussion is presented on the functions of various weather service agencies as they relate to one another in the dissemination of information to the pilot and to the air traffic controller Improvements in the aviation weather service and weather knowledge are cited as future goals The weather service at the present time is an efficient system but future aviation objectives dictate more improvements are needed (especially in automation technology) to enhance flight planning and for safe and efficient flight execution G Y

**N78-19717*** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

**AIRPLANE DESIGN FOR GUSTS**

John C Houbolt *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 58-71 refs

Avail NTIS HC A15/MF A01 CSCL 01C

*There are two basic approaches used for the structural design* of aircraft due to dust encounter One is a discrete gust approach, the other is based on power spectral techniques Both of these approaches are explained in this report Tacit to the above approaches is the assumption that loading on the airplane arises primarily from vertical gusts A study of atmospheric turbulence was made not only on the vertical component, but on the *longitudinal and transverse gust components as well An analysis* was made to establish the loads that develop when explicit consideration is given to both the vertical and head-wind components The results are reported Also included in this report are brief comments on gust effects during approach and landing G Y

**N78-19718*** Federal Aviation Administration Washington, D C
**A SYNOPSIS OF THE WEATHER PROBLEMS FACING TODAY'S GENERAL AVIATION PILOTS**
James C Pope *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 72-82

Avail NTIS HC A15/MF A01 CSCL 04B

Concentration on weather to data has primarily been at the point of observation There have been efforts to obtain and disseminate en route weather through pilot reports (PIREPS), but the efforts have been meager What is needed is the cooperative efforts on the application of technology to the *acquisition and dissemination of the en route weather data for* those pilots in the air as well as those who are flight planning on the ground A comprehensive three-dimensional computer storage system is proposed that receives weather information from all aircraft on IFR flight plans and stores this information by altitude and geographic coordinates Also, a report on the Federal Aviation Administration's Research Engineering and Development Aviation Weather Program from the aspect of past, present and future is given G Y

**N78-19719*** National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala
**NASA'S AVIATION SAFETY RESEARCH AND TECHNOLOGY PROGRAM**
George H Fichtl *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 83-102 refs

Avail NTIS HC A15/MF A01 CSCL 01B

Aviation safety is challenged by the practical necessity of compromising inherent factors of design, environment and operation *If accidents are to be avoided these factors must be* controlled to a degree not often required by other transport modes The operational problems which challenge safety seem to occur most often in the interfaces within and between the design, the environment and operations where mismatches occur due to ignorance or lack of sufficient understanding of these interactions Under this report the following topics are summarized (1) *The nature of operating problems* (2) NASA *aviation safety* research, (3) clear air turbulence characterization and prediction, (4) CAT detection (5) Measurement of Atmospheric Turbulence (MAT) Program, (6) Lightning, (7) Thunderstorm gust fronts, (8) Aircraft ground operating problems (9) Aircraft fire technology, (10) Crashworthiness research (11) Aircraft wake vortex hazard research and (12) Aviation safety reporting system Author

**N78-19722*** Airline Pilots Association, Denison Tex
**PROBLEMS PILOTS FACE INVOLVING WIND SHEAR**
W W Melvin *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 175-187 refs

Avail NTIS HC A15/MF A01 CSCL 04B

Educating pilots and the aviation industry about wind shears presents a major problem associated with this meteorological phenomenon The pilot s second most pressing problem is the need for a language to discuss wind shear encounters with other pilots so that the reaction of the aircraft to the wind shear *encounter can be accurately described Another problem is the* flight director which gives a centered pitch command for a given angular displacement from the glide slope It was suggested that they should instead be called flight path command and should not center unless the aircraft is actually correcting to the flight path J C S

***N78-19723*** *Boeing Aerospace Co , Seattle, Wash*
**WIND MODELS FOR FLIGHT SIMULATOR CERTIFICATION OF LANDING AND APPROACH GUIDANCE AND CONTROL SYSTEMS**
Dwight R Schaeffer *In* Tennessee Univ Space Inst Proc of the 1st Ann Meteorol and Environ Inputs to Aviation Systems Workshop Mar 1977 p 188-274 refs

Avail NTIS HC A15/MF A01 CSCL 17G

The definition of a model suitable for certification was the main objective of this report The model was designed to simplify and reduce the wind model parameters to enable evaluation of a large number of aircraft and control system design parameters Analytical descriptions of wind phenomena were presented For *those parameters defying analytic description, probabilistic* descriptions were sought A brief analysis of the effects of wind on aircraft motion was conducted The axes transformations required between wind and turbulence components in their inherent axis system and in the airplane s axis system were shown Techniques of providing a random process on computers for the representation of turbulence were presented A simulation *model was presented that combines all the foregoing compo*nents J C S

**N78-19778*#** National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
**FUTURE COMPUTER REQUIREMENTS FOR COMPUTATIONAL AERODYNAMICS**
Feb 1978 515 p refs Proceedings held at Moffett Field, Calif , 4-6 Oct 1977
(NASA-CP-2032 A-7291) Avail NTIS HC A22/MF A01 CSCL 09B

Recent advances in computational aerodynamics are discussed as well as motivations for and potential benefits of a National Aerodynamic Simulation Facility having the capability to solve fluid dynamic equations at speeds two to three orders of magnitude faster than presently possible with general computers Two contracted efforts to define processor architectures for such a facility are summarized

**N78-19779*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
**COMPUTATIONAL AERODYNAMICS AND THE NUMERICAL AERODYNAMIC SIMULATION FACILITY**
Victor L. Peterson *In its* Future Computer Requirements for Computational Aerodynamics Feb 1978 p 5-30

Avail NTIS HC A22/MF A01 CSCL 09B

Technical and economic reasons for accelerating the maturation of the discipline of computational aerodynamics include the cost of conducting the experiments required to provide the empirical data base for new aeronautical vehicles and the limitations in test facilities (Reynolds number, wall and support interferences, aeroelastic distortions, real-gas effects, etc ) for simulating the full-scale vehicle environment General purpose computers do not have the necessary capability for the next stage of development Solution of the three dimensional Reynolds averaged Naiver-Stokes equations in a short time to be practical for design purposes will require 40 times the power of current supercomputers However, it is feasible to construct a special purpose processor that will meet these requirements to enhance the nation's aerodynamic design capability in the 1980's Author

**N78-19784*#** Boeing Co Seattle Wash
**COMPUTATIONAL AERODYNAMICS REQUIREMENTS. THE FUTURE ROLE OF THE COMPUTER AND THE NEEDS OF THE AEROSPACE INDUSTRY**
Paul E Rubbert *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 81-90
Avail NTIS HC A22/MF A01 CSCL 09B

The commercial airplane builder's viewpoint on the important issues involved in the development of improved computational aerodynamics tools such as powerful computers optimized for fluid flow problems is presented The primary user of computational aerodynamics in a commercial aircraft company is the design engineer who is concerned with solving practical engineering problems From his viewpoint, the development of program interfaces and pre-and post-processing capability for new computational methods is just as important as the algorithms and machine architecture As more and more details of the entire flow field are computed, the visibility of the output data becomes a major problem which is then doubled when a design capability is added The user must be able to see, understand, and interpret the results calculated Enormous costs are expanded because of the need to work with programs having only primitive user interfaces Author

**N78-19785*#** General Dynamics/Fort Worth Tex
**REMARKS ON FUTURE COMPUTATIONAL AERODYNAMICS REQUIREMENTS**
R G Bradley and I C Bhateley *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 91-101
Avail NTIS HC A22/MF A01 CSCL 09B

The development of upgraded and expanded computational aerodynamics methods for the design and analysis of aircraft configurations should be performed by both government and industry to ensure that the objectives for aircraft design are satisfied from both the industrial competitive design standpoint and from the government standpoint Any programs developed must be heavily user-oriented and provide maximum visibility and creditability to management Early consideration should be given to the adequate management of such a facility when it becomes available Author

**N78-19786*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
**FUTURE REQUIREMENTS AND ROLES OF COMPUTERS IN AERODYNAMICS**
Thomas J Gregory *In its* Future Computer Requirements for Computational Aerodynamics Feb 1978 p 102-107

Avail NTIS HC A22/MF A01 CSCL 09B

While faster computers will be needed to make solution of the Navier-Stokes equations practical and useful, most all of the other aerodynamic solution techniques can benefit from faster computers There is a wide variety of computational and measurement techniques, the prospect of more powerful computers permits extension and an enhancement across all aerodynamic methods, including wind-tunnel measurement It is expected that, as in the past, a blend of methods will be used to predict aircraft aerodynamics in the future These will include methods based on solution of the Navier-Stokes equations and the potential flow equations as well as those based on empirical and measured results The primary flows of interest in aircraft aerodynamics are identified, the predictive methods currently in use and/or under development are reviewed and two of these methods are analyzed in terms of the computational resources needed to improve their usefulness and practicality Author

**N78-19787*#** Lockheed-Georgia Co , Marietta
**PROJECTED ROLE OF ADVANCED COMPUTATIONAL AERODYNAMIC METHODS AT THE LOCKHEED-GEORGIA COMPANY**
Manuel E Lores *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 108-120
Avail NTIS HC A22/MF A01 CSCL 09B

Experience with advanced computational methods being used at the Lockheed-Georgia Company to aid in the evaluation and design of new and modified aircraft indicates that large and specialized computers will be needed to make advanced three-dimensional viscous aerodynamic computations practical The Numerical Aerodynamic Simulation Facility should be used to provide a tool for designing better aerospace vehicles while at the same time reducing development costs by performing computations using Navier-Stokes equations solution algorithms and permitting less sophisticated but nevertheless complex calculations to be made efficiently Configuration definition procedures and data output formats can probably best be defined in cooperation with industry, therefore, the computer should handle many remote terminals efficiently The capability of transferring data to and from other computers needs to be provided Because of the significant amount of input and output associated with 3-D viscous flow calculations and because of the exceedingly fast computation speed envisioned for the computer, special attention should be paid to providing rapid, diversified, and efficient input and output Author

**N78-19788*#** ARO, Inc , Arnold Air Force Station, Tenn
**COMPUTATIONAL AERODYNAMICS REQUIREMENTS IN CONJUNCTION WITH EXPERIMENTAL FACILITIES**
J Leith Potter and John C Adams *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 121-131

Avail NTIS HC A22/MF A01 CSCL 09B

The importance computational aerodynamics in improving quality and efficiency in production of information at a wind tunnel test center is discussed Some principal applications of the calculations are to extend or clarify the understanding of experimental data, particularly when wind tunnel or scaling limitations prevent attainment of all conditions of interest, and to furnish on-line or near-on-line math-model results or other comparative data needed for test direction Author

**N78-19789*#** Boeing Co , Seattle, Wash
**COMPUTATIONAL FLUID DYNAMICS (CFD)· FUTURE ROLE AND REQUIREMENTS AS VIEWED BY AN APPLIED AERODYNAMICIST**
H Yoshihara *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 132-142
Avail NTIS HC A22/MF A01 CSCL 20D

The problem of designing the wing-fuselage configuration of an advanced transonic commercial airliner and the optimization of a supercruiser fighter are sketched, pointing out the essential fluid mechanical phenomena that play an important role Such problems suggest that for a numerical method to be useful, it must be able to treat highly three dimensional turbulent separations, flows with jet engine exhausts, and complex vehicle configurations Weaknesses of the two principal tools of the aerodynamicist, the wind tunnel and the computer, suggest a complementing combined use of these tools, which is illustrated by the case of the transonic wing-fuselage design The anticipated difficulties in developing an adequate turbulent transport model suggest that such an approach may have to suffice for an extended penod On a longer term, experimentation of turbulent transport in meaningful cases must be intensified to provide a data base for both modeling and theory validation purposes Author

**N78-19791*#** McDonnell-Douglas Research Labs , St Louis, Mo
**VISCOUS FLOW SIMULATIONS IN VTOL AERODYNAMICS**
W W Bower *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 154-167 refs
(Contract N00014-76-C-0494)
Avail NTIS HC A22/MF A01 CSCL 01A

The critical issues in viscous flow simulations, such as boundary-layer separation, entrainment, turbulence modeling, and compressibility, are discussed with regard to the ground effects

problem for vertical-takeoff-and-landing (VTOL) aircraft A simulation of the two-dimensional incompressible lift jet in ground proximity is based on solution of the Reynolds-averaged Navier-Stokes equations and a turbulence-model equation which are written in stream function-vorticity form and are solved using Hoffman's augmented-central-difference algorithm The resulting equations and their shortcomings are discussed when the technique is extended to two-dimensional compressible and three-dimensional incompressible flows Author

**N78-19792*#** Air Force Flight Dynamics Lab, Wright-Patterson AFB, Ohio
**CRITICAL ISSUES IN VISCOUS FLOW COMPUTATIONS**

W L Hankey *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 168-175 refs
Avail NTIS HC A22/MF A01 CSCL 20D

In developing computer programs to numerically solve the Navier-Stokes equations, the purpose of the computation must be clearly kept in mind In the Air Force, the purpose is to provide design information on non-linear aerodynamic phenomenon for aircraft that perform throughout the flight corridor This translates into the requirement for a computer program which can solve the time averaged compressible Navier-Stokes equations (with a turbulence model) in three dimensions for generalized geometries The intended application of the results then controls the priorities in addressing critical issues Recurrent problem areas encountered in the study of viscous flow include (1) grid generation for arbitrary geometry, (2) numerical difficulties, (3) turbulence models, (4) accuracy and efficiency, and (5) smearing of discontinuities Author

**N78-19793*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
**VISCOUS FLOW SIMULATION REQUIREMENTS**
Julius E Harris *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 176-208 refs
Avail NTIS HC A22/MF A01 CSCL 20D

Although significant advances have been made in the simulation of two-dimensional compressible laminar viscous flows by numerically solving the compressible Navier-Stokes (N S) equations, problem areas still remain to be solved before viscous flows requiring solution of the compressible N S equations can be efficiently and accurately simulated for flows of aerodynamic interest These problem areas include turbulence (three-dimensional character), complex geometry, flow unsteadiness, placement of artificial boundaries relative to solid boundaries, specification of boundary conditions, and large flow gradients near surfaces and in the vicinity of shock waves for supersonic flows Author

**N78-19795*#** Georgia Inst of Tech, Atlanta
**PROSPECTS FOR COMPUTATIONAL AERODYNAMICS**

J C Wu *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 221-227 refs
Avail NTIS HC A22/MF A01 CSCL 01A

The integral representations approach, for the solution of the Navier-Stokes equations is discussed as well as experience in its development and in applying available finite-difference and finite-element techniques to the treatment of three-dimensional problems, and the computation of turbulent flow The magnitude of efforts required to develop turbulence models and three-dimensional algorithms indicates that the computational fluid dynamics research must have a broad base Broader access to modern computing facilities that are in existence within NASA should be promoted for active researchers not directly affiliated with that agency Author

**N78-19801*#** Tennessee Univ, Knoxville
**FINITE ELEMENT CONCEPTS IN COMPUTATIONAL AERODYNAMICS**

A J Baker *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 278-289 refs
(Contract NAS1-14307, Grants NsG-1261, NsG-1391)
Avail NTIS HC A22/MF A01 CSCL 09B

Finite element theory was employed to establish an implicit numerical solution algorithm for the time averaged unsteady Navier-Stokes equations Both the multidimensional and a time-split form of the algorithm were considered, the latter of particular interest for problem specification on a regular mesh A Newton matrix iteration procedure is outlined for solving the resultant nonlinear algebraic equation systems Multidimensional discretization procedures are discussed with emphasis on automated generation of specific nonuniform solution grids and accounting of curved surfaces The time-split algorithm was evaluated with regards to accuracy and convergence properties for hyperbolic equations on rectangular coordinates An overall assessment of the viability of the finite element concept for computational aerodynamics is made Author

**N78-19804*#** Colorado State Univ, Fort Collins Computer Science Dept
**REVIEW OF THE AIR FORCE SUMMER STUDY PROGRAM ON THE INTEGRATION OF WIND TUNNELS AND COMPUTERS**
Bernard W Marschner *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 326-334
Avail NTIS HC A22/MF A01 CSCL 09B

The present state of computational fluid dynamics and its impact on the design cycle and computer requirements for future developments in this field were explored The increase in productivity and efficiency which experimental facilities can achieve by a close integration with computers was investigated together with possible improvements in simulation quality of wind tunnels in conjunction with computer control Research experiments are outlined to provide a better understanding of the physics of fluid flow and to assist in the modeling of these phenomena for computational methods, with primary emphasis on turbulent flows Author

**N78-19805*#** IBM Research Lab, San Jose, Calif
**MULTIPROCESSING TRADEOFFS AND THE WIND-TUNNEL SIMULATION PROBLEM**
Tien Chi Chen *In* NASA Ames Res Center Future Computer Requirements for Computational Aerodynamics Feb 1978 p 335-342
Avail NTIS HC A22/MF A01 CSCL 09B

The architecture tradeoff issue is discussed, concentrating on an oversimplified version of the multiprocessing aspect A degree of symmetric multiprocessing is unavoidable, the choice is either complete symmetric multiprocessing or a number of identical pipelines The processing elements can be geared to do either plane-multiprocessing, or line-multiprocessing Other important design choices are the number notation, word length, main memory size, cache memory size, and different means to implement data transport Author

**N78-19814*#** Institute for Advanced Computation, Sunnyvale, Calif
**SPECIALIZED COMPUTER ARCHITECTURES FOR COMPUTATIONAL AERODYNAMICS**
David K Stevenson *In* NASA Ames Res Center Future *Computer Requirements for Computational Aerodynamics* Feb 1978 p 423-428
Avail NTIS HC A22/MF A01 CSCL 09B

In recent years, computational fluid dynamics has made significant progress in modelling aerodynamic phenomena Currently, one of the major barriers to future development lies in the compute-intensive nature of the numerical formulations and the relative high cost of performing these computations on commercially available general purpose computers, a cost high with respect to dollar expenditure and/or elapsed time Today's computing technology will support a program designed to create specialized computing facilities to be dedicated to the important

problems of computational aerodynamics One of the still unresolved questions is the organization of the computing components in such a facility The characteristics of fluid dynamic problems which will have significant impact on the choice of computer architecture for a specialized facility are reviewed
Author

**N78-19849#** Bolt Beranek, and Newman, Inc , Canoga Park, Calif
**NOISEMAP COMPUTER PROGRAM OPERATOR MANUAL ADDENDUM FOR VERSION 3 4 OF NOISEMAP**
Nicolaas Reddingius Wright-Patterson AFB, Ohio AMRL Dec 1977 14 p
(Contract F33615-76-C-0507)
(AD-A049070, AMRL-TR-77-75-Add) Avail NTIS HC A02/MF A01 CSCL 09/2

NOISEMAP is a computerized procedure for predicting contours of equal noise exposure around airbases It is routinely used to aid airbase planners to prevent community encroachment limiting the aircraft operational effectiveness of installations and for conducting environmental noise assessment studies This technical memorandum describes the four new features incorporated into version 3 4 of the NOISEMAP program These are new sideline noise exposure algorithm, estimation of maximum allowed cutoff for computation estimation of grid spacing on the basis of runway utilization, additions to the GPCP interface to make Compatible Use District Maps in the preferred format for USAF AICUZ analyses Author (GRA)

**N78-19868*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
**CONSERVATIVE IMPLICIT SCHEMES FOR THE FULL POTENTIAL EQUATION APPLIED TO TRANSONIC FLOWS**
Terry L Holst (Army Aviation R and D Command, Moffett Field, Calif ) and William F Ballhaus Mar 1978 37 p refs
(NASA-TM-78469, A-7338) Avail NTIS HC A03/MF A01 CSCL 12A

Implicit approximate factorization techniques (AF) were investigated for the solution of matrix equations resulting from finite difference approximations to the full potential equation in conservation form For transonic flows, an artificial viscosity required to maintain stability in supersonic regions, was introduced by an upwind bias of the density Two implicit AF procedures are presented and their convergence performance is compared with that of the standard transonic solution procedure, successive line overrelaxation (SLOR) Subcritical and supercritical test cases are considered The results indicate that the AF schemes are substantially faster than SLOR Author

**N78-19898*#** National Aeronautics and Space Administration Pasadena Office, Calif
**RESOLUTION ENHANCED SOUND DETECTING APPARATUS Patent Application**
James M Kendall, inventor (to NASA) (JPL) Filed 16 Dec 1977 10 p
(Contract NAS7-100)
(NASA-Case-NPO-14134-1, US-Patent-Appl-SN-861392) Avail NTIS HC A02/MF A01 CSCL 20A

The acuity of an acoustic mirror and microphone system is increased in order to precisely detect the location of a noise source, such as that created by an airframe in a wind tunnel, or by machinery The apparatus which includes mirror which reflects sound from a source to a microphone, can be shifted until the noise detected by microphone is loudest, to determine the precise location from which the sound originates An enclosure is positioned around the mirror and is filled with a heavy gas such as Freon The sound waves move slower in the heavy gas than in air, so the wavelength of sound waves is shorter, and the mirror can more accurately focus the sound waves onto the microphone A pair of thin sheets in front of the mirror is pressed apart by slightly pressured air between them so that all light rays pass perpendicular to the interface between the air in front of the wall and the Freon gas behind wall and are not refracted by the Freon gas NASA

**N78-19899*#** General Electric Co , Cincinnati, Ohio Advanced Engineering and Technology Dept
**EVALUATION OF THE IN-FLIGHT NOISE SIGNATURE OF A 32-CHUTE SUPPRESSOR NOZZLE: ACOUSTIC DATA REPORT**
M T Moore and V L Doyle Nov 1977 438 p refs
(Contract NAS2-9312)
(NASA-CR-152076) Avail NTIS HC A19/MF A01 CSCL 20A

Outdoor static and 40 x 80 FT wind tunnel tests of the J79-15 engine/nacelle system with the conic nozzle and 32-chute exhaust suppressor were conducted to acquire the data necessary to evaluate the simulated in-flight signature of an engine-size 32-chute exhaust nozzle suppressor using the 40 x 80 ft wind tunnel and to study possible engine core noise contamination of the jet signature The tests are described and and a sampling of the data acquired is presented Included are aero performance summaries, as-measured and composite 1/3 OBSPL spectra for the 70 ft sideline high and low mics from the outdoor static tests, sideline traverse spectra and internal noise measurements from both the outdoor static and the 40 x 80 ft wind tunnel tests
*Author*

**N78-20010#** Army Research and Technology Labs , Moffett Field, Calif
**ARMY AVIATION RDT AND E PLAN, SIXTH EDITION**
Oct 1977 372 p
(AD-A049214) Avail NTIS HC A16/MF A01 CSCL 01/3

This Plan presents a time-phased analysis and presentation of the scientific and technological R/D efforts required to support the development of advanced airmobile systems responsive to the future needs of the Army Plans and objectives are set forth for Army aviation research and development activities for FY78-97, with emphasis on the period from the present to 1982 Current R/D efforts in Army air mobility are directed primarily toward the development of a family of aircraft capable of vertical and short takeoffs and landings These aircraft will fulfill identified requirements in the land combat functions of mobility, intelligence, firepower, combat service support, and command control, and communications The Airmobile Systems section of the Plan is aligned to present the operational systems, developing systems, and R/D planning concepts as an element of the land combat functions of mobility, intelligence, firepower, combat service support, and command, control and communication rather than as individual systems The Technology sections present the research effort needed assuming no constraints on resources, to develop the technology base necessary to support the airmobile system concepts The Technology sections also provide a discussion of program planning and include the philosophy for the development of technical thrusts for the individual technologies The Plan covers RDT/E activities (6 1 through 6 7 program categories) and also MM/T activities, which are normally part of Procurement of Equipment and Missiles-Army (PEMA) GRA

**N78-20011#** Army Research and Technology Labs , Moffett Field, Calif
**ARMY RESEARCH AND TECHNOLOGY LABORATORIES, FY 1977 Annual Report**
1977 54 p
(AD-A049212) Avail NTIS HC A04/MF A01 CSCL 01/3

The U S Army Research and Technology Laboratories (RTL) perform the air mobility R and D efforts of the U S Army Aviation Research and Development Command (AVRADCOM) The capabilities of their staff of research, engineering, and support personnel span the sciences, disciplines, and technologies of Army aviation GRA

**N78-20012#** Army Research and Technology Labs , Moffett Field, Calif
**ARMY AVIATION RDT AND E PLAN SIXTH EDITION. EXECUTIVE SUMMARY**
Oct 1977 23 p
(AD-A049213) Avail NTIS HC A02/MF A01 CSCL 01/3
For abstract, see N78-20010

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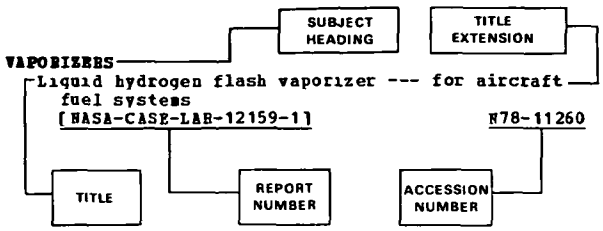


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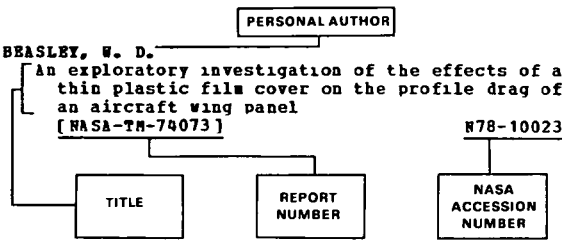


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