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Supplement 81

MARCH 1977

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 81

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

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

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

This supplement to *Aeronautical Engineering -- A Special Bibliography* (NASA SP-7037) lists 310 reports, journal articles, and other documents originally announced in February 1977 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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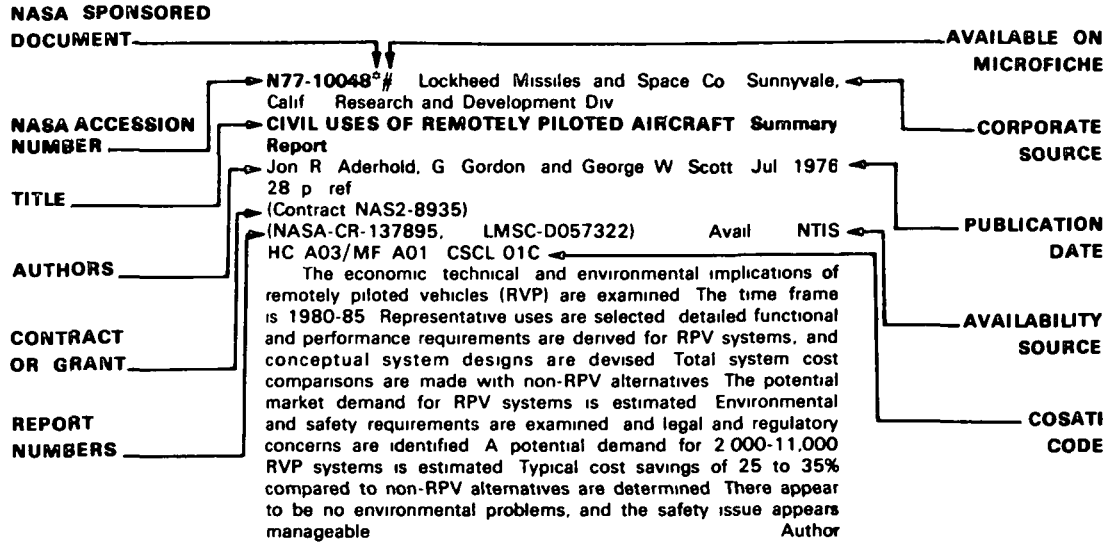

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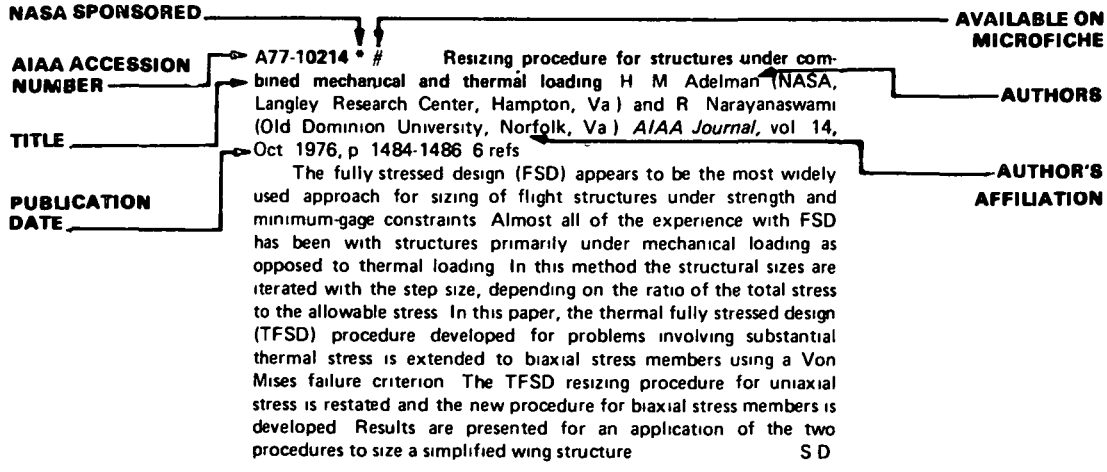

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 81)

MARCH 1977

IAA ENTRIES

A77-12978 # **Experimental data recording on cassette recorders, taking into account a use of commercial grade FM components (Messdatenaufzeichnung auf Kassettenrekorder unter Verwendung handelsublicher FM-Bausteine)** H J Klewe (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Symposium uber Telemetrie-Messdatenerfassung, Echtzeitdatenreduzierung und -speicherung, Munich, West Germany, June 23, 24, 1976, Paper 76-138* 5 p In German

Certain difficulties related to flight tests involving glider and light aircraft can be overcome by employing commercial grade cassette recorders for the onboard recording of the test data A description is presented of flight tests involving the use of a stereo cassette recorder model It was found that fluctuations in the speed of the recorder had to be compensated Attention is given to the approaches and devices which had to be employed to make a use of the cassette recorder for flight tests possible G R

A77-12981 # **Experimental data organization and experimental data processing in the flight tests of the Alpha Jet prototypes (Messdatenorganisation und Messdatenaufbereitung bei den Flugversuchen der Alpha-Jet-Prototypen)** H Friedrich, E Junke, P Kuhl, and L Platzoder (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Telemetrie-Messdatenerfassung, Echtzeitdatenreduzierung und -speicherung, Munich, West Germany, June 23, 24, 1976, Paper BS-86/76* 38 p In German

A description is given of the processing of the experimental data as a connecting link between flight test and the evaluation studies conducted in the technical departments The characteristics of the data-processing procedures are illustrated with the aid of an example involving the Alpha Jet aircraft A telemetry processing system is employed in connection with the flight tests The data which are transmitted to the ground station are recorded on magnetic tape The usable part of the data is sent to the technical departments of the French and German aerospace companies participating in the project for a detailed analysis Attention is given to the data acquisition system, details concerning the data formats employed, data compaction techniques, the synchronization of experimental data, and operational aspects of flight test evaluation G R

A77-12985 # **Acceleration-proof telemetry for the testing of aircraft propellers, turbines, and helicopter rotors (Beschleunigungsfeste Telemetrie fur die Erprobung von Flugzeugpropellern, Turbinen und Hubschrauberrotoren)** H Volland (Raumfahrtelektronik GmbH und Co , Goggenhofen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Telemetrie-Messdatenerfassung, Echtzeitdatenreduzierung und -speicherung, Munich, West Germany, June 23, 24, 1976, Paper* 16 p In German

The objectives and characteristics of telemetry are briefly examined A description is given of telemetry devices of modular design which can be adapted within wide limits to different application-related requirements Attention is given to mobile telemetry encoders, stationary telemetry encoders, and aspects of telemetry reproduction Examples concerning the application of telemetry are related to a helicopter rotor, aircraft propellers, gear operation, the superconducting rotor of a generator, a steam engine, and a revolving furnace for the production of concrete G R

A77-13048 # **A method for studying the aeroelastic stability of shallow shells in the flow of an incompressible fluid (Metod issledovaniia aerouprugoi ustoichivosti pologikh obolochek, obtekaemykh potokom neszhimalmoi zhidkosti)** L N Pokrovskii (Moskovskii Vechernyi Metallurgicheskii Institut, Moscow, USSR) *Prikladnaia Mekhanika,* vol 12, July 1976, p 70-77 In Russian

The vibrations and stability of shallow shells in the potential flow of an ideal incompressible fluid are examined The method of investigation is based on the analysis of integrals associated with the determination of aerodynamic pressure on the shell Two stability problems are discussed (1) that of a very long flat plate stretched at the midsurface, and (2) that of a rectangular membrane with finite detachment of its sides B J

A77-13171 **Some ergonomic aspects of cockpit panel design for airline aircraft** F Hawkins *Shell Aviation News,* no 437, 1976, p 2-9 21 refs

Cockpit panel design based on ergonomic principles, and many typical problems faced by crew members with occasional or even constant familiarization with cockpit panels of particular types, are discussed Glareshield panel placement, panel cutouts, how to avoid accidental switching, parallax and vision cutoff problems, obscuring of lettering by knobs or levers, and problems with too little or too glaring light in the cockpit are discussed, in addition to coding of knobs by shape, and knob motion and its relation to motion of the actuated system A check list diagram is presented for a typical cockpit panel bay Problems with roof panels, recessed panels, recognition time with upper case or lower case lettering, sweep-on or forward-on variants of switching lever and knob arrangement, and problems with pushbutton controls are discussed R D V

A77 13172 **Towards the Starflex concept** R Mouille (Societe Nationale Industrielle Aerospatiale, Paris, France) *Shell Aviation News,* no 437, 1976, p 10-13

Variants of articulated helirotor head design (Alouette, NAT, MIR, Biflex, Starflex, Triflex) are considered, and a more detailed presentation is made of the Starflex variant, in which both drag hinge and flapping hinge are eliminated and only the feathering hinge is retained The Starflex rotor head features a drastic reduction in number of parts, a self lubricated self aligning bearing at the end of the flexible arm, 45 percent weight reduction, 50 60 percent cost reduction, minimal maintenance, no ball or needle bearings, and no lubrication requirements The rotor disk tilt is appreciably damped in flight, with stability gain in hover and forward flight, elimination of pitch-up, and absence of flapping-pitch geometric coupling in the pitch control linkage Further simplification can be achieved using a fork type blade root The flight envelope of a Gazelle rotorcraft using a Triflex rotor head is reported R D V

A77-13173 **Developing an automatic grade monitor for aviation fuels** J Whittle (Shell Research, Ltd , Chester, England) and I N M Hardy (Shell International Trading Co , England) *Shell Aviation News,* no 437, 1976, p 20-24

Development of a simple fail-safe automatic grade monitor device to identify a fuel system on site and shut the system down if an unacceptable fuel is admitted to the system is described, along with likely fuel storage and tankage errors and field installation Critical points where blunders are likely to occur are identified (overwing fuelling of an aircraft, release of fuel to wrong storage receptacle at an airport fuel storage depot, contamination of fuels in supply trucks) Worst-hazard mistakes and lesser-hazard or delayed-hazard mistakes are compared and characterized Some densitometers, pitot valves, and in-line valves useful for the purpose are described, along with field tests and float design Requirements for a fuel grade monitor for field use are outlined R D V

A77-13174 **A new approach to airport lighting inspection** R A Milward (British Airports Authority, London, England) *Shell Aviation News,* no 437, 1976, p 26-31

Timely and thorough pinpointing and recording of deficiencies and needed repairs in airport landing light and runway illumination patterns with the aid of a nose-mounted camera taking 70 mm photographs of the runway on color film during an approach are described Existing runway lighting and information coding patterns are reviewed along with existing inspection procedures A Rockwell Shrike Commander L500 with a Vinten Reconnaissance Camera type 360 (250-exposure magazine) in its nose is selected for the operation Problems readily detected by this procedure include interleaving faults (variations in brilliancies occurring in alternate luminaires), misaligned luminaires causing brilliancy discrepancies, VASIS faults (imbalance between VASIS units), growing crops or tall grass adversely affecting the output of units along the line of sight to the descent path R D V

A77-13175 **Developing a cascade thrust reverser** S P Kolb (Continental Airlines, Inc , Los Angeles, Calif) *Shell Aviation News,* no 437, 1976, p 32 36

Successful tests of cascade type thrust reversers on Boeing 727 commercial aircraft are reported Problems with earlier thrust reversal arrangements are outlined, along with some improvements Severe fatigue loading leading to high failure rates are reported, with tests to determine drag penalties and endurance of the cascade type Criteria justifying retrofit programs are outlined, along with guidelines for maintenance cost reduction, fuel savings through weight reduction, lower operating costs through a reduction of spare parts for thrust reverser assemblies, and sales of serviceable hardware to companies not converting to cascade type thrust reversers Trouble-free operation and pilot acceptance are reported for the cascade type thrust reversers, while the breakeven cost of the retrofit program is achieved in less than two years R D V

A77-13289 **Effect of spectrum type on fatigue crack growth life** J A Reiman, M A Landy, and M P Kaplan (USAF, Structures Div , Wright-Patterson AFB, Ohio) In Fatigue crack growth under spectrum loads, Proceedings of the Symposium, Montreal, Canada, June 23, 24, 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 187-202 13 refs

A key requirement in damage tolerance analysis of a new aircraft is the type of fatigue loading spectrum to be used, where the exact methodology to derive the spectrum is presently ill-defined The paper describes methods of deriving loading spectra which can be used in the preliminary phases of airframe design The effect on crack growth life of varying certain important parameters is assessed These parameters include various sequences and cycle counting methods Sequencing effects comprise block loading or randomizing the loads on a mission segment or flight-by-flight basis It is shown that flight-by-flight spectra appear to result in a more conservative life estimate than block spectra if proper cycle counting procedures are used A randomized flight-by-flight spectrum is found to yield repeatable results independent of the exact random sequence S D

A77-13291 * **Crack growth in Ti-8Al-1Mo-1V with real-time and accelerated flight-by flight loading** L A Imig (NASA, Langley Research Center, Hampton, Va) In Fatigue crack growth under spectrum loads, Proceedings of the Symposium, Montreal, Canada, June 23, 24, 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 251-264 14 refs

Crack growth in Ti-8Al-1Mo-1V was measured and calculated for real-time and accelerated simulations of supersonic airplane loading and heating Crack-growth rates calculated on the assumption that an entire flight could be represented by a single cycle predicted the experimental rates poorly Calculated crack-growth rates were slower than the experimental rates for all tests with flight by-flight loading For room-temperature accelerated tests, the calculated rates agreed well with the experimental rates, but the calculations became progressively less accurate for progressively more complex test conditions (tests that included elevated temperature) Calculations of crack growth using the crack-closure concept can probably be improved through study of crack-opening stresses using finite-element models that account for variable-amplitude loading, residual stresses, and temperature effects The calculations of crack growth could also be improved through detailed studies of material properties and interactions among stress, temperature, and time as appropriate for the real time operating conditions of a supersonic transport airplane (Author)

A77-13293 **Structural reliability prediction method considering crack growth and residual strength** S R Varanasi and I C Whittaker (Boeing Commercial Airplane Co , Seattle, Wash) In Fatigue crack growth under spectrum loads, Proceedings of the Symposium, Montreal, Canada, June 23, 24, 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 292-305 8 refs

An analysis method to estimate structural reliability based on crack growth and residual strength of aircraft structures is presented The method is based on linear elastic fracture mechanics theory and allows for the variability of crack initiation and growth found in the experimental data of various metals At a reference stress intensity factor, the central tendency and the variance values of material crack-growth parameters are determined Combinations of these parameters are selected by Monte Carlo simulation techniques, and are used to describe the characteristically stochastic behavior of crack growth in a material This description of material crack growth behavior is then applied to the typical case of the built-up skin stringer configuration of fail-safe type airplane structures to predict the number and size of cracks in a fleet at any time during its life Thus, inspection routines may be established, based on realistic fleet performance, to provide suitable levels of structural reliability for a fleet of airplanes during its operational lifetime (Author)

A77-13295 **Spectrum fatigue crack growth in lugs** L F Impellizzeri and D L Rich (McDonnell Aircraft Co , St Louis, Mo) In Fatigue crack growth under spectrum loads, Proceedings of the Symposium, Montreal, Canada, June 23, 24, 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 320-336 15 refs

The paper presents empirical crack growth characteristics for a 6Al-4V annealed titanium lug subjected to a typical fighter aircraft flight-by-flight fatigue spectrum, and compares these spectrum crack growth test results to analytical calculations A number of the specimens were cold worked by mandrel hole enlargement to produce compressive residual stresses around the lug hole to retard

crack growth Comparisons of the crack growth life for the lug specimens revealed a potent beneficial effect due to cold working An approximate weight function for a hole is developed to compute stress intensities for different stress distributions surrounding the lug hole The Wheeler (1971) plastic zone model is used to determine crack growth retardation due to periodically applied higher load levels The crack growth predictions are found to correlate well with the spectrum test data obtained by SEM examinations of the lug fracture surfaces S D

A77 13331 **The Boeing 7N7 and 7X7 families** *Interavia,* vol 31, Nov 1976, p 1057-1059

A preliminary report is presented on two Boeing product families for the next decade Powerplants, seating layouts, wing planform, and cockpit systems for passenger aircraft of either system are indicated No firm decision has been made on what type of high-bypass-ratio engine will be installed, and twin jet and tri-jet variants are still under consideration Higher aspect ratios and advanced airfoil sections are described Various seating layouts (single aisle or two, six or seven abreast, 180 to 220 passengers) are described and illustrated Test results on aerodynamic performance, propulsion and engine noise, flap and door structures, flutter, and digital automatic flight controls are indicated Wing and nacelle configurations were tested with flaps down and at cruise Mach numbers Some remarks on international cooperation in the design project are added R D V

A77-13352 # **Aircraft longitudinal control combined with direct lift control (Prodelne rizeni letounu spojene s primym rizenim vztlaku)** V Pokorny *Zpravodaj VZLU,* no 3, 1976, p 175-181 In Czech

The paper describes the main characteristics of steady and quasi steady aircraft flight with longitudinal control coupling the control lever displacement with the displacement of the lift flap It is shown that such an arrangement may considerably improve the control qualities of the aircraft, increasing the velocity range and accelerating the reaction during flight direction changes These possible advantages are discussed for the Z-37 agricultural airplane Coupling the spoiler to the control lever is also discussed as being promising for transport aircraft during landing P T H

A77-13353 # **Use of structural model specimens for verification of aircraft fatigue life (Prispevek k vyuziti konstrukcnich modelovych vzorky pri prukazu unavove zivotnosti letadel)** V Nejedly *Zpravodaj VZLU,* no 3, 1976, p 183-193 16 refs In Czech

The paper sets forth the principles of simulating significant design and technological parameters that influence the fatigue characteristics of aircraft structures A method for designing model test specimens for testing fatigue properties is described Guidelines for ensuring that test results can be applied to the prediction of properties of real structures are discussed Extensive fatigue testing of model specimens serves for estimating the shape and scatter characteristics of the fatigue curve An example of the modeling of a connecting element subjected to fatigue conditions in an aircraft is given P T H

A77-13354 # **Fatigue characteristics of selected aluminum alloy Z 42 4206-71 (Unavove charakteristiky vyberove hlinikove slitiny Z 42 4206-71)** V Nejedly and K Hendrych *Zpravodaj VZLU, no* 3, 1976, 195-204 12 refs In Czech

Basic fatigue data on a specially developed aluminum alloy of the type Al Cu Mg-Mn-Si Cr-Ti are given The alloy has enhanced technological properties in comparison with the usual Duraloy material, especially as regards extruded shapes The initial material for the preparation of test specimens was plastically deformed to 2 5% plastic elongation, which improved machinability The new alloy is destined for use in aircraft parts operating under severe fatigue conditions P T H

A77-13362 **Concorde at the airport** E R Major (British Airways, London, England) *Airport Forum,* vol 6, Oct 1976, p 23, 24, 26 30, 32 In English and German

Ground handling of Concorde at Heathrow (London) and at Bahrain is discussed with emphasis on speedy turnaround and avoiding loss on the ground of time gained in the air for passengers Summer peaking of passenger lists, bunching of schedules and services for airports at certain times of day and days of the week, extended waiting time on the ground (for boarding, baggage reclaim), organization of aircraft refurbishment, positioning of airport service vehicles around a parked Concorde, refueling problems (with the large number of tanks and valves taken into account), and baggage handling (check-in, loading, sorting, reclaim) are discussed Travel times to and from airports are considered, and data on seat loading factors for Concorde craft now in service are reported Detailed charts are provided on Concorde turnaround timetables and on airport service vehicle positioning R D V

A77-13496 **Two-dimensional aft bodies for minimum pressure drag in supersonic flow** P R Viswanath and R Narasimha (Indian Institute of Science, Bangalore, India) *Aeronautical Quarterly,* vol 27, Nov 1976, p 263-269 18 refs

The base pressure correlation proposed earlier by the authors, to take into account the effects of the boundary layer and of the boat tail angle, is utilised in the design of two-dimensional aft bodies for minimum drag in supersonic flow The general advantages of boat tailing are indicated and charts of optimum profile parameters and minimum drag are provided for use in preliminary design The effects on aft-body drag of possible reversion of the boundary layer at a sudden expansion are discussed, and the relevance of the optimum shapes found to the lifting case is indicated The calculated optimum geometry is in good agreement with the experimental results of Fuller and Reid (Author)

A77-13499 **An alternative analytical method for ground-effect aerofoils** T Kida and Y Miyai (Osaka Prefecture, University, Sakai, Japan) *Aeronautical Quarterly,* vol 27, Nov 1976, p 292-308 13 refs

An alternative analytical method is applied to interference problems of an aerofoil very close to the ground, such as a free surface, a solid wall, and a slipstream The method of matched asymptotic expansions on the small ground clearance is used in the governing integral equation and this analysis is different from Widnall and Barrows' analysis They used the matched asymptotic method in the differential equation To show that the present method is reasonable, the problem of a ground-effect aerofoil in uniform fluid flow is considered and it is found possible to obtain the same results as those of Widnall and Barrows for the case of small ground clearance By comparing with some earlier studies, it is found that the asymptotic method used with small ground clearance is valid for a clearance less than about 0 3 of the chord length Next, the interference of ground-effect aerofoils in the channel wall, in a free jet stream, and in a slipstream are examined, and it is found that the present method can be easily applied to these problems (Author)

A77 13544 **Vulnerability of advanced aircraft fuel to ballistic and simulated lightning threats** J R Lippert (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *International Journal of Hydrogen Energy,* vol 1, Oct 20, 1976, p 321-330

The Advanced Fuel Vulnerability program is aimed at assessing relative vulnerability and identifying hazards associated with advanced (all but natural petroleum) fuels to determine their feasibility for use in military aircraft Although primarily concerned with military aircraft, these hazards would also apply in limited degree to commercial aircraft The initial advanced fuel selected for testing was Liquid Hydrogen (LH2) In addition to assessing it as a candidate petroleum fuel alternate, these tests with LH2 (the coldest fuel under consideration) could reveal problems associated with a cryogenic fuel Initial survey tests reported herein compared the response of confined LH2 and JP 4 to ballistic impacts and lightning strikes The reaction of LH2 results in less severe hydraulic ram and reduced fire The responses of LH2 to lightning strikes indicate that strikes through vented gas external to the structure does not pose a serious problem However, the internal arcing effect is a more complicated phenomenon and requires further investigation (Author)

A77-13643 # **Transport of the future and the tasks of science (Transport budushchego i zadachi nauki)** D P Velikanov *Akademiia Nauk SSSR, Vestnik*, no 8, 1976, p 10-26 In Russian

The prospects of the development of transportation into the relatively distant future (into the twenty first century) are examined in the context of scientific and technological progress, neglecting social, economic and political factors Attention is given to future developments in air transportation, surface rapid transit (rail, ground-effect, magnetic levitation, etc), urban passenger transportation (e g , subways), automobiles, and freight transportation Problems of transportation energy are considered B J

A77-13713 # **Nonoptimality of the steady-state cruise for aircraft** J L Speyer (Texas, University, Austin, Tex) *AIAA Journal*, vol 14, Nov 1976, p 1604 1610 11 refs

For a fairly general aircraft model and a large class of drag models, steady state cruise for a long time span is nonoptimal with respect to fuel economy This is proved by a second order variational analysis, using a frequency domain version of the classical Jacobi (conjugate point) optimality condition The variational analysis suggests a sinusoidal perturbation away from steady-state cruise which improves fuel economy (as confirmed numerically), but is still not optimal The form of the optimal trajectory for long duration cruise is unknown However, two intuitive reasons for improved fuel economy using cycle cruise paths are given (Author)

A77-13724 * # **Thermocouple time constant measurement by cross power spectra** W C Strahle and M Muthukrishnan (Georgia Institute of Technology, Atlanta, Ga) *AIAA Journal*, vol 14, Nov 1976, p 1642-1644 6 refs Grant No NsG 3015

A method of measuring thermocouple time constants is outlined which requires Fourier signal processing In this method, two thermocouples of differing time constants are placed in a gas flow as closely as possible to one another, and the time constant of the first thermocouple is determined directly from the extremum of the imaginary part of the ratio of the ensemble averaged cross-power spectrum to the ensemble averaged auto power spectrum of that thermocouple A coherence function is given for assuring the quality of the data, and results are presented for an experimental test of the method Some problems with the method are briefly noted F G M

A77-13729 * # **Skin friction on a flat perforated acoustic liner** D R Boldman (NASA, Lewis Research Center, Physical Sciences Div , Cleveland, Ohio) and P F Brinich *AIAA Journal*, vol 14, Nov 1976, p 1656-1659 7 refs

The report concerns the measurement of friction coefficients of a typical perforated acoustic liner installed in the side of a wind tunnel The results are compared with measured friction coefficients of a smooth hard wall for the same mean flow velocities in a wind tunnel At a velocity of 61 m/sec, an increase in the local skin coefficient of only a few percent was observed, but at the highest velocity of 213 m/sec an increase of about 20% was obtained This velocity is a realistic velocity for turbo-machinery components utilizing such liners, so a loss in performance is to be expected Some tests were also performed to see if changes in the mean boundary layer induced by imposed noise would result in friction increase, but only at low velocity levels was such an increase in friction noted P T H

A77-13733 **Durability of bonded aluminum structure** A W Bethune (Boeing Commercial Airplane Co , Seattle, Wash) *SAMPE Journal*, vol 11, July-Sept 1975, p 4 10 5 refs

The paper stresses that traditional test and evaluation methods are unreliable in predicting the service performance of adhesive-bonded aluminum structures The application of a sustained shear stress in conjunction with temperature and humidity is shown to be suitable for duplicating the type of failure experienced in service Its significance as a design parameter or a demonstration of real-life environmental durability is not considered applicable, at least for the type of bonded structure typical of a commercial jet or as long as the failure is not associated with the adhesive Particular attention is given to acceptability criteria and application of fracture toughness testing to process control The phosphoric acid anodizing process overcomes the underlying problems, since it produces a surface oxide which is completely resistant to moisture with the resultant preclusion of interfacial failures Further refinements are needed in the fracture mechanics approach to the evaluation of adhesive bonds S D

A77-13735 **Effect of surface exposure time on bonding of commercially pure titanium alloy** M C Ross, R F Wegman, M J Bodnar, and W C Tanner *SAMPE Journal*, vol 11, Oct -Dec 1975, p 4-6 7 refs

A77-13740 **Producibility aspects of advanced composites for an L-1011 aileron** I J Van Hamersveld and L D Fogg (Lockheed-California Co , Burbank, Calif) *SAMPE Journal*, vol 12, May-June 1976, p 6-13

An advanced composite aileron suitable for long-term service on transport aircraft includes Kevlar 49 fabric skins on honeycomb sandwich covers, hybrid graphite/Kevlar 49 ribs and spars, and graphite/epoxy fittings Weight and cost savings of 28 and 20%, respectively, are predicted by comparison with the production metallic aileron The structural integrity of the design has been substantiated by analysis and static tests of subcomponents The producibility considerations played a key role in the selection of design concepts with potential for low-cost production Simplicity in fabrication is a major factor in achieving low cost using advanced tooling and manufacturing methods such as net molding to size, draping, forming broadgoods, and cocuring components A broadgoods dispensing machine capable of handling unidirectional and bidirectional prepreg materials in widths ranging from 12 to 42 inches is used for rapid layup of component kits and covers Existing large autoclaves, platen presses, and shop facilities are fully exploited (Author)

A77-13742 **Producibility aspects of advanced composites for an L-1011 aileron II** J Van Hamersveld and L D Fogg (Lockheed-California Co , Burkbank, Calif) *SAMPE Journal*, vol 12, June-Aug 1976, p 4-9

Basic steps in the fabrication of an aileron (L-1011) from composite materials are summarized The production tooling policy for all components is outlined, producibility considerations in the selection of a low-cost design concept are discussed, and the assembly sequence, quality control and quality assurance steps, in-process inspection and verification, and nondestructive inspection measures are described Diagrams illustrate the fabrication process for rib attachment fittings, front spar ribs, covers, and trailing edge Suitable applications for X-radiography and for through-transmission and contact pulse-echo ultrasonography are indicated R D V

A77-13751 Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Symposium sponsored by the International Committee on Aeronautical Fatigue, Federal Ministry of Defence, Eidgenossisches Flugzeugwerk, Ecole Polytechnique Federale de Lausanne, and Swissair Edited by J Branger and F Berger (Eidgenossisches Flugzeugwerk, Emmen, Switzerland) Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975 1084 p $26 70 (ICAF-DOC-801)

Environmental effects on fatigue are investigated, taking into account environmental effects on fatigue crack initiation and propagation in ultrahigh strength steels, the mechanism of fatigue at the precrack stage, the effect of cladding condition on the stages of fatigue crack formation and growth, the influence of anodizing processes on the fatigue strength of aluminum alloys in a non-corrosive atmosphere, and the effects of heat on fatigue in aircraft structure Test spectra for fatigue life estimation and life estimation methods are considered, giving attention to the influence of two different test spectrum levels on a multiple failure mode component, the effect of engineering approximations on fatigue life evaluation for variable amplitude loading, and practical aspects of load spectra estimation for different parts of an aircraft structure Aspects of materials development and evaluation for fatigue performance are discussed along with questions related to crack propagation and fracture toughness

G R

A77-13752 # Reliability analysis of wing panel considering test results from initiation of first and subsequent fatigue cracks /The 5th F J Plantema Memorial Lecture/ S Eggwertz (Forsvarsdepartementet, Flygtekniska Forsoksanstalten, Bromma, Sweden) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 1 1/1 1 1/74 57 refs

A survey of the fatigue reliability problem in aircraft structures is presented and the conduction of a statistical analysis of fatigue failure at regular inspections is discussed The information available to support an analysis is considered, taking into account loadings, service life until fatigue crack initiation, crack propagation rate, residual strength, and problems of crack detection at the inspection A description is presented of investigations carried out with fatigue test panels, giving attention to test specimens and test procedure, crack initiation, crack detection, and crack propagation and residual strength Numerical calculations concerning the probability of failure are also discussed G R

A77-13759 Effects of heat on fatigue in aircraft structure J R Heath-Smith and F E Kiddle (Royal Aircraft Establishment, Farnborough, Hants , England) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 2 7/1-2 7/21, 2 7/23-2 7/42 23 refs

This paper reviews the present understanding in the U K of the effects of kinetic heating on fatigue in aluminum alloy aircraft structure It describes how heating can affect subsequent fatigue at ambient temperature by softening strain-hardened material and redistributing local stress by creep It also discusses the effect on structural joints of the relaxation of clamping pressure and interference fit, and the curing of interfay compound Tests on structural elements are described which show that, under representative load-temperature sequences with a maximum temperature of 100 C, effects on life can range between reduction and improvement by a factor of 2, depending on circumstances (Author)

A77-13762 # The effect of engineering approximations on fatigue life evaluation for variable amplitude loading A Conle, H Nowack, and D Hanschmann (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Cologne, West Germany) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 2/1-3 2/20 28 refs

In the first part of the study the construction of a recently developed computerized crack initiation life prediction procedure is outlined The capability of the analysis is examined by comparing the prediction of fatigue lives with actual lives of notched specimen subjected to the SAE-Transmission random load history and a standardized flight history for transport aircraft The computerized analysis leads to satisfactory life predictions in both cases In the second part of the study the effect of various assumptions and approximations in some of the components of the computerized analysis are considered The results show that fatigue life parameters incorporating mean stress and overstrain effects are important for accurate life predictions An incorporation of cyclic mean stress relaxation was not found to be necessary for the histories examined In the final portion of the study an example of engineering application of the computerized fatigue life analysis is given in detail to demonstrate the effective use of the prediction method in design (Author)

A77-13763 # Critical remarks on the validity of fatigue life evaluation methods based on local stress-strain behavior D Schutz and J J Gerharz (Fraunhofer Gesellschaft, Laboratorium fur Betriebsfestigkeit, Darmstadt, West Germany) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 3/1-3 3/22 9 refs

The conventional fatigue analysis method using nominal stresses has well known deficiencies which are thought to be responsible for inaccuracies of the life predictions It has been speculated that the most prevailing deficiencies can be overruled if local stresses and strains in the immediate vicinity of a stress raiser instead of nominal stresses are considered in the determination of fatigue life Recently a number of local stress-strain concepts were set up some of them being already developed to a state of practical applicability In the paper the best known concepts including their adherent parameters are described and opposed to each other Within these concepts much effort was related to the determination of the local stress-strain behavior at the notch root but conventional methods were kept for the damage accumulation Therefore the question arises whether improvements of details of these fatigue analysis processes result in a satisfactory overall improvement of the concept (Author)

A77-13764 # Practical aspects of load spectra estimation for different parts of an aircraft structure J Kloos and G Lundkvist (Saab-Scania AB, Linkoping, Sweden) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2 5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 4/1-3 4/16

The design policy with regard to fatigue, as applied at SAAB SCANIA's Aerospace Division, implies that load spectra are estimated during the design stage for any aircraft part that may have to be designed for fatigue Basic data for load spectra estimation are

obtained from the aircraft specification, measured load spectra, training schedules and pilot interviews Appropriate safety factors are introduced during the compilation of the spectra A survey is given of the different load spectra that were compiled during the design of the Saab 37 Viggen aircraft It is then shown by means of examples how other data regarding the intended use of the aircraft are needed because these have an appreciable, sometimes essential influence on the load spectra for parts of the aircraft (Author)

A77-13765 # **Correlation of test results from flight recorded strain gage data with several simulated flight-by-flight stress spectra** G J Roth (Dayton, University, Dayton, Ohio) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 5/1-3 5/29 6 refs USAF-sponsored research

Axially loaded specimens of 7075-T651 aluminum with a hole (K = 2 54) were fatigue tested using both loading histories derived from strain gage data recorded on operational aircraft and loading histories generated from statistical distributions of the operational data For the baseline data the magnitude and order in which the loads occurred during a flight were preserved The flight contained data from taxi, take-off, flight and landing strain histories Test sequences were developed that provided the proper simulation of the strain history data (Author)

A77-13766 # **A fighter aircraft loading standard for fatigue evaluation /'FALSTAFF'/ I - Introduction to FALSTAFF** G M van Dijk and J B de Jonge (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 61/1 3 61/39 21 refs Research supported by the Royal Netherlands Air Force

The development of a common fighter aircraft loading standard for fatigue evaluation (FALSTAFF) by Dutch, German, and Swiss organizations is discussed Aspects related to the consistency of a loading standard are considered along with the principal features of the FALSTAFF approach An outline of the development of FALSTAFF is presented, taking into account the basic data input, the unification of the load factor scale, questions of range filtering and omission, and aspects of flight types and flight length G R

A77-13767 # **A fighter aircraft loading standard for fatigue evaluation /'FALSTAFF'/ II - Generating the FALSTAFF load history by digital mini computers** M Huck and W Schutz (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2 5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 62/1-3 62/23

A description is presented of the method which is used to establish the three standardized FALSTAFF matrices The matrices are employed in connection with flight length indication and the insertion of taxi loads to derive the FALSTAFF sequence by a certain random draw method Attention is given to the requirements for a standardized load sequence, the analysis procedure, the generation of flight loads, and the program properties Original and synthetic flights are compared G R

A77-13768 # **A fighter aircraft loading standard for fatigue evaluation /'FALSTAFF'/ III - Influence of differences between genuine and generated load sequences effect of ground-load variations of FALSTAFF-like programs** J Branger (Eidgenossisches Flugzeugwerk, Emmen, Switzerland) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2 5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 63/1-3 63/22 7 refs

As FALSTAFF will be used for comparative fatigue testing during the preliminary design stage of fighter aircraft in order to evaluate material characteristics and relative component quality with the aim to find optimal solutions but not absolute fatigue life times, some of the questions which have to be cleared are the influence of the load sequence within a highly sophisticated fatigue loading program, and the influence of the complexity of ground loads, i e , of compressive loads within a realistic flight by flight program. Some results of adequate tests run to this aim, as well as results of program-variations of a forerunner of FALSTAFF, i e , with the loading program of the Swiss Venom Fighter, as well as results with F/104G and MIR III S/RS program variations are presented (Author)

A77-13769 # **A fighter aircraft loading standard for fatigue evaluation /'FALSTAFF'/ IV - The application of the standardized test program for the fatigue life estimation of fighter wing components** D Schutz and H Lowak (Fraunhofer Gesellschaft, Laboratorium fur Betriebsfestigkeit, Darmstadt, West Germany) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 3 64/1-3 64/22

The considered standard test program can be used in general research programs for the investigation of the fatigue quality of fighter wing materials and typical structural elements Another application is related to an employment in an early stage of a fighter development program when the load spectrum for that particular aircraft has not yet been fixed The standard test program can also be employed to generate design charts for a use in fatigue analysis in an early design phase A description is given of a method by which the user of design chart data in fatigue life estimation procedures can take into account spectrum differences G R

A77-13771 # **Spectrum loading in relation to aircraft design** H W Smith and U G Goranson (Boeing Commercial Airplane Co , Seattle, Wash) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 1/1 4 1/39 22 refs

The growing base of fatigue and crack growth data under spectrum loads is highlighting parameters beyond those inherent in a linear cumulative damage analysis founded on constant amplitude SN-data Analysis procedures aimed to cope with spectrum effects presume well defined load sequences that usually are unavailable to designers of aircraft structures The potentials for simplifications are assessed by examining historical fatigue test data in terms of significant load history effects to prognosticate a modified damage model Interaction phenomena demonstrated through load level truncation, omission, certain aspects of sequencing, and spectrum variation are examples of typical spectrum effects shown to be handled quantitatively The proposed damage model retains the inherent simplicity of linear cumulative damage techniques and has the potential to bring the extensive data base of constant amplitude testing to bear on the spectrum loading design problem (Author)

A77 13772 # **Comparison of fatigue design load spectra with flight test measurement and service experience** R Birrenbach (Deutsche Airbus GmbH, Munich, West Germany) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 2/1-4 2/13, 4 2/13a 4 2/27 8 refs

This paper summarizes the problems and the experiences encountered in the development of the A300 in the assessment of tail plane rolling moments Originally, this aspect of the aircraft's structural integrity was based on current literature which enabled design fatigue spectra to be defined Subsequent experience from flight testing, crew training and normal operation suggested that this does not give a sufficiently comprehensive analysis Firstly, the analysis did not account for the fatigue damage incurred during

testing, and secondly, the fatigue damage on the tailplane produced by aileron maneuvers The objective of this paper is to illustrate the reasons for this and to give recommendations for a fatigue evaluation of flight test aircraft and consideration of additional fatigue damage on the rear fuselage due to tail rolling moments induced by aileron maneuvers (Author)

A77-13773 # **Life estimation by parametric analysis.** P J Howard, C A Patching, and A O Payne (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 3/1 4 3/28 29 refs

A description is presented of an approach to fatigue life estimation and monitoring which is based on comprehensive mission analysis, flight recording, and fatigue testing The considered approach is used in the fatigue investigation of the wing of the Mirage III aircraft Attention is given to flight testing, flight loading conditions, the design of the fatigue test, the design of the testing rig, questions of calibration, the conduct of the test, the test results, and aspects of fatigue life monitoring Details concerning the conduction of a parametric analysis for the life estimation process are discussed along with the implementation of the parametric analysis procedure G R

A77-13774 # **United States Navy aircraft structural fatigue life evaluation program** R A Weinberger (U S Naval Air Systems Command, Washington, D C) and R M Catanese (U S Naval Material Command, Naval Air Development Center, Washington, D C) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 4/1-4 4/17 Navy-sponsored research

The considered aircraft fatigue life evaluation program of the U S Navy makes use of a commercially available counting accelerometer that records the number of times an aircraft reaches or exceeds four preset positive 'g' load levels Ten different four-level combinations are available for use in the program on various models of aircraft The basic goal of the program is related to the establishment of maintenance and retirement action schedules Attention is given to laboratory tests, the analysis procedure, the evaluation of counting strain gages, and reporting procedures G R

A77-13775 # **Fatigue load spectra for combat aircraft - Their derivation and data requirements** A P Ward (British Aircraft Corp , Ltd , Military Aircraft Div , Preston, Lancs , England) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 5/1 4 5/21, 4 5/23-4 5/27 8 refs

The paper discusses the derivation of fatigue loading spectra for combat aircraft and attempts to highlight the problem areas It is seen that much operational information is lacking, and for this reason proposals are made for comprehensive fatigue monitoring in service and a justification is given The use of flight test results to assist in defining the fatigue loading, and possible problems associated with ground and flight testing are discussed (Author)

A77-13776 # **Search for unified methods of fatigue life assessment** F H Hooke (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 4 6/1-4 6/16 32 refs

The statutory approach concerning fatigue life requirements is considered It is pointed out that the satisfaction of statutory fatigue requirements will not ensure absolute freedom from fatigue accidents, though it should result in a very low risk Attention is given to the need for a full scale structural fatigue test, the definition of the test sequence by the airworthiness authority, the application of statistical reliability theory to life and inspection interval determination, and the environmental effects of fatigue life Questions concerning the adjustment of life results to altered load histories are also discussed It is concluded that a unified approach to determining the environmental conditions appropriate to structural fatigue airworthiness test requirements would be an advantage G R

A77-13779 # **Fatigue evaluation of materials and processes** J C Ekvall, L Young, and L Bakow (Lockheed-California Co , Burbank, Calif) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2 5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 6 2/1-6 2/60 10 refs

This paper discusses how testing small coupons with a flight-by-flight fatigue loading sequence can be used to provide information for an improved-fatigue evaluation of materials and processes applicable to aircraft structure Comparative flight by-flight fatigue test results on hole notched coupons are presented for some materials, processes and fatigue loading spectra Flight-by-flight test results of mechanically fastened specimens show the effects of type of aluminum rivet material, type of aluminum rivet, sheet thickness, type of high strength steel and titanium fastener, and faying surface treatment (dry, sealant, bonded) Additional data show the effect of spectrum truncation and loading sequence, the effect of specimen geometries and the use of coupon tests to determine the equivalent stress concentration of structural components These examples illustrate how flight-by-flight coupon test results can greatly aid in the design of long life aircraft structure (Author)

A77-13781 # ***Crack detection capability of non-destructive* inspection methods in relation to the airworthiness of aircraft** K R A O'Brien, D C Hollamby (Department of Transport, Air Transport Group, Melbourne, Australia), L M Bland, D W Glanvill, and I G Scott (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) In Problems with fatigue in aircraft, Proceedings of the Eighth Symposium and Colloquium, Lausanne, Switzerland, June 2-5, 1975 Emmen, Switzerland, Eidgenossisches Flugzeugwerk, 1975, p 7 2/1-7 2/57 31 refs

A review is conducted of current aircraft structural design standards to establish a reference frame for a closer study of the capabilities of nondestructive inspection (NDI) It is pointed out that fracture mechanics provides a most valuable adjunct to NDI insofar as it makes it possible to establish analytical estimations of critical crack sizes Through the use of crack growth equations fracture mechanics provides a basis for the determination of repetitive inspection intervals The limitations of NDI capability are also investigated, taking into account operator performance, magnetic particle inspection, dye penetrant inspection, eddy current inspection, ultrasonic inspection, and radiographic inspection Attention is given to the effect of crack contour on detectability, the effect of fatigue mechanism on detectability, crack contamination, and the effect of surface environment on detectability G R

A77-13837 # **Reduction of the drag of a planar polywedge body (O snizhenii soprotivleniia ploskostnogo poliklinovogo tela)** Iu A Vedernikov *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* June 1976, p 41-46 6 refs In Russian

It was thought that a thin polywedge body should have a drag in hypersonic flow far less than that of a body of revolution of equivalent length and size The formation of spiral vortices on the lateral walls of the polywedge body, however, leads to less of a drag reduction than expected This paper proposes a method for reducing the drag of a thin polywedge body (with respect to the equivalent body of revolution) by modifying its tail region Wind tunnel tests performed at Mach 4 and 6 on a tail-modified four wedge body confirm the correctness of the method B J

A77-13839 # **A thin shock layer in three-dimensional hypersonic flow problems (Tonkii udarnyi sloi v prostranstvennykh giperzvukovykh zadachakh obtekaniia)** V M Belolipetskii (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* June 1976, p 53-57 5 refs In Russian

The equations of gasdynamics are used to examine the thin shock layer formed in the three-dimensional hypersonic flow of an inviscid gas about a sharp body An approximate solution is obtained under the assumption that the thickness of the perturbed region is small and the streamlines on the surface are nearly geodesic A two-dimensional approximation is used to determine flow parameters in the plane tangential to the geodesic and normal to the surface An approximation for pressure distribution is obtained iteratively, and the flow about a cone at angle of attack is studied as an example

B J

A77-13879 # **Application of the ultrasonic technique for examination and evaluation of concrete slabs of runways (Zastosowanie metody ultradzwiekowej do badania i oceny plyt betonowych nawierzchni lotniskowych)** T Flassiller *Technika Lotnicza i Astronautyczna,* vol 31, Oct 1976, p 23-25 In Polish

A77-13899 **Application of a gradient-projection method to minimum weight design of a delta wing with static and aeroelastic constraints** R R Craig, Jr and I O Erbug (Texas, University, Austin, Tex) *(National Symposium on Computerized Structural Analysis and Design, 2nd, George Washington University, Washington, D C , Mar 29 31, 1976) Computers and Structures,* vol 6, Dec 1976, p 529-538 21 refs Research supported by the University of Texas

A structural optimization algorithm based on gradient-projection is presented The algorithm is applied to minimum-weight design of a delta wing subject to multiple constraints Examples are provided for the following sets of constraints stress and minimum-gage, flutter and minimum-gage, stress, flutter and minimum-gage Analytical expressions are employed for evaluating constraint gradients, which are calculated only for active constraints Due to nonlinearity of the constraints, the optimization algorithm incorporates constraint tolerances and provides for returning to the constraints if they are violated For a triangular wing having 10 design variables and subject to stress, flutter (supersonic) and minimum-gage constraints a 44% weight reduction was obtained in 6 design steps, a 59% weight reduction was obtained in 17 steps

(Author)

A77-13900 **Computer-augmented preliminary design of aircraft wing structures** A D M Lewis (Purdue University, West Lafayette, Ind), P Tiewtranon (Chulalongkorn University, Bangkok, Thailand), and D W Malone (American University, Washington, D C) *(National Symposium on Computerized Structural Analysis and Design, 2nd, George Washington University, Washington, D C , Mar 29-31, 1976) Computers and Structures,* vol 6, Dec 1976, p 557-561

The paper describes a design procedure featuring interaction between the designer and a computer for determining the optimum wing box structure with respect to a minimum weight criterion for a given airfoil geometry Optimization of the wing box structure is done by the complex method of Box (1965) with opportunities for the designer to observe the results of the optimization process and to redirect it Cathode ray tube graphical displays enable checking input data and evaluation of tabulations and plots showing the wing structure layout as it progresses through the iterations Examples of graphical plots are given which show the objective function values of the design variables plotted against iteration number Such plots show clearly if the optimization is leading to improved objective function values, and indicate which design variables are being changed to obtain these improvements P T H

A77-14425 **Aircraft electrical systems** E H J Pallett London, Pitman Publishing, Ltd , 1976 165 p $10 85

A textbook and reference manual on aircraft electrical systems for crews and maintenance technicians Power supplies measuring instruments, power distribution, internal and external lighting, circuit controls and protection devices, motors, actuators, engine electrical systems, and electrical systems for temperature control, de-icing, fire detection and extinguishing, and warning indication systems are discussed, with illustrations Test questions are appended to each chapter DC generators, batteries, ac power supplies, frequency wild generators, rectifiers, transformers, and ground power units are dealt with, along with wiring and cabling, switches, and current breakers R D V

A77-14426 # **Investigation of the stability of a channel flow with a blocking compression shock at transonic flow rates (Issledovanie ustoichivosti techeniia v kanale s zamykaiushchim skachkom uplotneniia pri okolozvukovoi skorosti potoka)** A N Kraiko and V A Shironosov *Prikladnaia Matematika i Mekhanika,* vol 40, July-Aug 1976, p 579-586 6 refs In Russian

The stability analysis is carried out in a transonic approximation which allows for changes in the intensity of acoutic waves propagating in the channel Changes in the flow parameters along the channel length (between the cross section of the 'blocking' shock and the exit section) and changes in the Mach number derivative with respect to the longitudinal coordinate are neglected The situation under consideration may occur at the throat of a Laval nozzle The condition for reflection at the channel outlet is taken in the form of a linear relationship between the nonstationary disturbance of the left Riemann invariant (characterizing the reflected acoustic wave) and the right Riemann invariant and entropy function (which characterize the waves at the channel exit section) The instability region in the plane of the reflection factor is determined V P

A77-14551 # **Ejector performance at high temperatures and pressures** B Quinn (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *Journal of Aircraft,* vol 13, Dec 1976, p 948-954 16 refs

Attention has recently been given to the use of thrust augmenting ejectors in the wings of V/STOL aircraft Laboratory experiments using low temperature and pressure primary air have measured high performance levels with well-designed ejectors The present experiments were motivated by aircraft designers' questions regarding the effects of realistic temperatures and pressures on ejector performance The simplest geometry was used a convergent nozzle issuing into an axisymmetric duct that entrained from and exhausted to ambient conditions The length of the ejector was varied from 12 to 0 75 diam Primary temperatures and pressures spanned the intervals 60 to 1000 F and 10 to 80 psig In support of existing theory, the mass entrainment performance usually decreased with increasing primary pressure although an aeroacoustic interaction reversed the trend over small intervals Increasing the primary temperature decreased the performance of long ejectors but had little effect on the performance of short ejectors (Author)

A77 14554 * # **Optimum data utilization for parameter identification with application to lifting rotors** D Banerjee (Washington University, St Louis, Mo) and K Hohenemser *Journal of Aircraft,* vol 13, Dec 1976, p 1014-1016 6 refs Contract No NAS2-7613

The work is concerned with determining the minimum quantity of data needed for achieving best possible accuracy of identified parameters in transient testing of a lifting rotor blade Specifically, the problem is that of determining from blade flapping transients caused by blade pitch inputs the equivalent Lock number and the equivalent collective pitch setting For a given time-dependent blade pitch input function, the running time for the test less than which insufficient parameter accuracy is obtained and more than which little accuracy improvement is achieved was calculated with the aid of the Cramer-Rao lower bound for the parameter covariance matrix P T H

A77-14555 # **Separation ahead of steps on swept wings** L G Kaufman, II (Grumman Aerospace Corp , Bethpage, N Y) and L M Freeman (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Journal of Aircraft,* vol 13, Dec 1976, p 1016, 1017 11 refs

The paper is concerned with the problem of predicting the flow separation line on a swept wing ahead of a forward facing step under boundary layer transition conditions Two-dimensional strip-type analysis predicts a curved separation locus halfway between the leading edge and the step for laminar separation, and a straight separation line close to the step for turbulent separation If there are substantial regions of both laminar and turbulent flow on the wing surface, and the proposed strip analysis is correct, then on the inboard portion of the wing separation will occur along the curved turbulent line, and on the outboard portion separation will occur along the straight laminar line In-between, the separation line will follow an 's'-shaped curve This qualitative result has been confirmed in oil flow and schlieren tests on half-wings with mounted steps P T H

A77-14556 # **Explicit equations for barometric altitude computations** G R Sarma (National Aeronautical Laboratory, Bangalore, India) *Journal of Aircraft,* vol 13, Dec 1976, p 1017, 1018

Explicit equations involving only square root and summation operations are derived for computing barometric altitude from measured data Three different expressions are obtained for the altitude ranges -1,000 ft to 32,500 ft, 32,500 ft to 45,000 ft, and 45,000 ft to 60,000 ft, which satisfy the accuracy requirements for pressure altitude given in an ARINC specification Although implementation of the equations would not offer many advantages where advanced digital computation techniques are available, they go along with the equations for Mach number and airspeeds in the explicit forms given by Bogel (1974) P T H

A77-14557 * # **Aerodynamic heat transfer to a hypersonic research aircraft model /X-24C/ at Mach 6** P L Lawing and J L Hunt (NASA, Langley Research Center, High-Speed Aerodynamics Div , Hampton, Va) *Journal of Aircraft,* vol 13, Dec 1976, p 1018-1020 5 refs

The paper reports on results of heat-transfer tests conducted on a 1/29-scale model of the X-24C 12I hypersonic research aircraft configuration in a Mach 6 tunnel at a Reynolds number of thirteen million using the phase-change heat transfer technique Sequences of phase-change heat transfer pattern photographs are presented showing windward side and leeward side heating processes Theoretical predictions of dimensionless heat transfer coefficients along a data line on lower fuselage and on fuselage side bracket the experimental values A turbulent heating theory gives good agreement with data when shifted to a new virtual origin P T H

A77-14558 # **Aerodynamics of sideslipping delta wings at incidence with leading-edge separation** M J Cohen (Technion - Israel Institute of Technology, Haifa, Israel) *Journal of Aircraft,* vol 13, Dec 1976, p 1020-1022

Closed-form expressions are derived for the normal force and rolling moment coefficients of a slender delta wind in sideslip and in separated flow at incidence, and the functions are calculated for a given range of angle of incidence and angle of sideslip The results are compared with Pullin's numerical solutions of the same problem At relatively low incidences both methods yield comparable results, but at higher incidences Pullin's results are in closer agreement to experimentally measured values P T H

A77-14559 # **Aerodynamics of the Darrieus rotor** R E Wilson, S N Walker (Oregon State University, Corvallis, Ore), and P B S Lissaman (Aero Vironment, Inc , Pasadena, Calif) *Journal of Aircraft,* vol 13, Dec 1976, p 1023, 1024 8 refs NSF Grant No AER-74-04014A03

To analyze a Darrieus type crosswind-axis wind turbine, the forces on the system are expressed by a momentum analysis of the wake and by an airfoil theory at the lifting surface Equating wake and wing forces yields equations for determining induced flows Some available experimental data on rotor power and thrust coefficients are compared with theoretical results of Wilson and Lissaman (1974) P T H

A77-14563 *Air transportation and fuel consumption* **(Transport aérien et consommation d'énergie)** J C Wanner (ONERA, Châtillon sous-Bagneux, Hauts de-Seine, France) *Sciences et Techniques,* Nov 1976, p 34-36 In French

Various options available in present technology for reducing fuel consumption and holding air travel costs down are examined Improvements in thermodynamic efficiency by altering specific fuel consumption and bypass ratio, and two ways of raising the temperature upstream of the turbine, are considered The advantages of the delta sweepback wing and supercritical airfoils are outlined, in addition to possible weight reduction through the use of new advanced materials (more Ti, less steel, more composites) and optimized dimensional design of aircraft by finite element methods *Control configured vehicle approaches to aeronautical design* are outlined briefly, and the outlook for reliance on liquid hydrogen as fuel is sketched R D V

A77-14597 * # **Hypersonic technology-approach to an expanded program** D P Hearth (NASA, Langley Research Center, Hampton, Va) and A E Preyss (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Astronautics and Aeronautics,* vol 14, Dec 1976, p 20-37 12 refs

An overview of research, testing, and technology in the hypersonic range Military and civilian hypersonic flight systems envisaged, ground testing facilities under development, methods for cooling the heated airframe, and use of hydrogen as fuel and coolant are discussed extensively Air breathing hypersonic cruise systems are emphasized, the airframe-integrated scramjet configuration is discussed and illustrated, materials proposed for hypersonic vehicles are reviewed, and test results on hypersonic flight (X 15 research aircraft) are indicated Major advances and major problems in hypersonic flight and hypersonic technology are outlined, and the need for a hypersonic flying-laboratory research craft is stressed R D V

A77-14716 *Linearly polarized microstrip antennas* A G Derneryd (Chalmers Tekniska Hogskola, Goteborg, Sweden) *IEEE Transactions on Antennas and Propagation,* vol AP 24, Nov 1976, p 846-851 14 refs

A design procedure for square and rectangular microstrip radiators useful as conformal and low-profile aircraft antennas is presented, with equivalent network representation Antenna parameters (directivity, equivalent admittance, radiation pattern) are derived for a single slot configuration Two slots separated by a transmission line are employed to characterize the microstrip radiator Length and bandwidth of the microstrip resonator are calculated and the design of linear arrays of microstrip radiators is outlined Resonant length and optimum dimensions of a linear array of open-circuit microstrip radiators are derived Application of the theory to two-dimensional arrays for linear or circular polarization is straightforward R D V

A77-14744 # **Boundary layer theory - Prandtl's basic ideas, further developments and some applications on airfoils** K Jacob (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt Institut fur Stromungsmechanik, Gottingen, West Germany) In Cycle of Lectures in Homage to Ludwig Prandtl to Commemorate the First Centennial of His Birth, Escuela Tecnica Superior de Ingenieros Industriales de Tarrasa, Tarrasa, Spain, November 25-28, 1975, Proceedings Tarrasa, Spain, Escuela Tecnica Superior de Ingenieros Industriales, 1976 40 p 16 refs

A review is presented of Prandtl's revolutionary contributions to fluid dynamics in broad outline Basic equations of fluid dynamics and the boundary layer (BL) concept are presented and Prandtl BL equations are compared to the Navier-Stokes equations The exact solution of the BL equations for flow over a flat plate without incidence, the momentum integral equation of the BL, some approximate BL calculation methods, displacement of the outer flow, turbulence and transition, flow separation, and BL control are discussed Incompressible flow around simple airfoils and airfoils with slotted flaps is reviewed, along with the use of Prandtl's tripping wire, flow around an airfoil with a slat, and other special problems R D V

A77-14745 # **Energy dissipation in turbomachines due to boundary layers and their effects** H E Gallus, W Bitterlich, and W Kuemmel (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) In Cycle of Lectures in Homage to Ludwig Prandtl to Commemorate the First Centennial of His Birth, Escuela Tecnica Superior de Ingenieros Industriales de Tarrasa, Tarrasa, Spain, November 25-28, 1975, Proceedings Tarrasa, Spain, Escuela Técnica Superior de Ingenieros Industriales, 1976 42 p 60 refs

The paper gives a survey of some ways of definitions and measurements of the energy dissipation in turbomachines As boundary layers and their effects mainly cause flow energy losses the connection between them is pointed out The problem of the prediction of losses depends on a detailed knowledge of the local energy dissipation in its dependence upon all involved parameters, and it needs models for the superposition to the total amount of losses resp the total degree of efficiency Many attempts have been made to solve this task A further contribution is presented in this paper and results are communicated for the example of a one stage axial-flow compressor (Author)

A77-14746 # **Recent results in the experimental investigation of axial-flow compressors** H E Gallus (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) In Cycle of Lectures in Homage to Ludwig Prandtl to Commemorate the First Centennial of His Birth, Escuela Técnica Superior de Ingenieros Industriales de Tarrasa, Tarrasa, Spain, November 25-28, 1975, Proceedings Tarrasa, Spain, Escuela Técnica Superior de Ingenieros Industriales, 1976 30 p 46 refs

A program developed by the author for measurements of nonstationary flow through a single-stage axial-flow compressor in subsonic regimes and in supersonic regimes is outlined, along with measurement techniques and results of the first measurements Literature contributions on the theory of interaction between rotating and stationary rows of blades are reviewed briefly Unsolved problems in description and calculation of internal flow through turbomachinery stages are considered in the development of new experimental techniques for unsteady flow field measurements Pneumatic and semiconductor transducers for flow field measurements are described, and numerous plots of pressure distribution between blade rows are presented R D V

A77-14882 # **Investigation of the effect of interference of a delta wing and a half-body (Issledovanie effekta interferentsii treugol'nogo kryla i polutela)** K Ia Kosiachenko and G K Shcherbakov *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia*, July 1976, p 82-89 In Russian

The problem of the flow past a delta wing with a half-cone attached to its lower surface is considered in a linear formulation The range of variation of the parameters of the arrangement is determined in which adding the body to the wing improves its aerodynamic properties The contribution of the components of the interference forces to the total balance of forces is determined for a given lift P T H

A77-14895 # **Method of analyzing flutter in light aircraft (Metodyka analizy flatteru samolotow lekkich)** M Nowak (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland) and W Potkanski (Wytwornia Sprzetu Komunikacyjnego, Mielec, Poland) *Instytut Lotnictwa, Prace,* no 65, 1976, p 3-38 9 refs In Polish

Complex analysis of flutter in light aircraft is described, consisting of theoretical calculations complemented by experimental investigation of a dynamically similar model and resonance measurements on a prototype A method of calculating natural vibrations and flutter of a design is described, which enables use of beam models and unsteady aerodynamics of incompressible fluids Correlations between theoretical and experimental results are formulated Illustrative examples are taken from studies of an agricultural aircraft P T H

A77-14897 # **Effect of rotor relative diameter on the efficiency of a single-stage axial fan (Wplyw wzglednej srednicy wirnika na sprawnosc jednostopniowego wentylatora osiowego)** J Parafiniuk *Instytut Lotnictwa, Prace,* no 65, 1976, p 53-57 In Polish

A77-14906 # **A method for the preliminary stability analysis of aircraft structures - Numerical analysis (Metod predvaritel'nogo rascheta na prochnost' aviakonstruktsii - Chislennyi raschet)** Iu V Vasil'ev *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol 21, Apr-June 1976, p 201-210 16 refs In Russian

Two numerical models are used to analyze the stability of a thin walled fuselage for the case of a critical stress state produced by transverse loads and bending moments (1) a graph-analytical method in which the value to be determined is obtained as the intersection of two curves, and (2) a refined analytical method in which the parameter to be determined is obtained as the solution of a third-degree algebraic equation An analysis of different structural cross sections and cross-sectional geometries has permitted the selection of the optimal reinforcement and casing for the structure B J

A77-14937 **The problem of certifying helicopters for flight in icing conditions** H B Lake (RAF, Ministry of Defence, London, England) and J Bradley (Aeroplane and Armament Experimental Establishment, Boscombe Down, Hants, England) *(Royal Aeronautical Society, Icing on Helicopters Symposium, London, England, Nov 26, 1975) Aeronautical Journal,* vol 80, Oct 1976, p 419-433

Requirements for testing iced helicopters in forward and hovering flight, rotorcraft certification, techniques for observing and measuring ice accretion, performance of iced rotorcraft, and testing and certification of helicopters are discussed in a report on testing of rotorcraft icing under natural conditions Engine protection, autorotation performance with iced rotors, loss of climb capability, inability to achieve survivable descent, and asymmetric shake off of ice are discussed Difficulties in measuring liquid water content and rate of ice accretion under icing conditions, inadequacies of spray rigs for artificial icing tests, and attempted quantification of icing observations using a tailboom-mounted TV are discussed Recommendations on improving engine/rotor protection and improving testing/measuring techniques are presented R D V

A77-14938 **Advanced materials and their use in civil aircraft structures** A C Ham (Royal Aircraft Establishment, Farnborough, Hants, England) and A J Willshire (Hawker Siddeley Aviation, Ltd, Hatfield, Herts, England) *(Royal Aeronautical Society, Spring Convention on Seeds for Success in Civil Aircraft Design in the Next Two Decades, London, England, Mar 19, 20, 1976) Aeronautical Journal,* vol 80, Oct 1976, p 434 441

Advances in materials research and applications of advanced

engineering materials in civil aircraft design are reviewed, with emphasis on carbon fiber composites (CFC) and some metals (Al, Ti, Be) Reinforced composites using glass, Kevlar, carbon, or boron fibers are discussed at length with the focus mainly on carbon fiber reinforced plastics (CFRP) prepreg lamination in wing and control surfaces, fabrication techniques, bonding of joints, response to various environments, NDT, and airworthiness evaluation of parts made from such composites Cost savings and savings in aircraft structural weight are examined in the case of Al-Cu alloys, Al Zn alloys, Ti alloys, Be, and CFC Projections of materials selected for various specified aircraft components in years ahead are illustrated by a bar graph R D V

A77-14939 **The initial roll-up of a thick, two-dimensional wake behind a wing of finite span** H Portnoy (Technion - Israel Institute of Technology, Haifa, Israel) *Aeronautical Journal*, vol 80, Oct 1976, p 442 447 13 refs Grant No AF AFOSR 71-2145

Wake vorticity is assumed contained in a layer of finite thickness with some plausible cross section configuration, and the wake flow is assumed two dimensional, with roll up of the wake studied as a time-varying process The approach obviates unrealistic features of earlier models assuming zero wake thickness and confining vorticity to lines A slow roll up occurring well aft of the wing is dealt with, and the wake cross section with vorticity distributed continuously over it is divided into triangular elements in each of which vorticity is assumed constant, with simple expressions for the velocity field Assumptions governing the strength of the vorticity in each triangular element are stated The network is allowed to distort with time under its self induced velocity field, using Euler integration Roll-up examples are calculated for three wakes of different thicknesses, elliptic cross sections, and uniform downwash R D V

A77-14940 **Lift augmentation on a moderately swept wing by spanwise blowing** K P Clarke (RAF, London, Cranfield Institute of Technology, Cranfield, Beds , England) *Aeronautical Journal*, vol 80, Oct 1976, p 447-451 9 refs

Experiments with blowing a high-speed jet of air across the upper surface of a moderately swept wing parallel to the leading edge, with the object of initiating leading edge vortices or enhancing any such existing vortices, are described Effects of wing blowing on lift, form drag, and pitching moment of the wing were investigated by pressure plotting Lift due to potential flow over the wing and lift increment due to vortex flow are predicted by the method Spanwise blowing induces part-span vortices springing from the inboard leading edge A tuft grid mounted normal to the wing and parallel to the stream, a smoke generator, and TiO2 suspended in paraffin and painted on the wing upper surface were employed for flow visualization The strength of the vortices generated, and hence the vortex lift generated, is a function of blowing coefficient, nozzle position, and wing angle of attack R D V

A77-14941 **The independence of upper and lower wing flows at supersonic speeds** L C Squire (Cambridge University, Cambridge, England) *Aeronautical Journal*, vol 80, Oct 1976, p 452-456

Airfoil design for testing in small wind tunnels where the scale of the model wing may have to be larger than ideal model proportions, for mechanical strength requirements or in order to accommodate pressure tubes or other measuring devices and probes, is discussed Emphasis is placed on the conditions under which pressures measured on the flat surfaces of wings of beveled or triangular cross section are satisfactory representations of pressures as measured on the counterpart flat surfaces of thin wings Interaction of surfaces in supersonic flow when disturbances generated on one surface propagate upstream and affect flow over the other surface is analyzed Flow over delta wings with sharp leading edges and with curved leading edges is investigated R D V

A77 14953 # **The effect of the position of a high-pressure nozzle on the operational efficiency of an ejector (Vliianie polozheniia vysokonapornogo sopla na effektivnost' raboty ezhektora)** V V Usanov and T M Rozenoer *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Sept -Oct 1976, p 122-128 13 refs In Russian

Experiments were conducted to study the effect of the position of a high-pressure nozzle on the efficiency of an ejector with a cylindrical mixing chamber and a geometric parameter (the ratio of the areas of the outlet sections of the high pressure and low-pressure nozzles) of 22 The investigation focuses on a microejector with a high-pressure supersonic nozzle which had a critical section diameter of 0 64 mm and an outlet section diameter of 1 22 mm It is shown that the limit regimes of ejector operation connected with blocking of the mixing chamber at the outlet are not optimal regardless of where the nozzle is positioned due to diffuser losses The operation

A77 14964 **Radiation characteristics of acoustic sources in circular motion** V J Virchis and S E Wright (Southampton, University, Southampton, England) *Journal of Sound and Vibration*, vol 49, Nov 8, 1976, p 115-128

This paper examines the acoustic properties of periodic unsteady rotor blade forces An efficient computer program, which retains what is regarded as the essential radiation terms, has been developed to numerically evaluate the radiation equations for sources rotating in a circle A variety of operating conditions and types of blade loading have been computed, of special interest are the radiation properties of impulsive blade loading at high tip speeds These computations show an acoustic beaming effect similar to that which is radiated by helicopters in high forward speed flight (Author)

A77-14972 **Supersonic and subsonic, CTOL and VTOL, airplane design /4th edition/** G Corning (Maryland, University, College Park, Md) College Park, Md , Gerald Corning, 1976 610 p 83 refs $25

Aspects of subsonic and supersonic aerodynamic design are considered, taking into account design methods, wing thickness and sweepback, wing loading, thrust loading, weight estimation, total drag, range, fuel storage, climb requirements, current SST designs and studies, developments designed to reduce noise and pollution, and sonic boom problems Questions of aircraft layout are investigated along with aerodynamic heating problems, methods of performance calculation, and problems of stability and control Structural design considerations related to loads are discussed and a description of VTOL aircraft design procedures is provided G R

A77-15008 # **Calculation of the hydrodynamic interaction of arrays of thin profiles taking into account the evolution of vortex trails (Raschet gidrodinamicheskogo vzaimodeistviia reshetok tonkikh profilei s uchetom evoliutsi vikhrevykh sledov)** R L Kuliaev *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, July-Aug 1976, p 61-65 6 refs In Russian

A77-15026 ***Israel Annual Conference on Aviation and Astronautics*, 18th, Tel Aviv and Haifa, Israel, May 19, 20, 1976, Proceedings** *Israel Journal of Technology*, vol 14, no 1-2, 1976 116 p

Papers presented cover vortex lift theory extended to cambered wings, stability of circular cylindrical shells compressed axially and buckling of elastic bars, missile aerodynamics (induced roll and yaw in slender cruciform canard configurations, divergence range in homing, trajectory covariance error analysis), potential flow and supersonic flow calculations, computational techniques for identification of aircraft dynamics parameters, Raman scattering in diagnostics of multiphase flow systems, a new type of singularity in potential flow R D V

A77-15029 **Vortex lift predictions for cambered wings** M Shepshelovich (Technion - Israel Institute of Technology, Haifa, Israel) *(Israel Annual Conference on Aviation and Astronautics, 18th, Tel Aviv and Haifa, Israel, May 19, 20, 1976) Israel Journal of Technology,* vol 14, no 1-2, 1976, p 18-22 6 refs

The Polhamus (1966) leading edge suction analogy is extended to cambered wings Potential-flow lift and vortex lift theory are developed for high angles of attack, and conditions for reattached

A77-15033 **A recursive on-line estimation method with application to aircraft dynamics parameter identification** M Sidar (Ministry of Defense, Armament Development Authority, Haifa, Israel) *(Israel Annual Conference on Aviation and Astronautics, 18th, Tel Aviv and Haifa, Israel, May 19, 20, 1976) Israel Journal of Technology,* vol 14, no 1-2, 1976, p 56-65 16 refs

The problem of identifying constant system parameters and identifying and tracking variable parameters in multi-input, multi-output, linear and nonlinear systems is considered in this paper An identification algorithm is developed on the basis of the one step prediction error concept using the minimum variance and the maximum likelihood approach The identification is performed by applying the 'output error' approach The novel iterative algorithm, leading to recursive identification and tracking of the unknown parameters and the noise covariance matrix, is developed and presented here Agile tracking, accurate, consistent and unbiased parameter estimates are obtained Necessary conditions for a stable identification process are provided Among different caes studied, special emphasis was focused on the aircraft dynamics identification problem, the stability and control derivatives of aircraft being identified Some results are shown as examples in this paper (Author)

A77-15036 **Statistical analysis of the vibration response of external aircraft stores** G Hadan and R Eshel (Technion - Israel Institute of Technology, Haifa, Israel) *(Israel Annual Conference on Aviation and Astronautics, 18th, Tel Aviv and Haifa, Israel, May 19, 20, 1976) Israel Journal of Technology,* vol 14, no 1-2, 1976, p 86-93 7 refs

Vibrations in external stores of the Phantom F4E were measured and analyzed for various flight conditions Statistical relationships between the vibration levels and dynamic pressure, Mach number, store structure, etc , are observed and explained In particular, an impressive attenuation factor of 1 2 5 is observed for vibrations at supersonic flight versus vibrations at subsonic flight with equal dynamic pressure (Author)

A77-15129 **AEROSAT system** E Lucier (FAA, Washington, D C) In National Telecommunications Conference, New Orleans, La , December 1-3, 1975, Conference Record Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 9-1 to 9-5

The paper describes the system configuration, objectives, and capacity of the AEROSAT satellite system dedicated to satellite applications of communications and surveillance to oceanic air traffic control (ATC) AEROSAT consists of space, ground, and airborne segments Voice communications will be possible between pilots and oceanic air traffic controllers, airline personnel, and any other users Data communications will be available between the avionic input devices and the Aeronautical Satellite Communications Center (ASCC) computers, as well as airline data terminals and the Automated Oceanic Control Center computers ASCC will also provide the flexibility to evaluate various control concepts and operating modes, to develop potential operational hardware and software, and to enable demonstrations of potential operation system configurations and oceanic ATC procedures S D

A77-15134 **The Discrete Address Beacon System for air traffic control** H G Weiss (MIT, Lexington, Mass) In National Telecommunications Conference, New Orleans, La , December 1-3, 1975, Conference Record Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 14-19 to 14-22 6 refs FAA-sponsored research

An evolutionary upgrading of the Air Traffic Control Beacon System (ATCRBS), incorporating a discrete address and two way

A77-15274 **Some features and problems of metal composites** N J Parratt (Explosives Research and Development Establishment, Waltham Abbey, Essex, England) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14-18, 1975, Proceedings Volume 1 New York, Metallurgical Society of AIME, 1976, p 395-410 36 refs

The paper outlines the trends of existing applications, relevant properties, and effective fabrication processes of metal-matrix composites which are still at the threshold of industrial applications involving reinforced superalloys for operation above 1000 C and reinforced light alloys which are readily fabricated to operate within a few hundred degrees usually below 350 C The unique combination of mechanical properties of these composites suggest that they will be used progressively in the future to solve specific problems of high importance It seems that the aircraft industry will be the most important user of structural metal-matrix composites S D

A77-15287 **Fibre reinforced composites with non fracturing reinforcing elements** J G Morley (Nottingham University, Nottingham, England) In International Conference on Composite Materials, Geneva, Switzerland, April 7 11, 1975 and Boston, Mass , April 14-18, 1975, Proceedings Volume 1 New York, Metallurgical Society of AIME, 1976, p 744-753 14 refs Research supported by the Science Research Council and University of Nottingham

The reinforcing elements used in fibrous composites can be arranged not to fracture under overstrain conditions by means of a stress controlled reversible coupling mechanism operating at the fiber matrix interface By this means decoupling is initiated at the center of a long fiber and progresses outwards as the tensile load increases In this way a fiber of any length can be pulled through the composite structure at high stress levels against frictional losses This mechanism adds to the existing reinforcing principle the following features (1) a fail safe mechanism, (2) very considerable energy absorbing capabilities and (3) crack stopping characteristics The design and experimental properties of composites based on these principles are outlined (Author)

A77-15297 **Fiber composite structures** M J Salkind (Avco Corp , Avco Systems Div , Lowell, Mass) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14-18, 1975, Proceedings Volume 2 New York, Metallurgical Society of AIME, 1976, p 5-30 71 refs

Relevant design considerations of fiber-reinforced composites are reviewed, along with future developments Particular attention is given to a discussion of design procedures and to fatigue behavior of composites Although aerospace applications can be said to have developed and dominated the composites markets, the total amount of composite material used in recent years has been greater for non-aerospace applications such as composites for sporting goods When current shortcomings in manufacturing costs, reliability, and maintenance are removed, there will be extensive use of fiber composites in aerospace Numerous photographs supplement the text S D

A77-15298 **A replacement design for a structural wing box** J E Ashton (General Dynamics Corp , Fort Worth, Tex) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14-18, 1975,

Proceedings Volume 2 (A77-15260 04-24) New York, Metallurgical Society of AIME, 1976, p 31-45 Contract No N62269-73-C-0550

Results are presented for a design study of the use of composites in the structural wing box of a high-performance V/STOL fighter configuration The design constraints are successfully met with a replacement design using integrally I-stiffened graphite/epoxy skins bolted to aluminum spars and ribs The resulting design concept is confirmed by an experimental program developed to demonstrate that the integrally I-stiffened wing skin panels can be efficiently fabricated, that the design incorporating these skins on aluminum substructure is capable of carrying the design loads, and that the mechanical attachment and sealing system selected are acceptable S D

A77-15324 Advanced composite materials fabrication J D Ray (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14 18, 1975, Proceedings Volume 2 New York, Metallurgical Society of AIME, 1976, p 652-682

The two most significant factors controlling the cost of composite airframe structures are design and manufacturing Attention is focused on the discussion of such elements of the manufacturing plan as raw material, tooling, and fabrication methods The steps in the fabrication of composite parts are discussed relative to layup, laminate cure, joining, and machining Two methods of joining are discussed adhesive bonding and mechanical fastening, with special emphasis on the bonding technique because of its importance in saving structural weight in composite components Pertinent steps in the fabrication of different types of advanced composite aircraft structural configurations are examined, with particular reference to the full depth honeycomb sandwich structure, spar/rib built-up structure, and selective reinforcement structure S D

A77-15328 Roll diffusion bonding of boron aluminum composites G S Doble and I J Toth (TRW, Inc , Cleveland, Ohio) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14-18, 1975, Proceedings Volume 2 New York, Metallurgical Society of AIME, 1976, p 775-788 Contract No F33615-74-C-5076

Filamentary reinforced metal matrix composites are of interest for propulsion and aircraft structural applications because of high specific stiffness, strength, and design versatility The paper summarizes a laboratory development program on roll diffusion bonding of boron-aluminum in air with a view to reduce primary fabrication costs The procedure consisted of collimating the boron filaments into mats by drum winding with a fugitive binder of polystyrene The filament mat was placed between pieces of 6061 aluminum foil which had been lightly etched prior to assembly Either monotapes, consisting of foil filament sandwiches, or panels consisting of alternate layer of foil and filament mat, were assembled Rolling variables included temperature, roll pressure, rolling speed, and heating atmosphere, the rolling temperature and roll pressure being found to be the most important variables The roll consolidation pressure on the composite was adjusted by the size of the roll opening After rolling the package was air cooled and the composite evaluated by metallography, radiography, and tensile testing The cost of roll diffusion bonding was projected to be much less than press diffusion bonding, particularly due to the very short time required S D

A77-15335 Development and testing under static conditions of a B-Al load transfer element R Gunther and W Hartmann (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) In International Conference on Composite Materials, Geneva, Switzerland, April 7-11, 1975 and Boston, Mass , April 14 18, 1975, Proceedings Volume 2 New York, Metallurgical Society of AIME, 1976, p 993-1018 Research sponsored by the Bundesministerium der Verteidigung

The paper outlines the design, static strength evaluation, fabrication, testing and monitoring, and fracture testing of a load transfer component of composite material structure for aircraft applications. The load transfer component consists of fan-shaped B-Al corrugated webs joined to B-Al cover sheets of varying thickness The result is that a force applied at a point can be distributed over a large area It is shown that the design concept used in the development of this load transfer element made of composite material proves suitable for obtaining area stress distribution and that formed boron-reinforced aluminum parts can be fabricated by the braze-bonding process S D

A77-15345 Army applications of advanced composites R W Lewis and A E Gorum (U S Army, Army Materials and Mechanics Research Center, Watertown, Mass) In International Conference on Composite Materials, Geneva, Switzerland, April 7 11, 1975 and Boston, Mass , April 14-18, 1975, Proceedings Volume 2 New York, Metallurgical Society of AIME, 1976, p 1226-1249 13 refs

The development of composite rotor blades for Army helicopters from graphite, fiberglass and glass/graphite materials is considered with particular reference to the Heavy Lift Helicopter Blade Program The rotor blade concept selected consists of a closed fiberglass 'D' spar terminating in a multiple wraparound root end, fiberglass skins over Nomex honeycomb for the aft fairing assembly and a titanium/nickel nose cap erosion protection system Attention is also given to the development of tubular composite blades for the HLH, composite fuselages (using Thornel 300 and Kevlar 49), flight control components, and composite shafting The development of graphite/aluminum metal matrix composites is also discussed B J

A77-15406 Lightning protection for status and control lines of the Mark III instrument landing system G K Huddleston and G G Bush (Georgia Institute of Technology, Atlanta, Ga) In International Symposium on Electromagnetic Compatibility, San Antonio, Tex , October 7-9, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 3A1b1-3A1b3 6 refs

The lightning protection requirements for solid state circuits of the Mark III ILS which are connected to buried control cables are presented Susceptible circuits consist of transistor switches, relays, and dc power supplies Avalanche diode surge protectors with associated resistance are used to protect the circuits from the worst-case 1000-volt, 10 x 1000 microsec surge waveform expected (Author)

A77-15408 EMP hardening of aircraft by closing the points-of-entry G E Morgan (Rockwell International Corp , Anaheim, Calif) In International Symposium on Electromagnetic Compatibility, San Antonio, Tex , October 7 9, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 3A11d1-3A11d8

EMP (electromagnetic pulse) couples radio frequency energy into aircraft cables by a series of interactions with the total system In a series of trade studies it was concluded that to harden the C-130 aircraft against EMP, it would be most cost effective to begin by closing the points of entry into the fuselage It was indicated that this would provide the greatest benefit in improving hardness with the least effect on cost, weight, reliability, and maintainability A detailed investigation was begun to identify all the points of entry on the C-130, and to devise ways to close them This paper presents preliminary results of this investigation B J

A77-15410 An overview of the Air Force Intrasystem Analysis Program /IAP/ A L Hiebert (Rand Corp , Santa Monica, Calif) In International Symposium on Electromagnetic Compatibility, San Antonio, Tex , October 7 9, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 3B1a1-3B1a3 13 refs

The Intrasystem Analysis Program (IAP) for achieving electromagnetic compatibility is being developed by the Air Force for application in the acquisition of ground and aerospace systems IAP includes the Intrasystem Electromagnetic Compatibility Analysis Program for basic computer analysis applied to vulnerability assessments, design of specification limits, compatibility and waiver analyses, etc , a series of supplementary models for analysis of aircraft stores, lightning, magnetospheric substorms, static electricity, etc , nonlinear and EM/near-field analysis models, instrumentation, test, and measurement support equipment, and implementation, validation, and training programs B J

A77-15412 Prediction of lightning-induced voltages in aircraft electrical circuits K J Maxwell (General Electric Co , Environmental Electromagnetics Unit, Pittsfield, Mass) In International Symposium on Electromagnetic Compatibility, San Antonio, Tex , October 7-9, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 3Blc1-3Blc8 8 refs

The prediction of lightning induced transients in aircraft electrical circuits has usually lacked coordination between one system design and another This paper reports the work of the Environmental Electromagnetic Unit, Corporate Research and Development, General Electric Company, to develop some simplified models of the lightning/aircraft interactions applicable to most aircraft systems Two computer programs APERTURE and DIFFUSION were written to incorporate the two separate interaction mechanisms In addition, some experiments were performed in order to validate the assumptions on which the DIFFUSION program was predicated (Author)

A77-15416 Electromagnetic compatibility assurance tests for airborne systems controls in an RF-polluted environment C J Hanover (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) In International Symposium on Electromagnetic Compatibility, San Antonio, Tex , October 7-9, 1975, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p. 4Ald1-4Ald7

Following a review of a typical aircraft engine control system, and some of the possible effects of RF susceptibility on the control system, a typical procedure is presented for conducting EMC assurance testing on the control system The following recommendations are made (1) before starting a system design, determine the level of the RF environment in which the system must survive, (2) specify good EMI/EMC design practices for the electrical and electronic system and for the associated test equipment, giving attention to the bonding, shielding, and grounding of equipment, (3) conduct high level susceptibility tests on electronic equipment during the prototype phase, and (4) prior to conducting susceptibility tests in pulsed RF fields, preliminary data can be obtained by injecting dc pulsars at a high repetition rate into the dc lines and signal leads of equipment B J

A77-15508 Advanced joining processes F R Miller (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *SAMPE Quarterly,* vol 8, Oct 1976, p 46-54 6 refs

Three advanced metals joining processes are described continuous wave laser welding, brazing of titanium hybrid structures, and plasma arc welding Attention is given to the problem of delivering a shielding gas to the upper surface of a part being welded by a laser, and experiments with several alternative techniques for achieving this are described A concept for producing large precision hybrid titanium structures is mentioned in which a titanium honeycomb shear web is brazed to a welded frame Experiments in determining thickness limits for plasma arc single and multiple pass butt weld joints in titanium and steel alloys are discussed P T H

A77-15555 Some notes on unsteady lifting-line theory T Van Holten (Delft, Technische Hogeschool, Delft, Netherlands) *Journal of Fluid Mechanics,* vol 77, Oct 8, 1976, p 561-579 9 refs

A matched asymptotic expansion method is used to construct a lifting-line theory according to physical principles Matching of the near-field and far-field asymptotic expansions is accomplished by construction of an appropriate interpolation expression formed by summing the near and far pressure field, and subtracting a correction field A new definition of the induced velocity enables unsteady lifting-line theory to be constructed Weissinger's 3/4-chord method is shown to be exact to the order of terms in the inverse of the square of the aspect ratio in the case of an uncambered, linearly twisted, rectangular wing in steady flow P T H

A77-15557 Catalytic combustion of C3H8 on Pt coated monolith F B Wampler, D W Clark, and F A Gaines (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) *Combustion Science and Technology,* vol 14, no 1-3, 1976, p 25-31 10 refs

Various platinum-coated monolithic catalytic materials were evaluated with respect to performance as a primary combustion device The combustion/emission parameters were determined for various C3H8/air mixtures, temperatures and residence times The surface concentration of catalytic material appears to be an important factor to be considered High combustion efficiencies and low emission indices were achieved under certain experimental conditions, which indicates that catalytic combustors may be of value in emission abatement P T H

A77-15612 * Combined ground and aircraft based 1-4 micron spectra of LkH-alpha 101 R I Thompson (Steward Observatory, Tucson, Ariz), E F Ericson, F C Witteborn, and D W Strecker (NASA, Ames Research Center, Moffett Field, Calif) *Astrophysical Journal,* vol 210, Nov 15, 1976, pt 2, p L31-L33 7 refs NASA-supported research, NSF Grant No AST-75-04810

A77-15623 ARA proposes new propeller aerofoils A Bocci (Aircraft Research Association, Ltd , Bedford, England) *Flight International,* vol 110, Nov 27, 1976, p 1556, 1561

New low-solidity rotating airfoils offering a combination of improved supercritical flow characteristics and good low-speed performance are described and analyzed Propeller configuration requirements for fast take-off, high lift, cruise, and low noise are discussed Plots of pressure and suction across the top and underside of the airfoils are presented Clark Y, Naca Series 16, and ARA-D series rotating airfoils are compared Applications of the airfoils in aircraft propeller assemblies, hovercraft fans, helicopter rotors, windmill sails, and cooling towers are considered R D V

A77-15624 'Ski jump' Harrier /R J Mitchell Memorial Lecture/ J Fozard (Hawker Siddeley Aviation, Ltd , Kingston-on-Thames, Surrey, England) *Flight International,* vol 110, Dec 4, 1976, p 1630-1632, 1635

Basic principles and predicted performance data in the launching of Sea Harrier aircraft (now in advanced construction) from a curved ramp on the forward end of a specially designed aircraft carrier are outlined Deck speed, speed at the end of the deck run, launch airspeed, deck winds, launch angle of the 'ski jump' launch ramp, and time to wingborne flight, take-off with nozzles down or with nozzles fixed aft, stabilization of the Harrier against deck roll, take-off behavior in the bow-down phase of a carrier pitching cycle, and loads on undercarriage figure in the calculations Time to sea impact (2 5 sec) is considered in the event of a failure to achieve wingborne flight, along with options of jettisoning of stores and pilot ejection Brief information is presented on the projected seagoing Harrier Carrier R D V

A77-15634 # **Generation of gas to obtain lift from hydrazine - A compact light-structure system as alternative to hydrogen cylinders (Auftriebsgaserzeugung aus Hydrazin - Ein kompaktes Leichtbausystem als Alternative zu Wasserstoff-Flaschen).** J Schaper (ERNO Raumfahrttechnik GmbH, Bremen, West Germany) In Symposium on Research Utilizing Balloons, Schliersee, West Germany, October 10, 11, 1974, Proceedings
Garching, West Germany, Max-Planck-Institut fur Physik und Astrophysik, 1976, p 105-114 *In German*

The catalytic decomposition of hydrazine provides a gaseous mixture of hydrogen, nitrogen, and ammonia with a molecular weight of 11 3 Balloons filled with this gaseous mixture must have a launching volume which is 1 5 times greater than the corresponding volume of hydrogen-filled balloons, if the same free lift capacity is to be obtained A description is presented of an investigation which has been conducted to explore the feasibility to use the gas obtained by the decomposition of hydrazine for the operation of balloons It is found that the considered use of hydrazine for balloon operations is feasible and has certain advantages related to the lower weights and volumes of hydrazine systems in comparison to hydrogen cylinders G.R

A77-15667 **Choice of optimal throat dimensions for the diffusor in a condensing injector** A F Gandel'sman, S I Vainshtein, A E Morozov, A P Sevast'ianov, E E Shpil'rain, and K A Iakimovich (Akademiia Nauk SSSR, Naucho-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur,* vol 14, Mar-Apr 1976, p 365-371) *High Temperature,* vol 14, no 2, Sept 1976, p 326 331 9 refs Translation

The condensing injector (or ejector) is a jet pump that operates with two-phase rather than one-phase flow and exhibits a superior performance (as compared to single-phase jet pumps), due to the favorable thermodynamic difference in the inlet states The device operates by using the momentum transfer through which the vapor stream pumps the liquid stream In the present paper, the influence of the diffuser throat dimensions on the output pressure is analyzed with allowance for friction losses as a function of the mixing chamber configuration A computational procedure is proposed, using which the velocity and density of the two phase flow in front of the shock and the mixing chamber losses can be determined from pressure, temperature and flow rate measurements V P

A77-15701 # **Application of holography to panel flutter** D A Evensen (J H Wiggins Co , Redondo Beach, Calif) *AIAA Journal,* vol 14, Dec 1976, p 1671-1674 12 refs

Application of differential pulsed holography (DPH) to measurement of panel deflections in a fluttering panel, with large amplitudes of motion, is demonstrated Two differential holograms made at separate times are sufficient to determine the amplitude and phase of all modes participating in the flutter (at a single frequency) Holography appears potentially useful for virtually all modes of panel flutter, regardless of panel shape and/or boundary conditions Applicability of DPH to nonlinear and unsteady flutter is demonstrated Similar DPH techniques appear applicable to the general flutter problem, including flutter of an aeroelastic aircraft model, or transonic flutter of aerodynamic surfaces R D V

A77-15718 # **Flight-test base pressure measurements in turbulent flow** B M Bulmer (Sandia Laboratories, Albuquerque, N Mex) *(American Institute of Aeronautics and Astronautics, Thermophysics Conference, 11th, San Diego, Calif , July 14-16, 1976.) AIAA Journal,* vol 14, Dec 1976, p 1783-1785 9 refs ERDA-USAF-supported research

Flight-test pressure measurements for four relatively sharp, slender reentry vehicles are discussed The data are related to the hypersonic, supersonic, and subsonic flow regimes The data are correlated to provide an empirical prediction capability for vehicles characterized by very low heatshield ablation rates in turbulent flow An analysis reveals that the base pressure increases with increasing nose bluntness and cone angle, in agreement with previous correlations of nonablating data G R

A77-15768 **LF/VLF NAVAID signal reliability in airborne applications** J M H Bruckner and R A Auerbach (Rockwell International Corp , Collins Avionics Div , Cedar Rapids, Iowa) *Navigation,* vol 23, Fall 1976, p 209-216

Transmitter failure data for Loran-C, Omega, and VLF-commercial navaid stations are compared, as a basis for calculating MTBF and MTTR statistics for individual transmitters and averages for transmitter types, and generating information on redundancies Redundant signal coverage, redundant navigation system failure probabilities, and navaid reliability are examined Reported Loran failures to date are found to last much longer than either Omega or VLF commercial navaid failures The Loran system is found currently more reliable than Omega in terms of supplying a continuous navigation signal if the transmitter network features zero or one station of redundancy, but the performances equal out when two stations of redundancy are involved R D V

A77-15769 **Progress report on the Gettysburg Workshop sixteen months later** J F Culbertson (U S Coast Guard, Washington, D C) *(Institute of Navigation, National Marine Meeting, Hunt Valley, Md , Oct 14-17, 1975) Navigation,* vol 23, Fall 1976, p 217 227 5 refs Research sponsored by the U S Coast Guard and Wild Goose Association

An updated report on follow-up of recommendations at the June 1974 Gettysburgh Workshop on Loran-C systems sponsored by the U S Coast Guard and the Wild Goose Association is presented Motivation of the workshop is discussed and the working groups and their topics are listed Progress toward future workshops on acceptance and implementation of Loran C systems and remedial steps needed where little progress is reported are discussed Great Lakes Loran-C coverage, minimum standards (user-oriented) for Loran C, formation of a viable Loran Users Advisory Council, a timetable for implementation of Loran-C coverage throughout the Coastal Confluence Zone (CCZ), government funding of development of solid-state devices for low-cost Loran-C receivers, compilation of general Loran-C charts and special charts for fisheries and urban transportation areas, and Loran-C minichain compatibility studies are among the areas singled out for further attention R D V

A77-15772 **The use of microprocessors in navigation systems** C O Culver and R W Danklefs (Micrologic, Inc , Chatsworth, Calif) *(Institute of Navigation, Annual Meeting, Washington, D C , June 26, 1975) Navigation,* vol 23, Fall 1976, p 245-248

The limited use of microprocessors in navigation systems to date is surveyed and reasons for their lack of acceptance are weighed Navigation applications of minicomputers and dedicated logic circuits are mentioned and disadvantages in replacing available navigation system minicomputers with microcomputers are listed A Loran-C receiver using a microprocessor with 70 IC, a floating point interpreter designed to simplify navigation computations on a 4-bit microprocessor, and a Loran coordinate conversion program for the interpreter (using 4096 words of 8-bit memory, with latitude/longitude computed to within 50 ft in 22 sec) are described Functions and operations performed by the microprocessor systems are reported in greater detail It is felt that the market for navigation microprocessor devices, including pocket navigational computers, is not large enough to recover development expenses R D V

A77-15773 **Design considerations for a flare guidance subsystem** P D Hodgkins (FAA, Washington, D C) and N J Cafarelli (Automation Industries, Inc , Vitro Laboratories Div , Silver Spring, Md) *(Institute of Navigation, Annual Meeting, 31st, Washington, D C , June 24, 1975) Navigation,* vol 23, Fall 1976, p 249-256

This paper describes the design considerations associated with the development of a flare guidance subsystem for the time reference scanning beam (TRSB) microwave landing system (MLS) The two basic concepts for providing MLS flare guidance information are examined, the touchdown zone and wind model are defined,

technologies and equipment that are candidates for providing flare guidance are identified, the advantages of the MLS in providng a transition capability from glide slope to altimetry are discussed, various flare algorithms are tabulated, flare antenna option is presented with configuration decision guidelines, and flight test results are shown that demonstrate the guidance capability of the elevation antenna in the approach threshold vicinity (Author)

A77-15774 **PALM - A system for precise aircraft location.** I G Stiglitz, J E Evans, D Karp, R LaFrey, and R J McAulay (MIT, Lexington, Mass) *(Institute of Navigation, Annual Meeting, 31st, Washington, D C , June 24, 1975) Navigation,* vol 23, Fall 1976, p 257-261 7 refs FAA-USAF-supported research

An experimental test facility, the antenna subsystem, and basic theory of operation and time delay discrimination features of the Precision Altitude and Landing Monitor (PALM) system are described Key PALM features include no special avionics, only a standard transponder, high-accuracy position data, broad airspace coverage, and low-life-cycle equipment cost Two fixed antenna arays near the glide path intercept point provide data on elevation and azimuth Information on beacons, transponder operation, and displays is provided, in addition to antenna design and multipath rejection techniques Aperture sampling of the incident field and handling of multipath reflections are discussed briefly, along with experimental flight test results and errors at small elevation angles (1 mrad at less than 2 5 deg) R D V

A77-15775 **Collision avoidance - The state of the art and some recent developments and analyses** J J Bagnall, Jr (Institute for Defense Analyses, Arlington, Va) *(Institute of Navigation, Annual Meeting, 31st, Washington, D C , June 24, 1975) Navigation,* vol 23, Fall 1976, p 262-273 8 refs

Little progress toward operational use is reported in this survey of airborne collision avoidance systems (CAS), covering both beacon-only and time-frequency techniques ANTC-117 logic, air traffic control radar beacon systems (ATCRBS) applied to collision avoidance, threat criteria and altitude criteria, and algorithms for separation distance calculations and altitude difference calculations are discussed Specific cooperative CAS dealt with include SECANT (RCA), VEGAS, AVOIDS (Honeywell), and Mitre and Litchford CAS Escape maneuvers allowed in the vertical plan only (for lack of speedy reliable information on bearings of aircraft closing in) and time allowances for pilot reaction are covered Basic information on data inputs handled by each system, transponder and interrogator responses, encoding and decoding, and data routing are presented, in addition to handling of interference (fruit) and garbling R D V

A77-15795 # **Aircraft antiskid braking systems (Przeciwposlizgowe uklady hamowania samolotow)** J Pruss (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1976, p 11-14 In Polish

The physics of braking of aircraft undercarriage wheels is reviewed, and the several types of antiskid braking systems are classified and discussed Forces operating on wheels, grip between the wheels and the runway surfaces (dry or wet concrete, ice or snow), and blocking of wheels of parked aircraft are dealt with Pneumatic, hydraulic, and electrically actuated braking systems discussed include systems based on measurements of angular lag (negative acceleration) of the wheel, systems based on measurements of the difference in angular velocity of a braked and unbraked wheel, skid-measuring systems, and adaptive braking systems R D V

A77-15796 # **Some problems with corrosion of aircraft structures made from aluminum alloys (Niektore problemy korozji elementow samolotow wykonanych ze stopow aluminium)** E Sitko (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) and W Wyrwa (Instytut Metali Niezelaznych, Gliwice, Poland) *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1976, p 26 28 9 refs In Polish

Typical cases of corrosive attack on parts and structures of aircraft made from AlCuMg alloys are surveyed Layer corrosion and pitting corrosion, stress corrosion cracking, intergranular corrosion, and peeling of protective coatings, on control surfaces, wing skins, and fuselage skins are discussed, with metallographic illustrations of corrosion damage Corrosion due to weather, artificial fertilizers and pesticide materials sprayed from aircraft, and salt applied to iced runway surfaces are mentioned Close attention is given to intergranular corrosion of Al alloys used in the forward flanges of wing spars, and attack on metal near threaded holes and rivet holes, with separation of corrosion-affected layers, in addition to methods for cleaning and refurbishing the protective coats of airframe and wing surfaces R D V

A77-15797 # **Slip of bearings with both races rotating in axial-flow compressor two-spool engines (Poslizg lozysk z obu wirujacymi bieznami w silnikach dwuwirnikowych ze sprezarka osiowa)** M Ostapkowicz *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1976, p 29-31 In Polish

Interaction between the speeds of rotation of the low-pressure and high-pressure rotors in transient and steady states of a two-spool engine is studied The action of the control system for the nozzle exit cross section and smooth control of fuel flow to the combustion chambers, and afterburner effects, are considered in relation to the rotation speeds of the rotors, in steady state and during transients Changes in bearing slip as a function of rotation speed and its effect on the operation of bearings with both races rotating are examined Damage to precision bearings with both races rotating (spalling, layer separation, out-of-round of balls or roller cross sections, hot spots, corrosion, dents, pitting) and their causes under service conditions (including fatigue) is scrutinized R D V

A77-15798 # **Application of simulation studies to the design and improvement of fuel control systems for aviation turbine engines (Zastosowanie badan symulacyjnych w procesie projektowania i dopracowywania ukladow paliwowo-regulacyjnych lotniczych silnikow turbinowych)** M Chrobot and A Hager *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1976, p 32-34 In Polish

A77-15840 **Optical communications systems for aircraft (Systèmes de communications optiques à bord d'avions)** T A Hawkes and J C Reymond (Thompson - CSF, Departement Avionique Générale, Issy-les-Moulineaux, Hauts-de-Seine, France) In European Conference on Optical Fiber Communications, 2nd, Paris, France, September 27-30, 1976, Reports Paris, Comité du Colloque International sur les Transmissions par Fibres Optiques, 1976, p 399-407 24 refs In French

Advances in short-haul fiber optics communications systems have advanced to the point where practical aircraft communications applications are on the agenda Fiber performance, properties specifications (physical, mechanical, chemical) for cabling materials, fiber optics (FO) connectors, emitters, receivers, and couplers are discussed, along with coupling architecture and comparisons of electrical and FO data busses Airborne data systems best suited to early introduction of FO are indicated (cockpit displays and indicators, multifunction displays) The present performance level of LEDs and PIN Si diodes, and the advantage of security afforded by FO systems, render them competitive with electrical data systems in the near future R D V

A77-15841 **A hybrid configured fiber optic data bus system** D R Porter and I R Reese (Boeing Commercial Airplane Co , Seattle, Wash) In European Conference on Optical Fiber Communications, 2nd, Paris, France, September 27-30, 1976, Reports Paris, Comité du Colloque International sur les Transmissions par Fibres Optiques, 1976, p 421-427 7 refs

The feasibility of using fiber optics as a transmission medium in future large-scale airplane data buses is investigated A fiber optic data bus configuration developed specifically for airplane application is introduced and performance is compared with the Tee and Star configurations found in previous literature The new configuration, called 'Hybrid' exhibits moderate loss between terminals and has the potential for low optical signal range, a feature necessary for efficient

data bus operation A 24-port feasibility demonstration system is also reported which confirms the validity of the Hybrid fiber optic data bus approach (Author)

A77-15874 Ground time costs money - Handling problems at airports K Hohle *Interavia*, vol 31, Dec 1976, p 1148 1150

Ground-handling considerations for commercial aircraft are widely determined by the need to keep turn around times down in connection with the maximum utilization of the aircraft for economic reasons Decisions concerning an installment of supplementary equipment in an aircraft for facilitating ground-handling operations must take into account the factor of increased fuel consumption due to the weight of the equipment The problem of aircraft positioning for aircraft which serve as freighters as well as passenger carriers are examined It is pointed out that the A 300 Airbus has the advantage that 33 tonnes of freight or baggage can be unloaded in 45 minutes G R

A77-15875 The Shenyang F-9 combat aircraft N. Cherikov *Interavia*, vol 31, Dec 1976, p 1160-1162

China began the development of its own combat aircraft, designated the F-9, after the final break with the Soviet Union at the beginning of the 1960s The design of the F-9 is largely based on that of the Soviet MiG-19, which had been constructed in China under license The F-9 was to be given an all-weather capability A description is given of various modifications which had been made to improve aircraft performance and enhance its operational life Technical data concerning the F-9 are listed in a table The development of the F-9 from the MiG-19 is viewed as an interim solution According to reports, a supersonic combat aircraft with delta wing is already at the design stage in China G R

A77-15975 New aspects of the aeroelasticity of turbo machines L E Ol'shtein *(Problemy Prochnosti*, Mar 1976, p 3-7) *Strength of Materials*, vol 8, no 3, Dec 1976, p 255 258 Translation

The principal results of the All-Union Conference on the Aeroelasticity Problem are reviewed Theoretical and experimental work on the unsteady aerodynamics of cascades is discussed, along with efforts of developing blade models having the properties of actual turbine blades Numerical methods for calculating unsteady aerodynamic characteristics of cascades of arbitrary vibrating blades are examined, along with methods of calculating three-dimensional flows through such cascades Solutions to damping and flutter problems are presented V P

A77-15976 Aeroelastic stability of ring arrays of blades with a random dynamic inhomogeneity N V Dovzhenko and R A Shipov *(Problemy Prochnosti*, Mar 1976, p 8-12) *Strength of Materials*, vol 8, no 3, Dec 1976, p 259-263 5 refs Translation

The aerodynamic stability of cascades whose dynamic non uniformity parameters are random quantities is analyzed in linear formulation of the problem A stability analysis is carried out for cascades characterized by a random distribution of the natural frequencies of serial-production blades, manufactured without controlling frequency Statistical distributions of stability levels are obtained V P

A77-15977 An analysis of the nonlinear properties of compressor blade rings in the case of self-excited vibrations E A Lokshtanov and V M Sachin *(Problemy Prochnosti*, Mar 1976, p 13-15) *Strength of Materials*, vol 8, no 3, Dec 1976, p 264 267 5 refs Translation

A method is proposed for calculating the nonlinearities of compressor blade ring characteristics on the basis of inextensive experimental data of a single parameter the amplitude of the limit cycle of synchronous natural vibrations Expressions relating the amplitude of the natural vibrations to the coefficients in the equation of motion of an equivalent vibrator are derived, and the coefficients are determined from a few known values of the amplitude Expressions are obtained for calculating the self-excitation bounds of both the blade ring and limit cycle amplitude as a function of the mode of operation The application of these models to the prediction of blade ring behavior in the presence of temperature and pressure changes is demonstrated V P

A77-15978 Determination of the aerodynamic damping of bending-twisting oscillations of turbomachine blades in air streams A A Kaminer, V A Balalaev, and N Ia Nastenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti*, Mar 1976, p 16-19) *Strength of Materials*, vol 8, no 3, Dec 1976, p 268-272 Translation

A77-15979 The external synchronization of slightly nonlinear blade crowns B F Shorr, E A Lokshtanov, N S Santalov, and A N Fedosova *(Problemy Prochnosti*, Mar 1976, p 20-24) *Strength of Materials*, vol 8, no 3, Dec 1976, p 273-278 11 refs Translation

The mechanism of the influence of external periodic effects, induced by the peripheral nonuniformity of the flow in compressor stages, on the synchronous natural vibrations of the bladings is analyzed, treating the latter as nonconservatively coupled weakly nonlinear vibrators The conditions under which this influence can manifest itself are identified The proposed mechanism of the influence of external disturbances on the stability of bladings is associated with the presence of random disturbances that disrupt the constancy of phase shifts between the blades The minimal values of external disturbances capable of affecting the stability of blades are determined V P

A77-15980 The chances of 'classical' flutter onset in the moving blades of turbines A A Khorikov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) *(Problemy Prochnosti*, Mar 1976, p 25-28) *Strength of Materials* vol 8, no 3, Dec 1976, p 279 283 8 refs Translation

The conditions for the onset of blade instability of the type of classical flutter are studied on the basis of an analysis of the frequencies and mode shapes of natural vibrations of the blades A stability condition for a uniform blade ring is formulated as a function of the dimensionless parameters of the flow and of the natural vibrations of the blades The range of variation of these parameters is studied for various situations It is shown that the risk of appearance of self vibrations becomes more pronounced when two normal mode shapes of vibration occur at similar frequencies and the mode shapes themselves possess similar torsional bending characteristics V P

A77-15981 Analysis of the nonstationary aerodynamic characteristics of cascades of arbitrarily shaped profiles V P Riabchenko *(Problemy Prochnosti*, Mar 1976, p 29-32) *Strength of Materials*, vol 8, no 3, Dec 1976, p 284-287 5 refs Translation

The problem of unsteady potential flow of an inviscid incompressible fluid through cascades of piecewise-smooth blades of arbitrary shape is studied in linear and nonlinear formulation The influence of the three dimensionality of the blades, the vibration amplitude, and the vortex configuration behind the blades on the aerodynamic characteristics of the cascades is analyzed, using a numerical approach It is shown that for closely spaced cascades, the three dimensionality of the blades has an appreciable effect on the nature of the relationship between aerodynamic damping and the phase shift between the vibrations of neighboring blades The influence of the nonlinear effects on the aerodynamic characteristics of the cascades is found to be insignificant V P

A77-15982 **The force on a confusor ring from an unevenly distributed nonstationary flow** S I Ginzburg, G I Rabinovich, and L A Suslennikov *(Problemy Prochnosti,* Mar 1976, p 33-37) *Strength of Materials,* vol 8, no 3, Dec 1976, p 288-291 7 refs Translation

The influence of trailing vortices generated by a cascade of cylindrical blades on the aerodynamic characteristics of cambered blades behind this cascade was studied experimentally Measurements of pressure changes at the blade surface showed that the amplitude of pressure pulsations changes markedly along the blade cord and from the blade face to the blade back The fluctuations of the aerodynamic force are found to depend strongly on the Strouhal number, even at values of the Strouhal number as small as 0 05 V P

A77-15983 **The problem of aeroelastic stability of ring arrays** N V Dovzhenko and R A Shipov *(Problemy Prochnosti,* Mar 1976, p 38-41) *Strength of Materials,* vol 8, no 3, Dec 1976, p 292-295 6 refs Translation

A program (for the BESM-6 computer) is proposed for optimizing numerically the dynamic nonuniformity of an annular cascade by searching for the blade normal-mode distribution that provides the highest level of annular cascade stability for a given level of nonuniformity and a given influence coefficient The computed dynamic nonuniformity distributions provide stability margins that are considerably higher than those of cascades with blade normal mode distributions usually encountered in practice V P

A77-15984 **Determination of aerodynamic damping during torsional vibrations of turbine blades** A A Kaminer, V A Balalaev, and N Ia Nastenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Mar 1976, p 42-44) *Strength of Materials,* vol 8, no 3, Dec 1976, p 296-299 Translation

A77-15985 **Certain characteristics of blade oscillations under conditions of rotating distortion** V A Kulagina (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) *(Problemy Prochnosti,* Mar 1976, p 45-48) *Strength of Materials,* vol 8, no 3, Dec 1976, p 300-304 Translation

Actuator disk theory is applied to the analysis of axial-flow-compressor rotor blade vibrations excited by rotating stall The analysis is carried out for axial-flow compressors with a smooth exhaust duct and with radial diaphragms at the outlet, taking the operating conditions into consideration Blade vibration curves are plotted for various relative rotating stall velocities It is shown that the rotating stall and its velocity are decisively affected by the conditions of compressor operation V P

A77-15986 **Investigation of oscillations of packets with a finite number of rotor blades** Iu S Vorob'ev and N G Medvedev *(Problemy Prochnosti,* Mar 1976, p 49-52) *Strength of Materials,* vol 8, no 3, Dec 1976, p 305-309 Translation

A variational method is used to solve the vibration problem for an elastically shrouded equally spaced packet of blades, treated as a single deformable system The blades are modeled by twisted rods of asymmetric variable cross section A system of basis functions is used to describe the changes in the approximating quantities along the blade length and across the blade row The asymmetric forms of the displacements and stresses induced by vibrations within the packet are identified The manner in which the design parameters and the number of shrouds affect the frequency spectrum of the system is demonstrated V P

A77-15989 **A supersonic flutter excitation mechanism for compressor blades** S I Ginzburg, N A Nabatova, and R A Shipov *(Problemy Prochnosti,* Mar 1976, p 62-65) *Strength of Materials,* vol 8, no 3, Dec 1976, p 321 324 8 refs Translation

Experimental data on flexural flutter point toward the existence of a feedback mechanism leading to an intensification of the energy exchange between the flow and blades This mechanism is not associated with changes in the compressor's aerodynamic characteristics in the transition to supersonic flow Using a quasi-stationary approach, it is shown analytically that the interaction between blades made to vibrate by periodic displacement of shock waves incident on the blades may constitute an additional destabilizing mechanism of supersonic cascades The theoretical results are verified, using an axial flow compressor V P

A77-15990 **Influence of aerodynamic factors on the excitation of torsional flutter in the blades of compressor cascades** N D Tikhonov *(Problemy Prochnosti,* Mar 1976, p 66-69) *Strength of Materials,* vol 8, no 3, Dec 1976, p 325-328 8 refs Translation

A77-15991 **Effects of axial-compressor stage design parameters on aerodynamic damping and bending flutter excitation in dynamically uniform blades** S I Ginzburg *(Problemy Prochnosti,* Mar 1976, p 70-80) *Strength of Materials,* vol 8, no 3, Dec 1976, p 329-338 8 refs Translation

A77-15992 **Calculating the vibrations of bladed disks of turbomachines with their asymmetry taken into account** M V Bekh and Iu S Vorob'ev *(Problemy Prochnosti,* Mar 1976, p 81 84) *Strength of Materials,* vol 8, no 3, Dec 1976, p 339-343 6 refs Translation

The combined vibrations of a turbine disk and its twisted blades are calculated by a variational strain-energy technique The conditions for the coupling between the disk and blades are obtained by taking into account the cross-sectional, tangential, and radial pliability of the disk in the mathematical model The mathematical model of the blades is developed on the basis of the theory of twisted blades of asymmetric cross section V P

A77-15993 **Experimental determination of aerodynamic influence coefficients during bending-twisting oscillations of blades in a flat lattice** A A Kaminer and V A Balalaev (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Mar 1976, p 85-88) *Strength of Materials,* vol 8, no 3, Dec 1976, p 344-348 Translation

A77 15994 **Vibrations in compressor blades exposed to radial irregularity of flow** S M Grinberg, A E Lur'e, and Iu P Rotmistrov *(Problemy Prochnosti,* Mar 1976, p 89-91) *Strength of Materials,* vol 8, no 3, Dec 1976, p 349-351 Translation

Strain-gauge measurements were carried out on the blades of the first three stages of a compressor with nonuniform pressure fields at the inlet to study the blade sensitivity to inlet disturbances The flow nonuniformities were generated by mounting axisymmetric spoilers at the inlet The obtained diagrams of the total pressure fluctuations, the vibrational stresses in the blades, and the changes in the nonuniformity parameter as a function of the rotational frequency of the rotor are discussed V P

A77-15995 **Effect of certain aerodynamic factors on inducement of vibrations in turbomachine blades** Iu M Tereshchenko (Kievskoe Vysshee Voennoe Aviatsionnoe Inzhenernoe Uchilishche, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Mar 1976, p 92-94) *Strength of Materials,* vol 8, no 3, Dec 1976, p 352-354 Translation

A77-15996 **Turbine blade excitation by an irregular peripheral flow** I V Egorov *(Problemy Prochnosti,* Mar 1976, p 95-98) *Strength of Materials,* vol 8, no 3, Dec 1976, p 355-358 5 refs Translation

The unsteady exciting force arising due to a nonuniform temperature and pressure field in front of the nozzle ring is examined The intensity of the force is determined under the assumptions that the flow is quasi stationary, that the gas is compressible, that only the absolute value, but not the structure, of the peripheral flow nonuniformity varies along the turbine length, and that in the expansion of the nonuniformity parameters into a Fourier series, the value of their maximal harmonic is smaller than the number of guide vanes and rotor blades V P

A77-15997 **Nonradial arrangement of turbomachine guide vanes** A A Kovalev, V A Strunkin, and I I Kurtseva *(Problemy Prochnosti,* Mar 1976, p 99-102) *Strength of Materials,* vol 8, no 3, Dec 1976, p 359 362 Translation

The influence of nozzle-guide-vane inclination on the intensity of variable stresses in rotor blades is studied analytically It is shown that the variable stresses depend not only on the inclination but also on the number of the blades, the relative diameter of the turbine, and the mode shape of blade vibrations V P

A77-15998 **Force on a fixed row of blades from an evenly distributed nonstationary flow** S I Ginzburg, G I Rabinovich, and L A Suslennikov *(Problemy Prochnosti,* Mar 1976, p 103-107) *Strength of Materials,* vol 8, no 3, Dec 1976, p 363-366. Translation

A method is proposed for measuring unsteady surface pressures at blades and the moment of force acting on the blades The local and total mechanical load exerted by an unsteady axial flow on two series connected cascades, one with cambered blades and the other with diverging blades, is measured The amplitudes of the pressure and load fluctuations obtained experimentally as a function of the amplitude and frequency of the velocity fluctuations of the oncoming flow are compared with their theoretical values obtained numerically, in a quasi-stationary approximation, on the basis of data for these cascades in steady flow V P

A77-15999 **Application of a mathematical simulation method representing the propagation of mechanical perturbations to the analysis of nonlinear vibrations in blades subject to collisions** B F Shorr and G V Mel'nikova *(Problemy Prochnosti,* Mar 1976, p 108 113) *Strength of Materials,* vol 8, no 3, Dec 1976, p 367-372 5 refs Translation

A77-16000 **An analysis of the stability of blade rims under conditions of random actions** E A Lokshtanov *(Problemy Prochnosti,* Mar 1976, p 114-120) *Strength of Materials,* vol 8, no 3, Dec 1976, p 373-381 16 refs Translation

The theory of information is applied to the analysis of the development and spectra of random vibrations in mechanical systems The relations obtained from an analysis of the entropy of single-frequency vibrations of a system of oscillators, the entropy of mechanical vibrations with distributed spectra, the determination of a random spectrum by minimizing its entropy, and the determination of the limiting reduction rate of the vibration entropy are used to study the synchronization conditions of blade rings in the presence of random external effects Relations defining the kinetic thresholds of formation of vibrational mode shapes in the presence of random disturbances are derived V P

STAR ENTRIES

N77-11973# Boeing Vertol Co, Philadelphia Pa
THE USE OF COMPUTERS IN ROTARY WING TESTING

William G S Hardy and Edward J Pyne *In* AGARD Numerical Methods and Windtunnel Testing Oct 1976 12 p refs

Avail NTIS HC A10/MF A01

Computer requirements for testing rotary wing aircraft models are discussed and a general purpose processing system is described Some considerations for data acquisition and presentation are presented The types of analyses required for rotary wing models are covered Both real time and off-line analysis methods are reviewed Author

N77-11979# National Aerospace Lab Amsterdam (Netherlands)
WIND TUNNEL TESTS AND AERODYNAMIC COMPUTATIONS, THOUGHTS ON THEIR USE IN AERODYNAMIC DESIGN

J W Slooff *In* AGARD Numerical Methods and Windtunnel Testing Oct 1976 6 p refs

Avail NTIS HC A10/MF A01

After comparing the possibilities and limitations of numerical methods and wind tunnel tests their respective roles in aerodynamic design are discussed It is concluded that the key problems of aerodynamic design are not solved by substituting numerical methods for the wind tunnel Author

N77-11981# Dornier-System G m b H, Friedrichshafen (West Germany)
THEORETICAL AND EXPERIMENTAL SIMULATION METHODS FOR EXTERNAL STORE SEPARATION TRAJECTORIES

J VonDerDecken P Esch, and P Fritz *In* AGARD Numerical Methods and Windtunnel Testing Oct 1976 5 p refs

Avail NTIS HC A10/MF A01

Numerical methods and experimental techniques for the simulation of separation trajectories of external powered and unpowered stores at low and high speed are reviewed For the theoretical simulation, potential flow methods are used to calculate the quasi-steady loadings on the store while the trajectory itself is determined by solving the equations of the 6-degree-of-freedom motion Based on the experience of numerous systematic experimental studies gained with the high loads and the freedrop technique for unpowered stores the advantages and limitations of different wind tunnel techniques are demonstrated including a critical discussion of scaling effects Autho

N77-11982*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
EXPERIMENTS PLANNED SPECIFICALLY FOR DEVELOPING TURBULENCE MODELS IN COMPUTATIONS OF FLOW FIELDS AROUND AERODYNAMIC SHAPES

Joseph G Marvin *In* AGARD Numerical Methods and Windtunnel Testing Oct 1976 13 p refs

Avail NTIS HC A10/MF A01 CSCL 01A

Building block experiments and companion numerical simulations intended to verify and guide turbulence modeling are described A series of experiments and computations being used to enhance modeling development for the shock wave turbulent boundary layer interaction problem is emphasized Results are given for transonic flow over a circular arc airfoil undergoing shock wave induced boundary layer separation for supersonic flow along a tube wall undergoing normal shock wave induced boundary layer separation Experimental data which use the complete Navier-Stokes equations are discussed Author

N77-11983# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
THE IMPORTANCE OF EXPERIMENTALLY-DETERMINED CLOSURE CONDITIONS IN TRANSONIC BLADE-TO-BLADE FLOWS CALCULATED BY A TIME-DEPENDENT TECHNIQUE

M Couston *In* AGARD Numerical Methods and Windtunnel Testing Oct 1976 23 p refs

Avail NTIS HC A10/MF A01

The use of a time dependent technique to determine inviscid blade-to-blade flow in the transonic regime for axial turbomachines is faced with the problem of closure conditions The importance of a Kutta condition in subsonic flow calculations is well known but for transonic blades the problem is still more complex The quasi-discontinuous character of the flow through shock waves and Prandtl-Meyer expansions is then superimposed on the viscous effects which dominate near the trailing edge In order to get more information about the importance of this problem a comparison between detailed measurements and calculations is presented The calculations were performed for several trailing edge flow approximations including experimentally determined conditions Author

N77-11988 British Library Lending Div Boston Spa (England)
FLOW-INDUCED VIBRATIONS RESULTING FROM KARMAN VORTEX TRAILS

Y N Chen 25 Mar 1976 16 p refs Transl into ENGLISH from Energietechnik (Leipzig), v 25 no 5 May 1975 p 200-205 Presented at 6th Power Station Technol Colloq, Dresden East Germany 24-25 Sep 1974
(BLL-Risley-TR-2994-(9091 9F)) Avail British Library Lending Di Boston Spa Engl

Karman eddy streets are formed on flow around structural elements of a power station and individual cylinders, tube bundles plates, which induce periodic dynamic forces transverse to the flow at these elements The Karman eddy street beyond a plate exposed to longitudinal flow depends largely on the outlet edge shape of the plate If the plate has a very slender outlet edge then the frequency of the Karman eddy is determined by the Tollmien-Schlichting instability wave in the separated boundary layer If however the outlet edge is not of slender shape, so that a thick flow run-on forms beyond the plate then the eddy frequency is determined by the thickness and configuration of the outlet edge Author

N77-11989*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
VORTEX SIMULATION OF THE PRESSURE FIELD OF A JET

Y T Fung and C H Liu Nov 1976 29 p refs Presented at 92d ASA Meeting, San Diego Nov 1976
(NASA-TM-X-73984) Avail NTIS HC A03/MF A01 CSCL 01A

Fluctuations of the pressure field of a jet are simulated numerically by a flow model consisting of axisymmetric vortex rings with viscous cores submerged in an inviscid uniform stream Vortex shedding time intervals randomly created to imitate the time-history characteristics of the pressure signals of a jet are generated based on a probability distribution of the intervals between successive pressure peaks obtained from experiments It is found that up to five diameters downstream of the jet exit the characteristics of the pressure fluctuations and the most proable time intervals between experimental and numerical results show good qualitative agreements The role played by the axisymmetric vortex model in pressure field as well as extensions of the model is also discussed Author

N77-11992*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

A METHOD FOR THE ANALYSIS OF NONLINEARITIES IN AIRCRAFT DYNAMIC RESPONSE TO ATMOSPHERIC TURBULENCE

Kenneth Sidwell Washington Nov 1976 83 p refs
(NASA-TN-D-8265 L-10487) Avail NTIS HC A05/MF A01 CSCL 01C

An analytical method is developed which combines the equivalent linearization technique for the analysis of the response of nonlinear dynamic systems with the amplitude modulated random process (Press model) for atmospheric turbulence The method is initially applied to a bilinear spring system The analysis of the response shows good agreement with exact results obtained by the Fokker-Planck equation The method is then applied to an example of control-surface displacement limiting in an aircraft with a pitch-hold autopilot Author

N77-11994*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

SCRAMJET NOZZLE DESIGN AND ANALYSIS AS APPLIED TO A HIGHLY INTEGRATED HYPERSONIC RESEARCH AIRPLANE

William J Small John P Weidner and P J Johnston Washington Nov 1976 46 p refs
(NASA-TN-D-8334 L-11003) Avail NTIS HC A03/MF A01 CSCL 01C

Engine-nozzle airframe integration at hypersonic speeds was conducted by using a high-speed research aircraft concept as a focus Recently developed techniques for analysis of scramjet-nozzle exhaust flows provide a realistic analysis of complex forces resulting from the engine-nozzle airframe coupling By properly integrating the engine-nozzle propulsive system with the airframe efficient controlled and stable flight results over a wide speed range Author

N77-11995*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

WIND TUNNEL INVESTIGATION OF INTERNALLY BLOWN JET-FLAP STOL AIRPLANE MODEL

Raymond D Vogler Washington Nov 1976 87 p
(NASA-TN-D-8309 L-10887) Avail NTIS HC A05/MF A01 CSCL 01C

The low speed longitudinal characteristics of the jet flap STOL model were determined The 17 percent thick supercritical swept wing had leading edge slats and a full span 0 30 chord plain flap with flaperons divided into six equal spanwise segments The angle of attack range was -4 deg to 24 deg and the blowing momentum range was from 0 to 2 3 Flap deflections were from 0 deg to 70 deg Most flap deflections were full span although there were some tests of partial span deflections and partial span blowing Author

N77-11997*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

LOW-SPEED WIND-TUNNEL INVESTIGATION OF A LARGE SCALE ADVANCED ARROW-WING SUPERSONIC TRANSPORT CONFIGURATION WITH ENGINES MOUNTED ABOVE WING FOR UPPER-SURFACE BLOWING

James P Shivers H Clyde McLemore and Paul L Coe, Jr Washington Dec 1976 61 p refs
(NASA-TN-D-8350, L-10994) Avail NTIS HC A04/MF A01 CSCL 01A

Tests have been conducted in a full scale tunnel to determine the low speed aerodynamic characteristics of a large scale advanced arrow wing supersonic transport configuration with engines mounted above the wing for upper surface blowing Tests were made over an angle of attack range of -10 deg to 32 deg sideslip angles of + or - 5 deg, and a Reynolds number range of 3 530 000 to 7 330,000 Configuration variables included trailing edge flap deflection engine jet nozzle angle engine thrust coefficient, engine out operation, and asymmetrical trailing edge boundary layer control for providing roll trim Downwash measurements at the tail were obtained for different thrust coefficients tail heights and at two fuselage stations Author

N77-11998*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

INVESTIGATION OF VERY LOW BLOCKAGE RATIO BOATTAIL MODELS IN THE LANGLEY 16-FOOT TRANSONIC TUNNEL

David E Reubush Washington Nov 1976 65 p refs
(NASA-TN-D-8335 L-11063) Avail NTIS HC A04/MF A01 CSCL 01A

An investigation at an angle of attack of 0 deg was conducted in a 16 foot transonic tunnel at Mach numbers from 0 4 to 1 05 to determine the limits in Mach number at which valid boattail pressure drag data may be obtained with very low blockage ratio bodies Extreme care was exercised when examining any data taken at subsonic Mach numbers very near 1 0 and lower than the supersonic Mach number at which shock reflections miss the model Boattail pressure coefficient distributions did not indicate any error but when integrated boattail pressure drag data was plotted as a function of Mach number data which were in error were identified Author

N77-11999*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

CORRELATION OF FULL-SCALE HELICOPTER ROTOR PERFORMANCE IN AIR WITH MODEL-SCALE FREON DATA

William T Yeager Jr and Wayne R Mantay Washington Dec 1976 60 p refs Prepared in cooperation with Army Air Mobility R and D Lab Hampton Va
(DA Proj 1F1-61102-AH-45)
(NASA-TN-D-8323 L-10844) Avail NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted in a transonic dynamics tunnel to measure the performance of a 1/5 scale model helicopter rotor in a Freon atmosphere Comparisons were made between these data and full scale data obtained in air Both the model and full scale tests were conducted at advance ratios between 0 30 and 0 40 and advancing tip Mach numbers between 0 79 and 0 95 Results show that correlation of model scale rotor performance data obtained in Freon with full scale rotor performance data in air is good with regard to data trends Mach number effects were found to be essentially the same for the model rotor performance data obtained in Freon and the full scale rotor performance data obtained in air It was determined that Reynolds number effects may be of the same magnitude or smaller than rotor solidity effects or blade elastic modeling in rotor aerodynamic performance testing Author

N77-12000*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
COLD-AIR PERFORMANCE OF A TIP TURBINE DESIGNED TO DRIVE A LIFT FAN 1 BASELINE PERFORMANCE
Jeffrey E Haas, Milton G Kofskey, Glen M Hotz and Samuel M Futral Jr Washington Dec 1976 25 p refs Prepared in cooperation with Army Air Mobility R and D Lab Cleveland
(NASA-TM-X-3452 E-8754) Avail NTIS HC A02/MF A01 CSCL 21E

Full admission baseline performance was obtained for a 0 4 linear scale of the LF460 lift fan turbine over a range of speeds and pressure ratios without leakage air These cold-air tests covered a range of speeds from 40 to 140 percent of design equivalent speed and a range of scroll inlet to diffuser exit static pressure ratios from 2 0 to 4 2 Results are presented in terms of specific work torque mass flow efficiency and total pressure drop Author

N77-12001# Laboratoire de Recherches Balistiques et Aerodynamiques Vernon (France) Service Aerodynamique
SUPERSONIC AIRCRAFT AFTER BODY STUDY OF A THICK BOUNDARY LAYER ON A TWO-DIMENSIONAL STEP [ARRIERE CORPS D'AVIONS SUPERSONIQUES ETUDE D'UNE COUCHE LIMITE EPAISSE SUR UNE MARCHE BIDIMENSIONNELLE]
F Kauba 17 May 1976 83 p refs In FRENCH
(Contract DRME-74-118)
(LRBA-E-815-PV-4/SAE) Avail NTIS HC A05/MF A01

Separation and reattachment of a thick boundary layer on a two-dimensional step was studied in a supersonic wind tunnel The ratio flow thickness (delta)/step height (h = 5 mm) was 2 The bi-dimensionality of the flow on the plane part of the step after flow reattachment was confirmed and the validity of certain results obtained for values delta/h smaller than or equal to 1 was checked Attempts to sound the recirculation zone are also described ESA

N77-12003# European Space Agency Paris (France)
DISPLAY AND CALCULATION OF FLOW PAST WINGS IN SUPERSONIC FLIGHT
Erich Leiter Oct 1976 126 p refs Transl into ENGLISH of Stroemungen um Tragflaechen im stationaeren Ueberschallflug Ihre Darstellung u Berechnung auf der Grundlage von Auftriebs-Aufwindbeziehungen DFVLR Goettingen West Ger Report DLR-FB-75-61 26 Aug 1975 Original report in GERMAN previously announced as N76-31204 Original German report available from DFVLR Cologne DM 57 50
(ESA-TT-333 DLR-FB-75-61) Avail NTIS HC A07/MF A01

A linearized wing theory was derived from a general relation between lift and down/upwash-distribution This equation was obtained as a solution of an initial value problem of Hadamrad s integration theory The known results are deduced Analytical approximations are given for the upwash-distribution In the case of wings with two subsonic leading edges successive approximations and estimations of errors are made available A new subsonic-supersonic analogy is pointed out Author (ESA)

N77-12006# Army Missile Research Development and Engineering Lab , Redstone Arsenal Ala Aeroballistics Directorate
INVESTIGATION OF JET PLUME EFFECTS ON THE LONGITUDINAL STABILITY CHARACTERISTICS OF A BODY OF REVOLUTION WITH VARIOUS FIN CONFIGURATIONS AT MACH NUMBERS FROM 0 2 TO 2 3 (NORMAL JET PLUME SIMULATOR)
James H Henderson 20 Feb 1976 95 p refs
(DA Proj 1W3-62303-A-214)
(AD-A024978 RD-76-22) Avail NTIS HC A05/MF A01 CSCL 20/4

Transonic wind tunnel tests were conducted on a body of revolution with various fin configurations to investigate jet plume effects on missile longitudinal stability A series of cold air normal jets located downstream of the base were utilized to simulate the jet plume Fins of various planform geometry were tested at a forward longitudinal location The angle of attack range was -4 to 11 degrees at Mach numbers of from 0 2 to 2 3 The test was run at the Arnold Engineering Development Center Transonic 16t and Supersonic 16S wind tunnels and was designated AEDC SF 172/TF 360 GRA

N77-12007# Strategic Air Command Offutt AFB Nebr Office of Science and Research
SUMMARY AND EVALUATION OF THEORETICAL DEVELOPMENTS RELATING TO TRAILING WING TIP VORTICES GENERATED BY AIRCRAFT
Albert G Carpenter 10 May 1976 50 p refs
(AD-A025614 SAC-NR-76-01) Avail NTIS HC A03/MF A01 CSCL 01/3

This report presents a summary of theories and measurements which are believed to be applicable to the prediction of details concerning the structure and behavior of wing tip vortices created by large aircraft Emphasis is placed upon the chronological development of theories their comparison and the selection of those which are believed to be most useful in predicting detailed velocity profiles of and within vortices from the moment of wing tip shedding until considerable trailing distances have been established with the passage of time Author (GRA)

N77-12010# Toronto Univ (Ontario) Inst for Aerospace Studies
VELOCITY MEASUREMENTS ON THE AERODYNAMIC WAKE OF A HOVERCRAFT USING LASER DOPPLER ANEMOMETRY
W E R Davies and J H DeLeeuw Jun 1976 26 p refs
(Grant AF-AFOSR-2091-71)
(UTIAS-TN-203 CN-ISSN-0082-5263) Avail NTIS HC A03/MF A01

The laser Doppler technique was applied to determine the aerodynamic wake velocity components behind a tethered air cushion vehicle which runs close to a confining wall Two velocity components were measured for a number of locations behind the vehicle using the fringe mode and forward scattering from unseeded air Some auxiliary forward and back scatter experiments with pulsed and D C lasers are also described A video tape recorder was used to record all the laser Doppler data, which could then be processed by an oscilloscope a spectrum analyser of a DISA 55L signal processor Results are presented which show that the stabilized wake effects are minimal Author

N77-12013# Advisory Group for Aerospace Research and Development Paris (France)
THROUGH-FLOW CALCULATIONS IN AXIAL TURBOMACHINERY
Oct 1976 237 p refs Proceedings held at Cologne West Germany 20-21 May 1976
(AGARD-CP-195 ISBN-92-835-0179-9) Avail NTIS HC A11/MF A01

An axisymmetric approach is used in considering flow distributions at design and off-design conditions in single and multi-stage turbomachines

N77-12014# Societe Nationale d'Etude et de Construction de Moteurs d Aviation Villaroche (France)
MODELS FOR CALCULATING FLOW IN AXIAL TURBOMACHINERY [MODELES DE CALCUL DE L'ECOULEMENT DANS LES TURBOMACHINES AXIALS]

Jean-Marine Thiaville *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 16 p refs In FRENCH

Avail NTIS HC A11/MF A01

The problem of calculating axial flow in turbomachines is approached using the model of current surfaces S1 and S2 of C H Wu Viscous effects are introduced under the form of loss and the effects of displacement The boundary layer theory is accepted The simplified model is used to analyze the connection of the estimates of surfaces S1 and S2 Transonic flow is studied Diagrams of loss and of angles beyond adaptation are provided Blocking and secondary flow are considered Applications in which the model is defective are discussed and methods for resolving the difficulties are suggested Transl by A H

N77-12015# Durham Univ (England) Dept of Engineering Science

THROUGH-FLOW CALCULATIONS IN AXIAL TURBOMACHINERY A TECHNICAL POINT OF VIEW

H Marsh *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 19 p refs

Avail NTIS HC A11/MF A01

The through-flow theory for turbomachines and a detailed discussion on the methods of streamline curvature and matrix through-flow are reported These two methods of solution are shown to be two different techniques for calculating the flow on a mean stream surface The Mach number limitations are outlined and the lack of a rigorous definition for the mean stream surface is discussed The use of a consistent loss model leads to an improved form of the matrix method Recent advances in the calculation of wall boundary layers and secondary flows are reported Work on time marching techniques is reviewed Author

N77-12016# Carleton Univ , Ottawa (Ontario)

THROUGH-FLOW CALCULATIONS BASED ON MATRIX INVERSION LOSS PREDICTION

W Roland Davis (Davis and Associates, Ottawa) and D A J Millar *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 12 p refs

Avail NTIS HC A11/MF A01

The inviscid flow field in the meridional (hub-to-shroud) plane of an axial compressor is solved by a finite difference technique which employs matrix inversion The viscous flow effects are accounted for by using empirical data and the performance of the compressor is determined by an interactive solution This describes the loss and deflection system which is used to model the effects of blade passage and end wall losses and of blade passage deflection of the working fluid The manner in which this system interacts with the matrix inviscid solution is described Author

N77-12017# Detroit Diesel Allison Indianapolis, Ind

THROUGH-FLOW CALCULATIONS THEORY AND PRACTICE IN TURBOMACHINERY DESIGN

John E Carutners and Theodore F McKain *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 14 p refs

Avail NTIS HC A11/MF A01

The through-flow calculation is an integral and vital element of any effective turbomachinery design and development process The assumptions involved with typical formulation of the basic equations and the solution techniques employed in such areas as boundary condition specification, numerical evaluation of derivatives and numerical stability are presented Experimental verification of the theory using turbomachinery applications is presented to demonstrate the accuracy of the calculation Finally, the normal compressor design and development cycle is reviewed to stress the importance of the through-flow calculation in this process Author

N77-12018# Vrije Universiteit Brussels (Belgium) Dept of Fluid Mechanics

FINITE ELEMENT METHOD FOR THROUGH-FLOW CALCULATIONS

Ch Hirsch *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 16 p refs

Avail NTIS HC A11/MF A01

The finite element method is applied to the radial equilibrium equation in the form obtained after introduction of the stream function A short presentation of the basic features of the F E M is given and the particular aspects of its application to the through-flow problem in turbomachines are described A comparison with an analytic solution for an axisymmetric transitional annulus with swirl allows an estimation of the numerical accuracy of the method Other examples of results include a transonic axial compressor and an axial turbine The coupling with an end-wall boundary layer calculation for axial compressors is also briefly described Author

N77-12019*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

THREE-DIMENSIONAL FLOW CALCULATION FOR A TRANSONIC COMPRESSOR ROTOR

William T Thompkins Jr and David A Oliver *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 18 p refs

(Grant NGL-22-009-383)

Avail NTIS HC A11/MF A01

A numerical calculation of the steady inviscid, three dimensional flow in a isolated transonic compressor rotor has been completed using MacCormack s second order accurate time-marching scheme This rotor has a tip Mach number of 1 2, an overall diameter of 2 feet and inlet hub/tip ratio of 0 5 The computed rotor total pressure ratio is 1 82 Comparisons between the numerical solution measurements of the intra-blade static density field obtained by gas fluorescence and time resolved exit flow measurements showed that the inviscid computation accurately models transonic rotor aerodynamics and rotor blade pressure distributions in the upstream portions of the blade passages the viscous effects influencing mainly the downstream flow Author

N77-12020# GEC Turbine Generators Ltd , Manchester (England) Theoretical Aerodynamics Group

THROUGH-FLOW CALCULATION PROCEDURES FOR APPLICATION TO HIGH SPEED LARGE TURBINES

H J A Cox *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 13 p refs

Avail NTIS HC A11/MF A01

Major difficulties arise in the evaluation of through-flow solutions relevant to conditions existing within the rear stages of large modern low pressure steam turbines The highly loaded stage designs in which convergent-divergent profiles are used require computation procedures which can accurately allow for supersonic Mach numbers at both guide and runner blade outlet high values of streamline slope in the meridional plane and varying quantities of mass flow tapped off between stages The consequent effect of these conditions on turbine performance and various methods by which they can be incorporated into a streamline curvature computation process are discussed together with the use of steam thermodynamic data Procedures which can be employed to obtain numerical stability and convergence in the computation process are suggested and further problems concerned with the evaluation of off-design solutions are briefly considered Author

N77-12021# Brown Boveri and Co , Ltd , Baden (Switzerland) Dept of Gas Turbines

DESIGN OF TURBINE, USING DISTRIBUTED OR AVERAGE LOSSES, EFFECT OF BLOWING

D K Mukherjee *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 14 p refs

Avail NTIS HC A11/MF A01

The design of a multi-stage turbine begins with one dimensional calculations Flow field computations which then follow are invaluable as they allow to determine velocity triangles at different radii and to design the blades In these calculations, aerodynamic losses and outlet angle deviations due to secondary and tip clearance flow as well as the influence of coolant on the main stream expansion are taken into account Author

N77-12022# Northern Research and Engineering Corp., Cambridge Mass Fluid Dynamic Systems Group

A CRITICAL REVIEW OF TURBINE FLOW CALCULATION PROCEDURES

A F Carter *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 7 p refs

Avail NTIS HC A11/MF A01

Blade row performance parameters, such as total-pressure-loss coefficients and flow deviations remain the weak assumptions in most of the otherwise sophisticated calculations of turbine flow conditions Some of the areas are reviewed in which further efforts are needed Since a turbine s performance ultimately depends on the detailed design of the balding the paper concentrates on this aspect of turbine design and analysis Author

N77-12023# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Cologne (West Germany)

COMPRESSOR DESIGN AND EXPERIMENTAL RESULTS

H B Weyer *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 15 p refs

Avail NTIS HC A11/MF A01

After an introduction to current techniques available to evaluate the axisymmetric flow field in turbomachines at design and off-design conditions research was concentrated primarily on proving these calculation methods by comparing the results with corresponding experimental data from real test machines Considered were (1) A single-stage transonic compressor without inlet guide vanes (2) a three-stage transonic compressor without inlet guide vanes and (3) a 4-stage compressor with inlet guide vanes Complete geometrical data and test results are provided G G

N77-12024# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Cologne (West Germany)

COMPARISON BETWEEN THE CALCULATED AND THE EXPERIMENTAL RESULTS OF THE COMPRESSOR TEST CASES

H B Weyer and R Dunker *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 26 p refs

Avail NTIS HC A11/MF A01

For the calculation of the compressor s overall performance one-dimensional techniques as well as duct flow and through-flow methods were used No characteristic differences encounter from the various methods indicating that a severe effect of a more or less complete physical flow model does not exist The deviations as far as observed with respect to the experiments are primarily due to the inaccuracy of the flow loss and flow turning predictions particularly at off-design operating conditions The duct-flow and through-flow calculation techniques were mainly utilized to compute in detail the compressor internal flow Streamline curvature, matrix and finite element methods thereby served as numerical procedures to resolve the flow equations Concerning the flow parameters calculated outside of the blade rows no evident superiority was observed for any method even for the through-flow techniques although their physical background seems to be more accomplished taking for instance into account the effects of blade thickness, blade turning a s o Discrepancies in the experimental results are believed to be caused by an inexact estimation of the wall boundary-layer blockage, and by 3-dimensional flow effects which are not accounted for in the 2-dimensional calculation techniques Author

N77-12025# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

TURBINE TEST CASES PRESENTATION OF DESIGN AND EXPERIMENTAL CHARACTERISTICS

J Chauvin and C Sieverding *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 19 p

Avail NTIS HC A11/MF A01

Full geometric data are presented for a two-stage, two-shaft HP-IP turbine for advanced gas turbine engines Traverse data are available before and after each blade row for total pressure, total temperature static pressure and absolute angle Author

N77-12026# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

TURBINES PRESENTATION OF CALCULATED DATA AND COMPARISON WITH EXPERIMENTS

J Chauvin *In* AGARD Through-Flow Calculations in Axial Turbomachinery Oct 1976 24 p refs

Avail NTIS HC A11/MF A01

Performance test results together with geometric design data for two axial flow turbomachines are detailed Data include nominal 2pm and nominal mass flow as well as nominal pressure ratios and efficiencies General information on utilized computer programs and calculation methods is included G G

N77-12027*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

FULL-SCALE CRASH TEST OF A CH-47C HELICOPTER

Claude B Castle Washington Dec 1976 38 p refs Film supplement L-1211 to this report is available on request (NASA-TM-X-3412, L10854) Avail NTIS HC A03/MF A01 CSCL 01C

A full-scale crash test of a large troop/cargo carrying CH-47C helicopter was conducted at the Langley impact dynamics research facility The crash test of this large helicopter was performed as part of a joint U S Army-NASA helicopter test program to provide dynamic structural and seat response data The test, the procedures employed the instrumentation a general assessment of the resulting damage and typical levels of accelerations experienced during the crash are reported Various energy-absorbing seating systems for crew and troops were installed and instrumented to provide data for use in the development of design criteria for future aircraft The crash conditions were selected to simulate known crash conditions and are representative of the 95th percentile accident environment for an autorotating helicopter Visual examination of the crashed test specimen indicated irreparable damage to many of the structural components The highest accelerations were recorded by the accelerometers located on the cabin floor in the aft section of the helicopter, directly above the primary impact location and on the floor of the cockpit above the secondary impact location(s) Author

N77-12031*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

SPECTRALLY BALANCED CHROMATIC LANDING APPROACH LIGHTING SYSTEM Patent Application

Wendell D Chase inventor (to NASA) Filed 10 Dec 1976 21 p

(NASA-Case-ARC-10990-1 US-Patent-Appl-SN-749420) Avail NTIS HC A02/MF A01 CSCL 17G

A landing approach lighting system which corrects for the effects of chromatic aberration of the human eye to help prevent a pilot from making misjudgments leading to landings short of a runway threshold is described The system utilizes red warning lights to delineate the runway approach with additional blue lights juxtaposed with the red lights such that the red lights are chromatically balanced The red/blue point light sources result in the phenomenon that the red lights appear in front of the blue lights with about one and one-half times the diameter of the blue To a pilot observing these lights along a glide path those red lights directly below appear to be nearer than the blue lights For those lights farther away seen in perspective at oblique angles the red lights appear to be in a position closer to the pilot and hence appear to be above the corresponding blue lights NASA

N77-12036# Massachusetts Inst of Tech Cambridge Lab of Electronics

NARROW-BAND PASSIVE SYSTEMS THEORY WITH APPLICATIONS TO POSITIONING AND NAVIGATION Ph D Thesis

Jose Manuel Fonseca DeMoura 28 Apr 1976 216 p refs (Contract DAAB07-75-C-1346)

(AD-A025743 TR-490) Avail NTIS HC A10/MF A01 CSCL 17/7

The passive tracking problem with narrow-band and linear constraints on geometry and motion is considered In Part I a model is developed which exhibits explicitly the nonhomogeneous received wave field structure induced by the spatial baseline (observer s array) and/or temporal diversity (source motion) This model encompasses the basic phenomena of many practical situations and is sufficiently simple to be useful in analytical studies The fundamental question of global parameter identifiability is pursued with emphasis on passive ranging The structure and global and local performance of the optimal and suboptimal receivers are examined and by considering two limiting geometries (distant and close observer) analytical intuitively pleasing expressions are derived which bound the mean-square performance In Part 2 a practical hybrid solution to the passive tracking problem is developed and a compromise is achieved between global parameter identifiability and receiver complexity The behavior of the hybrid algorithm and its sensitivity to the underlying model assumptions of linear path perturbations are analyzed The theory of passive tracking is applied to positioning in such situations as air traffic control underwater acoustics, and navigation (orbiting and geostationary satellites) GRA

N77-12039*# Douglas Aircraft Co Inc Long Beach Calif

ADVANCED COMPOSITE RUDDERS FOR DC-10 AIRCRAFT DESIGN, MANUFACTURING, AND GROUND TESTS Final Technical Report, 18 Jan 1974 - 30 Apr 1976

George M Lehman D M Purdy, A Cominsky A V Hawley M P Amason J T Kung, R J Palmer N B Purves, P J Marra, G R Hancock et al Washington NASA 30 Apr 1976 144 p

(Contract NAS1-12954)

(NASA-CR-145068) Avail NTIS HC A07/MF A01 CSCL 01C

Design synthesis tooling and process development, manufacturing and ground testing of a graphite epoxy rudder for the DC-10 commercial transport are discussed The composite structure was fabricated using a unique processing method in which the thermal expansion characteristics of rubber tooling mandrels were used to generate curing pressures during an oven cure cycle The ground test program resulted in certification of the rudder for passenger-carrying flights Results of the structural and environmental tests are interpreted and detailed development of the rubber tooling and manufacturing process is described Processing tooling and manufacturing problems encountered during fabrication of four development rudders and ten flight-service rudders are discussed and the results of corrective actions are described Non-recurring and recurring manufacturing labor man-hours are tabulated at the detailed operation level A weight reduction of 13 58 kg (33 percent) was attained in the composite rudder Author

N77-12040*# Princeton Univ, N J Dept of Aerospace and Mechanical Sciences

AN EXPERIMENTAL INVESTIGATION OF THE FLAP-LAG STABILITY OF A HINGELESS ROTOR WITH COMPARABLE LEVELS OF HUB AND BLADE STIFFNESS IN HOVERING FLIGHT Final Report

H C Curtiss, Jr and W F Putman Jun 1976 33 p refs (Contract NAS2-7615)

(NASA-CR-151924 AMS-1300) Avail NTIS HC A03/MF A01 CSCL 01C

An experimental investigation of the flap-lag stability of a hingeless rotor in hovering flight is presented and discussed The rotor blade and hub configuration were selected such that the hub and blade had comparable levels of bending stiffness Experimental measurements of the lag damping were made for various values of rotor rotational speed and blade pitch angle Specifically at a blade pitch angle of 8 deg at three-quarters radius the lag damping was determined over a range of rotational speeds from 200 RPM to 320 RPM and also over a range of blade pitch angles from 0 deg to 8 deg Author

N77-12041*# General Electric Co Cincinnati Ohio

ANALYSIS OF PRESSURE DISTORTION TESTING Final Report

K E Koch and R L Rees Washington NASA Dec 1976 103 p refs

(Contract NAS3-19522)

(NASA-CR-2766, Rept-76AEG272) Avail NTIS HC A06/MF A01 CSCL 20D

The development of a distortion methodology method D, was documented and its application to steady state and unsteady data was demonstrated Three methodologies based upon DIDENT, a NASA-LeRC distortion methodology based upon the parallel compressor model, were investigated by applying them to a set of steady state data The best formulation was then applied to an independent data set The good correlation achieved with this data set showed that method E one of the above methodologies is a viable concept Unsteady data were analyzed by using the method E methodology This analysis pointed out that the method E sensitivities are functions of pressure defect level as well as corrected speed and pattern Author

N77-12042# Army Aviation Engineering Flight Activity Edwards AFB Calif

ARMY PRELIMINARY EVALUATION JOH-58A HELICOPTER WITH LOW REFLECTIVE PAINT AND INFRARED COUNTERMEASURE EXHAUST SYSTEM Final Report, 1 Jul - 14 Oct 1975

Charles L Thomas Tom P Benson and Robert M Buckanin Dec 1975 105 p refs

(AD-A024727 USAAEFA-75-11) Avail NTIS HC A06/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted an Army Preliminary Evaluation of a JOH-58A helicopter painted with a low reflective paint and equipped with a prototype infrared countermeasure exhaust system from 1 July through 14 October 1975 The testing was conducted at Edwards Air Force Base and at Point Mugu Naval Air Station California Results of these tests were compared with test results from earlier evaluations of the OH-58A performance and handling quality characteristics and with preliminary base-line testing performed during this evaluation One deficiency and two shortcomings were noted during this evaluation Although not classified as a deficiency or shortcoming the most significant

finding in this evaluation was the serious degradation in hover and level flight performance when the rotor blades are painted with low reflective paint GRA

N77-12043# Army Aviation Engineering Flight Activity, Edwards AFB *Calif*

AIRWORTHINESS AND FLIGHT CHARACTERISTICS EVALUATION YAH-1S IMPROVED COBRA AGILITY AND MANEUVERABILITY HELICOPTER Final Report, 17 Mar - 17 Apr 1975

Gary L Skinner William Y Abbott, and Richard C Tarr Aug 1975 114 p refs

(AD-A025476 USAAEFA-74-34) Avail NTIS HC A06/MF A01 CSCL 01/1

Limited flight tests of a prototype aircraft were conducted at 3 test facilities at various altitudes Testing concentrated on hover and level flight performance controllability, and low-speed flight characteristics at heavy gross weight high density altitude test conditions The YAH-1S represents a significant improvement over the AH-1G/Q helicopter by virtue of its increased useful load-carrying capability directional controllability and control margin and hover performance capability The control system characteristics of the YAH-1S failed to meet several requirements of applicable paragraphs of military specification MIL-H-8501A and the approved BHC deviations to MIL-H-8501A against which they were tested, but were still considered satisfactory One shortcoming was noted GRA

N77-12044# Rock Island Arsenal Ill

MEASUREMENT OF THE STATIC INFLUENCE COEFFICIENT OF THE AH-1G COBRA FUSELAGE Preliminary Report, 1 Feb 1975 - 30 Jan 1976

Donald E Frericks Edward R Lindquist, Robert A Peterson, and Robert J Radkiewicz 1 Feb 1976 682 p *refs*

(AD-A025114 RIA-R-TR-76-005) Avail NTIS HC A99/MF A01 CSCL 01/3

An AH-1G Cobra Helicopter (minus the tailsection) was mounted in a vertical position by personnel at the Ware Simulation Center Rock Island Arsenal and the response of the fuselage to various applied loads was then measured The response measured as deflections in the direction of applied load will be used by Bell Helicopter Company for the validation of their NASTRAN math model of the Cobra Helicopter Initial results of the test indicate good agreement between the experimentally measured deflections and the math model predicted deflections GRA

N77-12045# United Technologies Corp, Stratford, Conn Sikorsky Aircraft Div

VALIDATION OF THE ROTORCRAFT FLIGHT SIMULATION PROGRAM (C81) FOR ARTICULATED ROTOR HELICOPTERS THROUGH CORRECTION WITH FLIGHT DATA Final Report

S J Briczinski May 1976 62 p refs

(Contract DAAJ02-74-C-0046 DA Proj 1F2-62208-AH-90)

(AD-A025934, SER-50956 USAAMRDL-TR-76-4) Avail NTIS HC A04/MF A01 CSCL 09/2

The Rotorcraft Flight Simulation Program C81 (Version AGAJ74) was run, simulating a wide variety of flight conditions in order to gather data for comparison to flight test data and data originating from other analyses to determine the accuracy with which the C81 program predicts various characteristics of articulated rotor helicopters The C81 input data were prepared, modeling the H-53 and S-67 helicopters, and runs were made to obtain trim, performance, stability, time history response, and rotor loads data predictions The results of this study of the application of C81 to articulated rotor helicopters pointed out severe limitations to its application to rotors with any significant blade parameter discontinuities Even under most favorable circumstances, this study did not indicate any significant increase in accuracy over other methods available for handling the disciplines covered by C81 While the ability to treat performance stability and control, and rotor loads all within the same program has some advantages in this case the advantages appear to be offset by excessive running times required for performance and maneuver response problems which normally can be handled by much simpler and quicker running programs Author (GRA)

N77-12046# Bell Helicopter Co, Fort Worth Tex

HIGH-SURVIVABLE TRANSMISSION SYSTEM Final Report, Jan 1974 - Aug 1975

David J Richardson May 1976 114 p

(Contract DAAJ02-74-C-0019 DA Proj 1F2-62205-AH-88)

(AD-A025930 USAAMRDL-TR-76-8) Avail NTIS HC A06/MF A01 CSCL 01/3

The purpose of this program was to design fabricate, and test an integrated survivable transmission system for the AH-1G/Q helicopter that would be capable of operation for 60 minutes following the loss of the normal lubrication system Utilizing the results of previous contractual research efforts, an engineering analysis was performed which produced a design that included an emergency lubrication system in conjunction with some improved components One transmission which incorporated the design modifications was fabricated and tested The test program included an emergency lubrication test run in which a ballistic hit resulting in total loss of the main lubrication system was simulated and the transmission was run on emergency lubrication at 950 input horsepower (85% of takeoff horsepower) with 25 horsepower through the tail rotor until failure occurred The transmission ran 4 0 hours following the loss of the normal lubrication system After 4 0 hours of emergency running, the teeth of the lower sun gear were stripped off resulting in complete loss of the mast torque and termination of the test The design concept for the high-survivable transmission (HST) system tested during this program appears to be more than adequate to provide 60 minutes of transmission operation following the loss of the normal lubrication system Test results indicate that the transmission could have operated indefinitely if the emergency oil had not leaked past the input seal Author (GRA)

N77-12047# Air Force Weapons Lab Kirtland AFB N Mex

ANALYSIS OF DYNAMIC AIRCRAFT RESPONSE TO BOMB DAMAGE REPAIR Final Report

Lawrence D Hokanson Nov 1975 54 p refs

(AF Proj 2104)

(AD-A025647, AFWL-TR-75-138) Avail NTIS HC A04/MF A01 CSCL 01/5

Expedient repair methods and settlement of expedient repair materials create roughness in repaired airfield pavement surfaces The effect of this roughness on aircraft operated over a repair has been of serious concern to organizations designing repair procedures An analysis is made of the dynamic response of F-4 aircraft when operated over an actual AM-2 mat Bomb Damage Repair (BDR) surface utilizing data obtained in FY73 BDR full scale testing A computer code entitled TAXI yields the g loadings on various parts of the aircraft, the strut forces, and the strut displacements when the repair profile is used as program input It was determined that a speed of 45 fps yields the largest responses Running the program with variations of the profile to simulate settlement of the backfill indicated that the initial construction roughness creates more adverse effects than settlement within the repair area of up to 0 4 foot Consequently *any effort to reduce roughness should concentrate* on repair surface grading rather than improving the quality of the backfill material GRA

N77-12048# Air Force Materials Lab Wright-Patterson AFB Ohio

ENVIRONMENTAL EFFECTS ON MAINTENANCE COSTS FOR AIRCRAFT EQUIPMENT Final Report, Nov 1973 - Jan 1976

Thomas K Moore May 1976 33 p refs
(AF Proj 7351)
(AD-A025801 AFML-TR-76-31) Avail NTIS HC A03/MF A01 CSCL 01/3

A series of mathematical models of the influence of environmental effects on maintenance costs was constructed using linear regression analysis The equipment whose behavior was modeled was the KC-135 Doppler Radar and the F-4E engine starter Models explaining more than 20% of the variation in maintenance cost as a result of weather factors were developed where only the two most current months weather was considered Recommendations for further research using more sophisticated model development techniques are presented A limited economic analysis of some life cycle cost implications of failure countermeasures for increased environmental resistance is given GRA

N77-12049# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
F-111A WING FATIGUE TEST PROGRAM Final Report, 24 Mar 1971 - 10 Jul 1974
Robert L Schneider Apr 1976 47 p refs
(AD-A025795 AFFDL-TR-76-30) Avail NTIS HC A03/MF A01 CSCL 01/3

An F-111A wing was fatigue tested in the full stores configuration for evaluation of the wing wing hard points, and fixed pylons The spectrum consisted of nine test conditions with loads applied at three wing sweep angles 25 50 72 5 deg The repeated application of these test conditions simulated 24 000 hrs of service (6 test lives) Upon completion of the six test lives the spectrum was modified and cycling continued for an additional four test lifetimes (16,000 hrs) After completion of the 10th fatigue test lifetime 65% limit load constant amplitude cycles were applied until failure occurred The F-111A wing has a satisfactory fatigue life for the spectrum imposed upon it GRA

N77-12050# Naval Air Test Center Patuxent River Md
DEVELOPMENT OF A TOW CAPABILITY FOR THE HH-3F HELICOPTER Final Report
J E Ludwig F A Pinegar G Serotsky J H Edris and G E Clark Apr 1976 79 p refs
(AD-A025790 NATC-RW-9R-76 USCG-D-51-76) Avail NTIS HC A05/MF A01 CSCL 01/3

An extensive evaluation was conducted to determine the capability of the HH-3F helicopter to tow the Fast Surface Delivery (FSD) System The aircraft flying qualities aircraft response to simulated emergencies Automatic Flight Control System and the simplicity and reliability of the tow equipment enhance the ability of the HH-3F helicopter to fulfill the requirements of the U S Coast Guard tow mission Mission limitations are imposed by the low power margin at high gross weights in the low speed tow regime Inefficient transmission oil cooler operation limits the amount of time allowed in a downwind tow condition Further testing is recommended to determine pilot fatigue limitations due to unusual aircraft attitudes during tow operations Also additional testing is necessary to determine the effects of higher sea states on the aircraft and FSD combination Within the scope of this evaluation the HH-3F helicopter and FSD tow combination is satisfactory for the U S Coast Guard operational tow mission GRA

N77-12052# Boeing Vertol Co , Philadelphia Pa
ADVANCED HELICOPTER STRUCTURAL DESIGN INVESTIGATION VOLUME 1 INVESTIGATION OF ADVANCED STRUCTURAL COMPONENT DESIGN CONCEPTS Final Report, Jun 1974 - May 1975
Donald J Hoffstedt and Sidney Swatton Mar 1976 368 p refs
(Contract DAAJ02-74-C-0066 DA Proj 1F2-62208-AH-90)
(AD-A024662, D210-10965-1 USAAMRDL-TR-75-56A) Avail NTIS HC A16/MF A01 CSCL 01/3

A preliminary design study for a complete helicopter, incorporating advanced structural design concepts and advanced material was conducted by the Boeing Vertol Company The purpose was to evaluate the impact of advanced concepts and materials on the payload and configuration of a medium utility transport helicopter when compared to a baseline helicopter of conventional design Major structural systems were identified with assessment of structural efficiency cost/producibility fail-safety safety reliability maintainability survivability and crashworthiness In addition risk and feasibility assessment of the advanced structural systems was conducted Author (GRA)

N77-12054# Solar San Diego Calif
DEVELOPMENT OF EROSION RESISTANT CLADDINGS FOR HELICOPTER ROTOR BLADES Final Summary Report, 2 Jan 1974 - 30 Nov 1975
Victor S Moore and Alvin R Stetson Mar 1976 117 p refs
(Contract DAAG46-74-C-0054)
(AD-A024894 RDR-1788-2, DRSAV-76-16 AMMRC-CTR-76-9) Avail NTIS HC A06/MF A01 CSCL 13/8

The objective of this program is to optimize the Solar boriding process to obtain a well supported boride on a metallic substrate (clad) and to evaluate the erosion resistance and other critical properties of a clad substrate Processes were also developed for adhesive bonding the cladding to the leading edges of helicopter rotor blades Test results demonstrated that dense boride coatings on steel and titanium alloys can reduce the dust erosion rate, compared to uncoated metal by 30 to several hundred fold Overall the borided titanium alloy clad appeared most favorable of the four clad alloys evaluated The extreme hardness of TiB2 afforded essentially complete erosion protection with a coating thickness of only 0 0005 inch Resistance to rain erosion impact, and saline water corrosion also favored the titanium alloy Of the steels the alpha alloy SAE 430 was best in performance in erosion impact and saline water corrosion Performance of the boride coated 430 and Ti-6Al-4V alloys in rain erosion tests was excellent The use of a boride coated metallic cladding to reduce rain and dust erosion to extremely low levels was demonstrated Forming of SAE 430 and Ti-6Al-4V alloys before boriding maintaining dimensions during boriding, and the subsequent adhesive bonding of the borided shapes to sections of metallic and glass-epoxy rotor blades were shown to be feasible GRA

N77-12055*# Systems Technology Inc Hawthorne Calif
INVESTIGATION OF THE USE OF AN ELECTRONIC MULTIFUNCTION DISPLAY AND AN ELECTROMECHANICAL HORIZONTAL SITUATION INDICATOR FOR GUIDANCE AND CONTROL OF POWERED-LIFT SHORT-HAUL AIRCRAFT Final Report
Warren F Clement Aug 1976 173 p refs
(Contract NAS2-8973)
(NASA-CR-137922 TR-1072-1) Avail NTIS HC A08/MF A01 CSCL 01D

The use which pilots make of a moving map display from en route through the terminal area and including the approach and go-around flight phases was investigated The content and function of each of three primary STOLAND displays are reviewed from an operational point of view The primary displays are the electronic attitude director indicator (EADI), the horizontal situation indicator (HSI) and the multifunction display (MFD) Manually controlled flight with both flight director guidance and raw situation data is examined in detail in a simulated flight experiment with emphasis on tracking reference flight plans and maintaining geographic orientation after missed approaches Eye-point-of-regard and workload measurements coupled with task performance measurements pilot opinion ratings and pilot comments are presented The experimental program was designed to offer a systematic objective and subjective comparison of pilots use of the moving map MFD in conjunction with the other displays Author

N77-12056# European Space Agency Paris (France)
FLIGHT SIMULATOR EVALUATION OF AN ELECTRONIC PARAVISUAL GUIDANCE INDICATOR
Josef Thomas Ernst Kohnen et al Nov 1976 61 p refs Transl into ENGLISH of Erprobung einer elektron erzeugten paravisuellen Flugfuehrungsanzeige im Flugsimulator, DFVLR Brunswick Report DLR-FB-76-28 6 May 1976 Original report in GERMAN previously announced as N76-33203 Original German report available from DFVLR Cologne DM 21 30
(ESA-TT-350, DLR-FB-76-28) Avail NTIS HC A04/MF A01

An electronic paravisual indicator presenting a checkerboard pattern moving in two axes in a head-down display was evaluated in a moving cock-pit flight simulator The experiment was directed towards the effects of the indicator on piloting accuracy and pilot workload in manually controlled ILS and flight director approaches In the overall assessment based on objective performance criteria and subjective pilot ratings, the statistical evaluation of the objective test data showed no significant influence of the indicator on the performance criteria whereas the pilot ratings suggest that the indicator may be useful for manual control of the lateral motion of an aircraft Author (ESA)

N77-12057*# Agnew Tech-Tran Inc Woodland Hills Calif
INFLUENCE OF AIR HUMIDITY ON COMPRESSOR AND TURBINE EFFICIENCY DETERMINED FROM EXPERIMENTAL DATA
B D Fishbeyn Washington NASA Jul 1976 10 p refs Transl into ENGLISH from Izv Vyssh Ucheb Zaved Aviats Tekh (USSR), v 18 no 3, 1975 p 154-158
(Contract NASw-2789)
(NASA-TT-F-17073) Avail NTIS HC A02/MF A01 CSCL 21E

Humidity is known to affect the isentropic exponent and the gas constant of the working fluid The errors due to neglect of humidity are assessed which arise in the determination of compressor and turbine efficiency from measurements of the flow parameters Author

N77-12058*# Notre Dame Univ Ind Dept of Electrical Engineering
ALTERNATIVES FOR JET ENGINE CONTROL Final Technical Report, 1 Mar 1975 - 29 Feb 1976
R J Leake and M K Sain 29 Feb 1976 42 p refs
(Grant NsG-3048)
(NASA-CR-146531) Avail NTIS HC A03/MF A01 CSCL 21E

Approaches are developed as alternatives to current design methods which rely heavily on linear quadratic and Riccati equation methods The main alternatives are discussed in two broad categories local multivariable frequency domain methods and global nonlinear optimal methods Author

N77-12059*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
SUMMARY OF NASA AERODYNAMIC AND HEAT TRANSFER STUDIES IN TURBINE VANES AND BLADES
Thomas P Moffitt, Francis S Stepka and Harold E Rohlik 1976 52 p refs Presented at Aerospace Eng and Mfg Meeting, San Diego Calif 29 Nov - 2 Dec 1976, sponsored by SAE
(NASA-TM-X-73518) Avail NTIS HC A04/MF A01 CSCL 21E

Aerodynamic effects of trailing edge geometry hole size, angle spacing and shape were studied in two- and three-dimensional cascades and in a warm turbine test series Heat transfer studies were carried out in various two- and three-dimensional test facilities in order to provide corresponding heat transfer data Results are shown in terms of cooling effectiveness and aerodynamic efficiency for various coolant fractions, coolant-primary temperature ratios, and cooling configurations Author

N77-12060# Army Air Mobility Research and Development Lab Moffett Field Calif
IN-FLIGHT FAR-FIELD MEASUREMENT OF HELICOPTER IMPULSIVE NOISE
Donald A Boxwell and Fredric H Schmitz 1976 15 p refs
(AD-A025979) Avail NTIS HC A02/MF A01 CSCL 20/1

An in-flight technique for measuring UH-1H helicopter impulsive noise (sometimes called blade slap) by stationkeeping with a quiet instrumented lead aircraft was found to be highly successful Far-field quantitative acoustic waveforms and radiation patterns were easily obtained over a wide continuous range of UH-1H flight conditions including several areas known to produce annoying acoustic radiation The data collected using this technique were not (to any significant degree) contaminated by transmission path distortions that have hindered measurement efforts in the past The major finding of this initial measurement program was judging the occurrence and severity of a helicopter's radiated impulsive noise signature from cabin-based noise measurements can be misleading For the UH-1H helicopter, reduction in cabin audible impulsive noise levels may be necessary but certainly not sufficient to indicate that far-field impulsive noise radiation has been reduced The following three distinct types of impulsive noise are radiated by the UH-1H helicopter while flying between 80 and 115 knots at descent rates from zero to 1 000 ft/min (1) a series of positive pressure pulses believed to be related to blade-tip vortex interaction These pulses are responsible for the crisp popping sound of the radiated noise (2) a negative pressure disturbance that rapidly increases in amplitude with forward velocity becoming quite intense and sawtoothed in shape at 115 knots IAS and (3) a narrow positive pressure spike that closely follows that sawtooth-shaped negative pressure pulse at high airspeeds (115 knots) GRA

N77-12061# Pratt and Whitney Aircraft East Hartford Conn
EVALUATION OF AUGMENTER LIGHT-OFF DETECTION SYSTEMS Final Technical Report, 1 Apr 1974 - 31 Mar 1975
T G Lenox May 1975 37 p refs
(Contract F33657-73-C-0619 AF Proj 668A)
(AD-A025321, PWA-5277 AFAPL-TR-75-57) Avail NTIS HC A03/MF A01 CSCL 21/2

This program was conducted to evaluate direct sensing augmenter flame detection systems to determine suitability for application in future augmented aircraft engines Experimental testing of commercially available flame detection devices and Pratt and Whitney Aircraft designed optical sensing probes was conducted to determine those components offering the most potential for future development A survey of detector units was conducted and several promising units in conjunction with optical probes, optic transmission cables and readout equipment were subjected to laboratory, burner rig and engine tests Four augmenter light-off detection system configurations consisting of a Geiger-Mueller phototube and two different semiconductor type detectors were tested at four different probe locations on an F100 engine afterburner Engine testing was conducted at NASA Lewis Research Center at simulated altitude conditions The results of this testing showed that a Geiger-Mueller type phototube detector system directly mounted to the engine case, performed the best and is recommended for further development Author (GRA)

N77-12062# Air Force Inst of Tech, Wright-Patterson AFB, Ohio School of Engineering
CONCEPTUAL STUDY OF A LOW COST TURBOJET ENGINE M S Thesis
Tommy J Kent Mar 1976 87 p refs
(AD-A025652, GAE/AE/76M-2) Avail NTIS HC A05/MF A01 CSCL 21/5

One candidate for an inexpensive engine is a turbojet constructed by adding a combustion chamber and nozzle to a commercial turbocharger for a reciprocating engine Two

turbocharger-engines were produced in this way capable of handling approximately 6 lb/sec and 15 lb/sec airflow A performance analysis using thermodynamic cycle analysis techniques was done to predict the thrust that could be generated by these engines The maximum thrust predicted was 27 lb and 67 lb dry with an afterburner, 36 lb and 96 lb was expected A combustion chamber and nozzle were added to the turbochargers and both were mounted on a test stand and successfully operated Thrust was increased by various improvements to 60 lb The performance parameters of possible interest were studied with particular emphasis placed on thrust, weight flow of the air, specific fuel consumption, compressor pressure ratio, and temperature of the gases at the compressor, turbine and nozzle GRA

N77-12063# United Technologies Corp Windsor Locks Conn Hamilton Standard Div

ADVANCED V/STOL PROPELLER CRITICAL COMPONENTS INVESTIGATION Final Report, Feb 1973 - Jun 1975

E H Walz Apr 1976 231 p refs

(Contract DAAJ02-72-C-0012 DA Proj 1G1-62207-AA-72)

(AD-A024663 USAAMRDL-TR-76-1) Avail NTIS HC A11/MF A01 CSCL 01/3

This report presents the results of an experimental program to evaluate a full-scale Borsic aluminum composite structure spar/titanium propeller barrel retention system and a high-contact-angle duplex tapered roller bearing for an advanced technology 2000-SHP propeller system Author (GRA)

N77-12064*# Army Air Mobility Research and Development Lab Hampton, Va

A NEW CAPABILITY FOR PREDICTING HELICOPTER ROTOR NOISE IN HOVER AND IN FLIGHT

Thomas J Brown and Fereidoun Farassat 1976 14 p refs

(Grant NGR-09-010-085)

(NASA-CR-147138 AD-A025982) Avail NTIS HC A02/MF A01 CSCL 20/1

This paper discusses a new theory and a computer program for realistic calculation of acoustic pressure signature and spectrum of rotor and propeller noise Many of the common restrictions of already existing theories are removed by using the new theory which is consistent with all previous theories Only deterministic pressure fluctuations may be used in the program at this stage of development This will limit the applicability of the program to relatively high tip speeds where it is known that high frequency unsteady pressure fluctuations do not contribute significantly to the sound level There are very few blade surface pressure measurements and reliable acoustic data available to test the theory in full Comparison with the measured acoustic data of a high-speed propeller by Hubbard and Lassiter using limited aerodynamic data in the blade tip region for acoustic calculations, has shown good agreement so far One important contribution of the new theory is believed to be the removal of the compactness assumption which can introduce errors in acoustic computations The new capability will be used to study this effect GRA

N77-12065*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

EFFECTS OF UPPER-SURFACE BLOWING AND THRUST VECTORING ON LOW SPEED AERODYNAMIC CHARACTERISTICS OF A LARGE-SCALE SUPERSONIC TRANSPORT MODEL

Paul L Coe Jr H Clyde McLemore and James P Shivers Washington Nov 1976 85 p refs

(NASA-TN-D-8296 L10979) Avail NTIS HC A05/MF A01 CSCL 01C

Tests were conducted in a full scale tunnel to determine the low speed aerodynamic characteristics of a large scale arrow wing supersonic transport configured with engines mounted above the wing for upper surface blowing and conventional lower surface engines having provisions for thrust vectoring Tests were conducted over an angle of attack range of -10 deg to 34 deg and for Reynolds numbers (based on the mean aerodynamic chord) of 5 17 x 1 million and 3 89 x 1 million A limited number of tests were also conducted for the upper surface engine configuration in the high lift condition at an angle of sideslip of 10 deg in order to evaluate lateral directional characteristics and with the right engine inoperative in order to evaluate the engine out condition Author

N77-12067# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept

FORTRAN PROGRAMS FOR THE DETERMINATION OF AERODYNAMIC DERIVATIVES FROM TRANSIENT LONGITUDINAL OR LATERAL RESPONSES OF AIRCRAFT

A Jean Ross and G W Foster London Aeron Res Council 1976 107 p refs Supersedes RAE-TR-75090 ARC-36303 (ARC-CP-1344, RAE-TR-75090, ARC-36303) Avail NTIS HC A06/MF A01 HMSO £3 30, PHI $12 95

Two FORTRAN computer programs are described, one for the analysis of longitudinal responses of aircraft and one for the analysis of lateral responses in the presence of small longitudinal motion The aerodynamic derivatives which affect the responses are determined by a Newton-Raphson technique to obtain iteratively the best least-squares fit to the observed data The numerical method and its implementation in the programs is described and separate guides for users are provided for the two programs An example is shown for each program Author (ESA)

N77-12068*# Vought Corp , Dallas Tex Systems Div

DEVELOPMENT OF A SELF CONTAINED HEAT REJECTION MODULE, PHASE 2 AND 3 Final Report

M L Fleming 17 Aug 1976 241 p refs

(Contract NAS9-14408)

(NASA-CR-151109 T211-RP-032) Avail NTIS HC A11/MF A01 CSCL 14B

The fabrication and testing of a prototype deployable radiator system is described Vapor compression with a conventional aircraft compressor yielded a net heat rejection effect at high environments while returning low temperature (10 F and 35 F) conditioned fluid to the payload thermal control system The system is compatible with shuttle orbiter payloads free flying experiment modules launched from the shuttle or by another launch vehicle Author

N77-12073# School of Aerospace Medicine, Brooks AFB Tex

OXYGEN ACCUMULATION IN HYPOBARIC CHAMBERS Final Report

Roger L Stork and Thomas R Morgan Apr 1976 7 p refs

(AD-A025860, SAM-TR-14) Avail NTIS HC A02/MF A01 CSCL 14/2

Chamber oxygen measurements were made on 12 hypobaric chamber flights These measurements were analyzed to determine whether or not venting the chamber would result in an oxygen accumulation It was observed that the oxygen percentage increased from the normal value of 20 9% to 27 1% This seriously compromised the effectiveness of the hypoxia demonstration conducted on these flights Author (GRA)

N77-12075# Franklin Inst Research Labs Philadelphia Pa

DESIGN STUDIES OF A MOTION SYSTEM FOR THE VTOL SIMULATION FACILITY Final Report, Aug 1975 - Mar 1976

Charles A Belsterling and Edward I Mucha Feb 1976 222 p refs

(Contract N61339-76-C-0007)

(AD-A024732 FIRL-F-C4270-01

NAVTRAEQUIPC-76-C-0007-1) Avail NTIS HC A10/MF A01

CSCL 01/2

This report documents the design studies involved in determining the best configuration for a new integrated display and motion system for the Naval Training Equipment Center VTOL Simulation Facility Four candidate schemes are considered and two are chosen for detailed comparison The result is the recommendation for a new six-degree-of-freedom suspended from a low-profile foundation structure Author (GRA)

N77-12077# Clarkson Coll of Technology Potsdam N Y
CUMULATIVE DEFLECTION AND RIGID PAVEMENT SERVICEABILITY Final Report, Jul 1974 - Sep 1975
William H Highter Nov 1975 63 p refs
(Contract F29601-75-C-0002 AF Proj 2104)
(AD-A024969 AFCEC-TR-75-20) Avail NTIS HC A04/MF A01 CSCL 01/5

This report describes efforts to relate the energy imparted to a rigid pavement system as measured by cumulative deflections to the condition of that system Analysis of raw data from the American Association of State Highway Officials Road Test showed no results that could be used for predictive purposes Use of average data points indicated there exists a threshold cumulative deflection beyond which pavement serviceability changes rapidly Author (GRA)

N77-12078# McDonnell Aircraft Co St Louis Mo
WIND TUNNEL MODELS FOR AERO-OPTICAL INTERACTION STUDY Final Report
B A Weber Apr 1976 7 p
(Contract F29601-75-C-0040 AF Proj 3326)
(AD-A024925, AFWL-TR-75-219) Avail NTIS HC A02/MF A01 CSCL 14/2

McDonnell Aircraft Company (MCAIR) has designed and fabricated wind tunnel models and provided technical support for an Air Force Weapons Laboratory/National Aeronautics and Space Administration (AFWL/NASA) aero-optical interaction study In accordance with the conditions of the contract, this final report consists only of a brief description of the models Author

N77-12139# Solar San Diego, Calif
NS-4 COATING PROCESS DEVELOPMENT FOR COLUMBIUM ALLOY AIRFOILS Final Report, Apr 1974 - Feb 1976
Victor S Moore and Alvin R Stetson Mar 1976 75 p refs
(Contract DAAG46-74-C-0089)
(AD-A025797 RDR-1811 AAMRC-CTR-76-8 DRSAV-76-17) Avail NTIS HC A04/MF A01 CSCL 11/3

The excellent potential of the Solar NS-4 coating for protecting columbium alloy turbine vanes up to 1371C was demonstrated Procedures were developed to coat both internal and external surfaces of configurations representative of turbine vanes With spray application of the modifier (the NS-4 process is a two-cycle coating with a W-Mo-V-Ti modifier applied first and vacuum sintered followed by pack siliciding) consistent 500-hour protection at 1371C was obtained on external radii as small as 0 25 mm Coating of internal surfaces by dipping was not reliable but many specimens survived 500 hours of cyclic exposure Tests of coated 15-degree wedges in an oxidation/erosion rig showed no failures after 500 severe thermal cycles between 260C and 1371C A number of cast hollow single vane segments were successfully coated and oxidation exposed one hour at 1371C Appearance was excellent Several problem areas that need additional investigation were elucidated, viz coating of internal surfaces and temperature gradient induced coating stresses GRA

N77-12212# Frankford Arsenal Philadelphia Pa
HIGH STRENGTH-HIGH DAMPING CAPACITY WROUGHT MAGNESIUM ALLOYS
Albert Zalcmann Jeffrey Waldmann and Milton Schwartz Oct 1975 34 p refs
(DA Proj 1T0-62105-AH-328)
(AD-A025164 FA-TR-75073) Avail NTIS HC A03/MF A01 CSCL 11/6

An investigation was carried out to provide information regarding the alloying elements and the strengthening processes that must be utilized to obtain wrought magnesium alloys having high strength and high damping capacity for use in structural applications in missiles and aircraft To this end wrought magnesium alloys containing such solute elements as Al Cd, In, Li, Mn Pb, Y Zn and Zr were prepared and evaluated with respect to strength and damping capacity The commercial alloy AZ31 composite materials of magnesium containing borsic fibers and a magnesium alloy strengthened by MgO particles were also evaluated The effects of solute type and concentration degree of cold work and grain size on the damping capacity of the alloys were investigated An inverse relationship exists between damping capacity and the strength of the materials This relationship holds for different types and concentrations of solute and for different degrees of cold work The significance of this relationship is discussed The Mg-Cd Mg-Mn and Mg-Zr alloys have the highest damping capacity of the alloys investigated Possible mechanisms for the strength-damping capacity behavior in wrought magnesium alloys are presented GRA

N77-12218*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
BORON-EPOXY-REINFORCED TITANIUM AIRCRAFT LANDING-GEAR DRAG STRUT
William E Howell Washington Nov 1976 32 p refs
(NASA-TN-D-8289 L-10527) Avail NTIS HC A03/MF A01 CSCL 13M

The structural performance of a boron-epoxy-reinforced titanium drag strut, containing a bonded scarf joint and designed to the criteria of a large commercial transport, has been evaluated experimentally and analytically The strut was exposed to two lifetimes of fatigue loading and was statically loaded to the tensile and compressive design ultimate loads Throughout the test program no evidence of any damage in the drag strut was detected by strain-gage measurements, ultrasonic inspection or visual observation The bonded joint was analyzed using the NASTRAN computer program A comparison of the strains predicted by the NASTRAN computer program with the experimentally determined values shows excellent agreement An analytical study indicated that the nonlinear behavior of a structural spacer at each end of the strut could be explained by the inelastic behavior and possible creep of the adhesive Author

N77-12232# Naval Research Lab , Washington, D C
ELECTROSTATIC PROPERTIES OF JP-5 JET FUEL FROM ALTERNATE SOURCES
J T Leonard May 1976 9 p refs
(WF57571301)
(AD-A025684 NRL-MR-3294) Avail NTIS HC A02/MF A01 CSCL 21/4

The electrostatic properties of JP-5 fuel from alternate sources were determined Two properties electrical conductivity and electrostatic charging tendency - were measured on seven samples Five coal-derived fuels and one sample derived from tar sands exhibited properties similar to jet fuels derived from petroleum and hence should not develop unusual ignition hazards in field handling A JP-5 produced from shale had higher values of conductivity and charging tendency than petroleum-derived fuels, but the combination of the two properties indicates that no abnormal electrostatic hazards should be encountered Author (GRA)

N77-12332*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
AUXILIARY POWER SYSTEM FOR ACTIVITY COOLED AIRCRAFT Patent Application
Robert A Jones inventor (to NASA) Filed 24 Nov 1976 9 p
(NASA-Case-LAR-11626-1, US-Patent-Appl-SN-744542) Avail NTIS HC A02/MF A01 CSCL 20D

A method is described for extracting heat energy from an active cooling system in an aircraft as a source of auxiliary power A secondary coolant such as a water-glycol mixture removes heat from near the outer surfaces of the vehicle and circulates through a heat exchanger Cryogenic fuel such as liquid hydrogen is first pressurized and passed through the heat exchanger and a turbine on its way to the engine The temperature of the fuel is raised in the heat exchanger to a value above that which is required for the engine because the fuel temperature and pressure will drop across the turbine The turbine converts this excess heat to provide energy to pressurize the fuel, circulate the secondary coolant and drive other aircraft equipment Author

N77-12336# National Aerospace Lab Kakuda (Japan) Solid Rocket Section

SECONDARY GAS INJECTION INTO A SUPERSONIC CONICAL NOZZLE

Goro Masuya, Nobuo Chinzei, and Shinichi Ishii 29 Jun 1976 36 p refs Backup document for AIAA Synoptic scheduled for publication in the AIAA Journal in Mar 1977

Avail NTIS HC A03/MF A01

Secondary injection thrust vector control (SITVC) of a rocket motor, attitude control of a flight vehicle by side jet and transverse fuel injection into a supersonic combustor have been studied Two types of pressure probes were used and wall static pressure was also measured The measurements indicate that flow field downstream of the jection port was composed of some elementary parts which were discerned due to their physical features The flow structure development downstream and the effect of the injection pressure on the flow structure together with the effect of secondary injection on the separation at the nozzle exit in the case of over-expanded main stream are also presented Author

N77-12413# DARCOM Intern Training Center Texarkana, Tex

AIRCRAFT TIRES BALANCE PAD BONDING INTEGRITY Final Report

Tracy Worthington Apr 1976 62 p refs

(AD-A024815 DARCOM-ITC-02-08-76-114) Avail NTIS HC A04/MF A01 CSCL 01/3

The purpose of this research was to determine the cause of balance pad bonding failures and establish the production requirements necessary to provide a satisfactory bond The scope of this work was limited to the tire rebuilding facilities at Red River Army Depot, Texarkana Texas Representative tires were compared for elongation due to inflation and the present installation procedure Revised procedures were then formulated and applied to a selected set of tires These tires were then tested to current conformance standards Based on these findings it was recommended that the present mechanical holding device not be replaced It is also suggested that additional studies be undertaken to improve productivity GRA

N77-12420# Boeing Aerospace Co Seattle, Wash

CERAMIC AIRFRAME BEARINGS Final Report, Feb 1975 - Feb 1976

Jan W VanWyk Feb 1976 106 p refs

(Contract N00019-75-C-0170)

(AD-A025142 D180-19447-1) Avail NTIS HC A06/MF A01 CSCL 13/9

A friction and wear screening investigation of ceramic coatings lubricants and lubricant reservoir designs was conducted for an 1100 F bearing application A slotted reservoir design was evaluated in both elevated- and room-temperature screening tests Load-spectrum and life bearing tests were conducted on a cylindrical lubricant reservoir design These tests demonstrated a maximum load capacity of 22 000 psi and a life of 19,862 cycles at 15,000 psi An improved lubricant reservoir ceramic bearing design was developed using a hot-pressed silicon nitride ball sliding against an alumina coating on titanium Tests conducted with the slotted reservoir design bearings at elevated temperatures resulted in early failure of the bearing Axial cracks in the silicon nitride ball were the apparent cause of bearing failure Room-temperature tests of the slotted reservoir design were conducted under conditions simulating a hydrofoil flap hinge application The tests demonstrated a significant improvement in performance A maximum load capacity of 28 000 psi and a wear life of 60 000 cycles at 15,000 psi were obtained with this design Author (GRA)

N77-12430# Flugzeugwerke Emmen (Switzerland)

FALSTAFF DESCRIPTION OF A FIGHTER AIRCRAFT LOADING STANDARD FOR FATIGUE EVALUATION

Mar 1976 71 p refs Prepared in cooperation with Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Ger) Natl Aerospace Lab Amsterdam, (Netherlands) and Industrieanlagen-Betriebsgesellschaft - M B H , Ottobrunn (West Ger)

Avail NTIS HC A04/MF A01

A mathematical model for investigating the fatigue performance of structural materials and configurations is presented This proposed loading standard has been adopted by Germany and the Netherlands and used to test transport aircraft wing root bending Algorithms and input data for applying the program to fighter aircraft wing bending are presented Author

N77-12435*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

ANALYTICAL COMPARISON OF EFFECTS OF SOLID-FRICTION AND VISCOUS STRUCTURAL DAMPING ON PANEL FLUTTER

Herbert J Cunningham Washington Nov 1976 36 p

(NASA-TN-D-8263, L-10914) Avail NTIS HC A03/MF A01 CSCL 13M

A Galerkin modal analysis is presented that accounts for the effects of both solid friction and viscous structural damping on panel flutter based on unsteady aerodynamic forces from supersonic potential flow The eigensolutions are made by complex eigenvalue computer routines Markedly different effects on the flutter boundary of the two types of structural damping are obtained This result establishes that there is not, in general, an equivalent viscous damping for solid-friction damping For the limiting case of the static-aerodynamic approximation, a substantially different flutter dynamic pressure is obtained for solid friction identically zero compared with solid friction approaching zero as a limit Use of the quasi-static aerodynamic approximation eliminates that difference Author

N77-12579# Army Aeromedical Research Lab Fort Rucker, Ala

PILOT OPINION OF FLIGHT DISPLAYS AND MONITORING GAUGES IN THE UH-1 HELICOPTER Final Report

Ronald R Simmons, Mark A Hofmann, and Michael A Lees Apr 1976 45 p refs

(AD-A024714, USAARL-76-18) Avail NTIS HC A03/MF A01 CSCL 01/4

Subjective responses were acquired from 54 Army aviators concerning the UH-1 instrument panel The aviator subjects were drawn from three experience levels student, tac-ticket, and fully instrument rated pilots They were asked to rank instruments with regard to frequency of use order of preference, reliability and readability The instruments were divided into flight displays and monitoring gauges Ranks were requested for various profiles and flight conditions Data analyses examined the amount of agreement between experience levels as well as the rankings concerning the areas mentioned above GRA

N77-12833# Institut Franco-Allemand de Recherches, St Louis (France)

PORTABLE N WAVE GENERATORS OF DIFFERENT POWER FOR SIMULATION OF SONIC BOOMS [PORTABLE N-WELLEN-GENERATOREN UNTERSCHIEDLICHER LEISTUNG ZUR SIMULATION VON FLUGZEUGKANALLEN]

M Froboese and G Mathieu 24 Apr 1975 57 p refs In GERMAN
(ISL-R-123/75) Avail NTIS HC A04/MF A01

Three models of portable sound generators are described which can produce N-shaped and other detonation profiles via loudspeaker combinations in a test chamber The equipment is used mainly for investigating the effect of sonic booms on small animals and test models The most powerful simulator can produce a maximum sound pressure of about 6 5 mbar The N-wave time can be extended to 400 ms in order to simulate sonic booms of military and passenger aircraft ESA

N77-12929# RAND Corp Santa Monica Calif
A COMPUTER MODEL FOR ESTIMATING DEVELOPMENT AND PROCUREMENT COSTS OF AIRCRAFT DAPCA-III *Interim Report*
H E Boren Jr Mar 1976 93 p refs Supersedes R-761-PR-abridged
(Contract F44620-73-C-0011)
(AD-A025276, R-1854-PR) Avail NTIS HC A05/MF A01 CSCL 01/3

The report describes and lists an updated computer model (DAPCA-III) that computes from parametric relationships the development and procurement costs of two major flyaway subsystems of an aircraft--airframes and engines Avionics costs are included but are treated as throughputs Cumulative average unit, and total flyaway costs are obtained for up to ten specified aircraft production quantities Flight and avionics procurements are allowed Although costs of spare engines are not considered to be flyaway costs they are calculated in the model as additional costs not included in the totals Unless otherwise specified, all costs are calculated in 1975 dollars GRA

N77-12932# National Archives and Records Service Washington, D C
CODE OF FEDERAL REGULATIONS 14 AERONAUTICS AND SPACE, PARTS 1 TO 59
1 Jan 1976 740 p refs Revised
Avail NTIS MF A01 SOD HC $5 30

Federal aviation procedural rules and standards for certification in some of the following areas are presented (1) air products (2) aircraft parts, (3) pilots and (4) flight instructors Other areas reported include operating rules for (1) air traffic, (2) airport traffic patterns and (3) airport security B B

N77-12933# National Archives and Records Service, Washington, D C
CODE OF FEDERAL REGULATIONS. 14 AERONAUTICS AND SPACE, PARTS 60 TO 199
1 Jan 1976 786 p refs Revised
Avail NTIS MF A01 SOD HC $5 60
For abstract see N77-12932

N77-12934# National Archives and Records Service, Washington D C
CODE OF FEDERAL REGULATIONS 14 AERONAUTICS AND SPACE, PARTS 200 TO 1199
1 Jan 1976 742 p refs Revised
Avail NTIS MF A01, SOD HC $6 20

Economic, procedural and special regulations for the Civil Aeronautics Board are presented along with statements of general policy B B

N77-12996 Stanford Univ , Calif
AERODYNAMIC LOADS NEAR CRANKS, APEXES, AND TIPS OF THIN, LIFTING WINGS IN SUBCRITICAL FLOW
Richard T Medan 1976 115 p
Avail Univ Microfilms Order No 76-26040

The calculation of the subcritical, linearized, and irrotational flow in the vicinity of tips and corners of thin lifting wings is considered The important characteristics of the flow are governed by an eigenvalue problem, which is nonlinear at the trailing edge because of the shed wake (which is assumed to be in the wing plane) A method was devised because the existing methods were either not valid for the trailing edge case or would have required excessive amounts of computer time The new method, which is fundamentally different from the previous ones, was used to calculate solutions for a number of cases, including cases for which correct answers had not previously been obtained Two of these solutions were used to determine the validity of leading edge suction distributions near the tips of a delta wing and a swept wing as calculated using both the vortex lattice method and a kernel function method One of the latter methods appeared to be giving incorrect results Dissert Abstr

N77-12998 *Stevens Inst of Tech , Hoboken, N J*
THIN AIRFOIL IN EDDY-ARRAY AND PART-STALLED OSCILLATING CASCADE Ph D Thesis
Periyammal V K Perumal 1975 183 p
Avail Univ Microfilms Order No 76-25167

A translating plane rectangular grid of eddy-array is represented by a suitable streamfunction The unsteady response of a flat plate airfoil to such large nonpotential flow disturbance is evaluated The method of analysis adopted is the singularity distribution principle in combination with the time-marching technique The problem is solved in two stages, namely, (1) auxiliary solution and (2) time-marching solution The analysis is extended to evaluate the perturbed aerodynamic response of a harmonically oscillating flat plate cascade at part-stalled flow conditions Conformal mapping the concept of acceleration potential and discretization scheme are essential features of the analysis Dissert Abstr

N77-12999*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
WIND-TUNNEL INVESTIGATION OF A LARGE-SCALE MODEL OF A LIFT-CRUISE FAN V/STOL AIRCRAFT WITH EXTENDED LIFT-CRUISE NACELLES
Bruno J Gambucci, Kiyoshi Aoyagi and Stewart L Rolls Aug 1976 95 p refs
(NASA-TM-X-73164 A-6727) Avail NTIS MF A01/MF A05 CSCL 01A

The aerodynamic characteristics of a large-scale model of a lift/cruise fan V/STOL aircraft were determined The model was equipped with three fans, one mounted in the forward section of the fuselage in a lift mode, and two mounted on top of the wing adjacent to the fuselage in a lift/cruise mode The data that were obtained include longitudinal and lateral-directional characteristics of the model with the horizontal tail on and off, for both the powered-lift and cruise configurations Lateral-directional characteristics were obtained with the horizontal and vertical tail sections removed Powered-lift data were obtained at several wind-tunnel velocities and at several lift-cruise fan thrust vector angles by varying the position of the hooded deflectors from 0 deg (the cruise condition) to 90 deg Author

N77-13001*# Boeing Commercial Airplane Co Seattle Wash
COMPARISONS OF SEVERAL AERODYNAMIC METHODS FOR APPLICATION TO DYNAMIC LOADS ANALYSES Final Report
Richard I Kroll and Ronald D Miller Jul 1976 127 p refs (Contract NAS2-7729)
(NASA-CR-137720, D6-44111) Avail NTIS HC A07/MF A01 CSCL 01A

The results of a study are presented in which the applicability at subsonic speeds of several aerodynamic methods for predicting dynamic gust loads on aircraft including active control systems, was examined and compared These aerodynamic methods varied from steady state to an advanced unsteady aerodynamic formulation Brief descriptions of the structural and aerodynamic representations and of the motion and load equations are

presented Comparisons of numerical results achieved using the various aerodynamic methods are shown in detail From these results, aerodynamic representations for dynamic gust analyses are identified It was concluded that several aerodynamic methods are satisfactory for dynamic gust analyses of configurations having either controls fixed or active control systems that primarily affect the low frequency rigid body aircraft response Author

N77-13003# Akron Univ , Ohio
DYNAMIC RESPONSE OF NONUNIFORM ROTOR BLADES
Demeter G Fertis 28 Jul 1975 25 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in May 1977
Avail NTIS HC A02/MF A01

Theoretical investigations related to the theory of rotating blades such as helicopter blades are presented The plane of rotation of the blade was not perpendicular to the axis about which the blade rotates Discontinuities along the elastic axis, as well as supporting shaft flexibility, were also taken into consideration The general differential equations of rotating pretwisted blades under arbitrary loading and the tedious general expressions for the quantities involved in these equations were derived The aerodynamic loadings are left in general form This theory can be used to solve problems where these effects are significant and also to evaluate the easily applicable less complete theories that are used in practice If the aerodynamic loadings are taken as zero then the case of the free vibration of the blade is obtained Author

N77-13004# Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)
CALCULATIONS ON AIRFOIL-FUSELAGE COMBINATIONS IN TRANSONIC FLOW PROBLEMS RESULTING FROM THE APPLICATION OF THE FINITE ELEMENT METHOD [CALCUL D'ENSEMBLE VOILURE-FUSELAGE EN REGIME TRANSSONIQUE PROBLEMES POSES PAR LA MISE EN EXPLOITATION DES METHODES D'ELEMENTS FINIS]
J Naves Paris Assoc Aeron et Astronautique de France 1975 39 p refs In FRENCH Presented at the 12th Ecole Natl Super de Mecan et d'Aerotech / CEAT Colloq d Aerodyn Appl , Poitiers France, 5-7 Nov 1975
(AAAF-NT-76-1, DGT-11 850 ISBN-2-7170-0379-7) Avail NTIS HC A03/MF A01 CEDOCAR Paris FF 25 (France and EEC) FF 29 (others)

The difficulties encountered in applying the finite element method to calculations on aircraft models in three-dimensional compressible transonic flow are presented Three-dimensional compressible flow calculation methods are recalled and compared integral, finite difference and finite element methods Problems related to the finite element method, such as general problem of gridding and choice of the logical description of the grid are presented and global schematic examples are discussed It is concluded that the development of the finite element method necessitates beginning with the resolution of a sophisticated spatial grid around complex aerodynamic bodies ESA

N77-13005# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept
DESIGN AND TEST OF A WIND TUNNEL MODEL PT2, A SONIC ROOF-TOP WING ON A SIMPLE BODY Final Report
Anders L Gustavsson 1976 45 p refs
(Contract FMV-F-INK-07-12615)
(FFA-TN-AU-928) Avail NTIS HC A03/MF A01

One of the possible transonic design principles for an airplane with a wing of moderate aspect ratio is to design the wing with straight isobars all over the span and a pressure plateau with local normal Mach number equal to one in the design point Such a sonic roof-top wing was designed built, and tested The wing is mounted on a cylindrical body both balance tests and pressure measurements were carried out An alternative area ruled body was also designed and tested The test results show that even though the target drag rise Mach number was not fully reached the PT2-model gives a drag rise Mach number as good as or better than a reference model PT1 in the same model series The PT2 results, however, were obtained with a much thicker wing root, which is very valuable for structural reasons Comparisons between measured and calculated pressure distributions are also included The agreement between the experimental and theoretical results produced by the panel method, used at the time of design for the PT2 model, is not very satisfactory Comparisons with theoretical results obtained with the latest improved version of the panel method and with the transonic small perturbation finite difference method show good agreement for subcritical and supercritical flow conditions, respectively Author (ESA)

N77-13006# Aeronautical Research Inst of Sweden, Stockholm Aerodynamics Dept
TRANSONIC WIND TUNNEL TESTS OF THE PT3 MODEL, A SUPERCRITICAL WING ON A SIMPLE BODY PART 2 TEST RESULTS AND ANALYSIS Final Report
Rolne Mattsson and Anders L Gustavsson 1976 66 p refs (Contract FMV-F-INK-82223-73-009-07-001)
(FFA-TN-AU-1134-Pt-2) Avail NTIS HC A04/MF A01

A supercritical airfoil was applied in a design of a wind tunnel model with a moderate aspect ratio wing The detailed results from wind tunnel tests are presented in tables, diagrams and oil flow pictures including the effect of different transition trip positions as well as the effect of yaw angle Author (ESA)

N77-13008# Dornier-Werke G m b H Friedrichshafen (West Germany)
EFFECT OF UNSTEADY VARIATIONS IN HORIZONTAL FLOW VELOCITY ON THE UNSTEADY AERODYNAMIC FORCES ON A PRELOADED LIFTING SURFACE [EINFLUSS INSTATIONAERER AENDERUNGEN DER HORIZONTALEN ANSTROEMGESCHWINDIGKEIT AUF DIE INSTATIONAEREN LUFTKRAEFTE AN EINER VORBELASTETEN AUFTRIEBSFLAECHE]
D Herberg and W Schuler Bonn DOKZENTBw 1975 72 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung
(BMVg-FBWT-75-28) Avail NTIS HC A04/MF A01, DOKZENTBw DM 50

Analytical investigations were carried out for the special practical problems of the fixed wing and the rotary wing Two corresponding mathematical methods were developed in the two-dimensional incompressible case considering the unsteady variation of horizontal velocity induced by vortex sheets Numerical calculations for selected examples were made after programming the theory in FORTRAN language The parameters introduced in the problem (angle of attack, distance between two lifting surfaces or vortex sheets, frequency of oscillation) were varied systematically with respect to various airfoil oscillations Results indicate that the influence of the additional horizontal velocity on unsteady aerodynamic forces is different in the particular examples and that the resulting additional parts of lift and moment must be considered in certain combinations of parameters Author (ESA)

N77-13010# Technische Univ , Berlin (West Germany) Inst fuer Luft- und Raumfahrt
DETACHMENT AND WIND RECIRCULATION OF RADIAL WALL JETS Ph D Thesis [ABLOESUNG UND WINDRUECKFUEHRUNG RADIALER WANDSTRAHLEN]
Siegfried Harmsen 1976 75 p refs In GERMAN
(ILR-9 ISBN-3-7983-0552-8) Avail NTIS HC A04/MF A01

The problem of reingestion of VTOL hot exhaust gases and thus thrust reduction, as a result of recirculation by wind or heat lift is dealt with The lift jets propagate on the ground, after deflection as radial wall jets The detachment radius of these jets is determined by applying similarity theorem to known

model test results The propagation properties, the detachment line and the recirculation phenomena of a radial wall jet subjected to wind were determined experimentally The detachment radius was calculated as a function of the velocity ratio and the jet propagation angle The form of recirculation can be approximated by a two-dimensional potential theory model It is shown for a four-jet model arrangement that an additional jet can to a large extent supress the various recirculation phenomena ESA

N77-13011# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept
EVALUATION OF A COMPUTERIZED METHOD FOR DESCRIPTION OF THE SUBSONIC, VISCOUS, ATTACHED FLOW ABOUT TWO-DIMENSIONAL, MULTI-COMPONENT AIRFOILS Final Report
Erling Weibust 1976 103 p refs
(Contract F-INK-82223-072-004-07-001)
(FFA-TN-AU-999) Avail NTIS HC A06/MF A01

A method, previously developed, for computation of the viscous flow about two-dimensional multi-component airfoils was evaluated The computer program is based on a mathematical model for approximate calculation of subsonic viscous attached flow on two-dimensional airfoils The airfoils may consist of up to four elements arbitrarily arranged The viscous flow is approximated by an external potential flow outside the boundary layer displacement thickness, and by boundary layer flows along the contours of the airfoil elements Mixing of a wake from a forward component with the boundary layer is considered and laminar flow bubbles can be handled, but not large separated regions Pressure distributions and boundary layer properties were calculated and compared with earlier results, both theoretical and experimental Results for single element airfoils appear very reliable, but some of the multiple component airfoils data could be improved It is believed that both the model for wake boundary layer mixing and the model for addition of the boundary layer into the equivalent airfoil need further development The program has been tested for estimation of maximum lift coefficient and stall angle for single element airfoils It is concluded that, as the program is developed for attached flow, it can only reliably predict the maximum lift coefficient if the separation occurs abruptly Author (ESA)

N77-13015# European Space Agency, Paris (France)
UNSTEADY AERODYNAMICS OF HELICOPTER BLADES
Rolland Dat Oct 1976 14 p refs Transl into ENGLISH of 'Aerodyn Instationnaire des Pales d Helicoptere', ONERA, Paris Report ONERA-TP-1975-121, 1975 Original report in FRENCH previously announced as N76-24149
(ESA-TT-327, ONERA-TP-1975-121) Avail NTIS HC A02/MF A01

A method that predicts the unsteady periodic aerodynamic forces on helicopter blades in forward flight is described The blade sections are assimilated to airfoils, the lift at high angle of attack is given by a mathematical model and the three-dimensional interferences between blades and between separate sections of the same blades are given by the linearized lifting surface theory The comparison between theoretical and experimental results is satisfactory The range of applications of the method used to synthesize the three-dimensional theory and the experiments in two-dimensional flow is not restricted to helicopters Author (ESA)

N77-13019# *Advanced Technology Labs, Inc, Westbury, N Y*
AN ANALYSIS OF TRANSONIC JET-FLAPPED AIRFOILS WITH THE INCLUSION OF VISCOUS EFFECTS Final Report, 1 Oct 1973 - 20 Sep 1975
S Elzweig P Baronti, and G Miller May 1976 52 p refs
(Contract F44620-74-C-0014, AF Proj 9781)
(AD-A027712 ATL-TR-230, AFOSR-76-0840TR) Avail NTIS HC A04/MF A01 CSCL 01/1

The inviscid and viscous effects associated with a jet-flapped airfoil in the transonic regime are investigated Integral methods are used for the description of the viscous portions of the flow, and a relaxation method is used for the inviscid portions The viscous-inviscid coupling is delineated Their coupling procedures along the wing and the jet acknowledge the importance and magnitude of the viscous effects on pressure distribution and directly incorporate the displacement effect on the wing and the effects of jet mixing into the boundary conditions for the computation of the entire flow Preliminary numerical results are presented to validate the solution A computer program for a systematic exploitation of the complete analysis is discussed GRA

N77-13020# General Dynamics/Convair, San Diego, Calif
NONLINEAR LIFTING LINE THEORY FOR PREDICTING STALLING INSTABILITIES ON WINGS OF MODERATE ASPECT RATIO Final Technical Report, 30 Jun. 1975 - 15 Jun 1976
Stanley T Piszkin and E S Levinsky 15 Jun 1976 94 p refs
(Contract N62269-75-C-0356)
(AD-A027645, CASD-NSC-76-001) Avail NTIS HC A05/MF A01 CSCL 01/1

A computational procedure has been developed for predicting the time dependent longitudinal and lateral aerodynamic characteristics of wing-body configurations at angles of attack up to and beyond stall The purpose of the procedure is to provide the aircraft designer with a tool for simulating and alleviating such adverse wing stalling characteristics as wing rock, wing drop loss of roll control or roll control reversal, etc and thereby lead to the design of aircraft with improved stall, departure and spin resistance characteristics The procedure is based on nonlinear lifting line theory which has been modified to include unsteady wake effects GRA

N77-13023# Federal Aviation Administration, Washington, D C
A CRASHWORTHINESS ANALYSIS WITH EMPHASIS ON THE FIRE HAZARD US AND SELECTED FOREIGN TURBINE AIRCRAFT ACCIDENTS 1964-1974 Final Report
Thomas G Horeff Jul 1976 166 p refs
(AD-A029162/5, FAA-RD-75-156) Avail NTIS HC A08/MF A01 CSCL 01/3

An analysis of 382 impact survivable/substantial damage turbine aircraft accidents and incidents which occurred during the 11-year period from 1964 through 1974 was performed as part of an overall study of the interrelationship of aircraft crashworthiness and airport crash fire rescue services The crashworthiness analysis indicated that 94 9 percent of the fatalities in world wide U S aircarrier impact survivable accidents resulted from accidents where fire occurred Fire and its effects were estimated to be the cause of (1) forty percent of the fatalities, (2) fatal injuries to 23 3 percent of the occupants in suvivable/fatal accidents and (3) a reduction in survivability, from 65 2 percent to 41 9 percent, of the occupants in survivable/fatal accidents The status of FAA crashworthiness R and D programs directed toward the development of aircraft fire protective measures is described to focus on efforts being taken to reduce the fire hazard Author

N77-13031# Federal Aviation Administration, Washington D C
FAA CATEGORY 3 INSTRUMENT LANDING SYSTEM A GROUND EQUIPMENT DEVELOPMENT OVERVIEW Final Report
Carl G Peterson Aug 1976 79 p refs
(AD-A030150/7, FAA-RD-75-107) Avail NTIS HC $5 00/MF A01 CSCL 17/7

Federal Aviation Administration Systems Research and Development Service VHF/UHF Category III Instrument Landing System development efforts resulted in the establishment of operational Category IIIA ILS at various airports in the United States Significant efforts and results are summarized Major differences between the FAA MARK III ILS and other types of ILS are pointed out Reliability aspects, the far field monitor,

the maintenance monitor and the ILs monitor precision calibrator as part of the Category II ILS development are presented Existing lightning problems and efforts to resolve these are covered
Author

N77-13033# National Aviation Facilities Experimental Center, Atlantic City, N J
TEST AND EVALUATION OF ATCRBS ELECTRONIC SCAN ANTENNA (SYSTEM TEST) Final Report, Jan 1973 - Jun 1975
Anthony D Bradley Aug 1976 59 p refs
(AD-A029486/8, FAA-NA-75-73, FAA-RD-76-97) Avail NTIS HC A04/MF A01 CSCL 17/9

The air traffic control radar beacon system (ATCRBS) experimental electronic scan antenna (ESA) consists of 56 array modules placed on a platform (ring) constructed around the top of an airport surveillance radar tower A shelter beneath the tower provides an enclosure for the control and radiofrequency distribution system of the ESA The system testing to demonstrate the ATCRBS ESA dynamic capabilities in typical terminal environment and to examine beacon monopulse performance is covered The computer-controlled ATCRBS ESA demonstrated the automated features of the antenna including agile beam management In addition, the ATCRBS ESA monopulse target detection system was exercised during the flight test effort This testing established that the field environment and aircraft maneuvering affected the resulting parameters of system operation (i e , azimuth accuracy and received signal level) Basic monopulse target detection and processing is feasible for the ATCRBS
Author

N77-13034# Syracuse Univ , N Y Electrical and Computer Engineering Dept
EFFECT OF SCATTERING BY OBSTACLES IN THE FIELD OF VOR/DVOR Final Report, Jun 1974 - Jun 1975
Harry Gruenberg and Kazuhiro Hirasawa Jul 1976 112 p
(Contract DOT-FA73WA-3272)
(AD-A029405/8, FAA-RD-76-21) Avail NTIS HC A06/MF A01 CSCL 17/7

Theoretical formulas tables and graphs are presented which summarize the results obtained for the course deviation errors caused by scattering from wires and cylinders in the vicinity of a VOR station A summary and an analysis of some experimental results are included On the whole the agreement between theory and experiment is satisfactory A listing of modified and simplified computer programs is included
Author

N77-13036# Westinghouse Defense and Electronic Systems Center, Baltimore, Md Aerospace and Electronic Systems Div
INSTALLATION AND TEST OF THE COMPENSATED WAVEGUIDE ANTENNA AT BUFFALO, NEW YORK, RUNWAY 23 GLIDESLOPE SITE Interim Report, Jan 1975 - Feb 1976
R Littlepage, R A Moore G Moussally, and A F Zahorchak Feb 1976 77 p
(Contract DOT-FA74WA-3360)
(AD-A029488/4 FAA-RD-76-9) Avail NTIS HC A05/MF A01 CSCL 09/5

By using previously developed techniques for digitally modeling terrain an antenna site was determined which would provide Category II performance using the compensated waveguide antenna The effects of reflections from the runway embankment and irregularities of the terrain were minimized by a combination of compensation coning and antenna placement Pattern measurements and antenna feed measurements provided information necessary for the installation and tuning of the antenna at Buffalo Once installed flight test information required small changes to the antenna feed system in order to meet Category II requirements Initially, the monitor system exhibited some instability but this was solved by using new loops and reconfiguring the monitor channels
Author

N77-13038*# Research Triangle Inst Research Triangle Park N C
PRELIMINARY STUDY OF NAVSTAR/GPS FOR GENERAL AVIATION Final Report
R D Alberts and W H Ruedger Nov 1976 82 p refs
(Contract NAS1-14302)
(NASA-CR-145059, Rept-43U-1228) Avail NTIS HC A05/MF A01 CSCL 17G

The activities conducted as a planning effort to focus attention on the applicability of the global positioning system for general aviation are described The description of GPS its impact on economic and functional aspects of general aviation avionics as well as a declaration of potential extensions of the basic concept have been studied in detail
Author

N77-13040# Philips Gloeilampenfabrieken N V Eindhoven (Netherlands) Lighting Div
VISUAL APPROACH SLOPE INDICATORS PRINCIPLES OF OPERATION, RECOMMENDATIONS FOR INSTALLATION AND MAINTENANCE
Aug 1975 44 p refs
(PHILIPS-ER-12) Avail NTIS HC A03/MF A01

Installation and maintenance instructions for Visual Approach Slope Indicators are presented This system is a precision aircraft approach and landing aid for day and night use either stand-alone or in conjunction with radio and instrument aids To fulfill the precision requirements, the system must be designed set out installed and commissioned to a high degree of accuracy as recommended
ESA

N77-13042# Naval Air Engineering Center Lakehurst N J Engineering Dept
ANALYSIS AND DESIGN OF AN ELECTRO-MECHANICAL OPTICAL LANDING SYSTEM FOR HELICOPTERS AT NIGHT IN VARYING SEA STATES
George E Bray 27 May 1976 111 p refs
(AD-A025346 NAEC-ENG-7858) Avail NTIS HC A06/MF A01 CSCL 01/2

This paper contains an analysis and design of an optical landing system for landing helicopters on small ships at night in heavy seas The work involves analyzing an existing landing light and ship motions From this analysis a platform capable of stabilizing the landing light was designed
Author (GRA)

N77-13043*# Optimization Software Inc , Los Angeles, Calif
IMPROVEMENTS IN AIRCRAFT EXTRACTION PROGRAMS
A V Balakrishnan and Richard E Maine 1976 96 p refs
(Contract NAS1-13824)
(NASA-CR-145090) Avail NTIS HC A05/MF A01 CSCL 01C

Flight data from an F-8 Corsair and a Cessna 172 was analyzed to demonstrate specific improvements in the LRC parameter extraction computer program The Cramer-Rao bounds were shown to provide a satisfactory relative measure of goodness of parameter estimates It was not used as an absolute measure due to an inherent uncertainty within a multiplicative factor, traced in turn to the uncertainty in the noise bandwidth in the statistical theory of parameter estimation The measure was also derived on an entirely nonstatistical basis, yielding thereby also an interpretation of the significance of off-diagonal terms in the dispersion matrix The distinction between coefficients as linear and non-linear was shown to be important in its implication to a recommended order of parameter iteration Techniques of improving convergence generally, were developed and tested out on flight data In particular, an easily implemented modification incorporating a gradient search was shown to improve initial estimates and thus remove a common cause for lack of convergence
Author

N77-13044*# Massachusetts Inst of Tech , Cambridge
RESEARCH ON THE EXPLOITATION OF ADVANCED COMPOSITE MATERIALS TO LIGHTLY LOADED STRUCTURES Final Report
James W Mar 30 Nov 1976 130 p
(Grant NGR-22-009-781)
Avail NTIS HC A07/MF A01 CSCL 01C

The objective was to create a sailplane which could fly in weaker thermals than present day sailplanes (by being lighter) and to fly in stronger thermals than present sailplanes (by carrying more water ballast) The research was to tackle the interaction of advanced composites and the aerodynamic performance the interaction of fabrication procedures and the advanced composites and the interaction of advanced composites and the design process Many pieces of the overall system were investigated but none were carried to the resolution required for engineering application Nonetheless, interesting and useful results were obtained and are here reported Author

N77-13045# Lockheed-California Co Burbank
FEASIBILITY AND TRADEOFFS OF A TRANSPORT FUSELAGE FIRE MANAGEMENT SYSTEM Final Report, Jul 1975 - Apr 1976
P Starrett, E Lopez, B Silverman J Susersky and J Logan
Jun 1976 168 p refs
(Contract DOT-FA75WA-3657)
(AD-A029242/5, FAA-RD-76-54 LR-27477) Avail NTIS HC A08/MF A01 CSCL 01/3

A feasibility investigation and tradeoff analysis was performed on two approaches to increase fire safety for a hypothetical aircraft an integrated fire management system, incorporating fire detection monitoring, and suppression, and improved nonmetallic materials with greater fire retardancy and lower emission of hazardous pyrolysis products Fire related accident and incident data over a 10-year period were analyzed Then the fire safety aspects of the hypothetical aircraft were studied on a zone-by-zone basis A survey was made of the relevant available technology to upgrade the aircraft fire protection A fire detection monitoring, and extinguishing system based on this technology was outlined Candidate material improvements were identified The two approaches were defined in terms of performance economics, and timeliness Performance and cost factors favored a fire management system over improved materials Author

N77-13046# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
THE CALCULATION OF THE rms VALUE OF AN AIRCRAFT'S NORMAL ACCELERATION DUE TO GAUSSIAN RANDOM ATMOSPHERIC TURBULENCE
J C vanderVaart Mar 1976 62 p refs
(VTH-213) Avail NTIS HC A04/MF A01

It is shown that a theoretical calculation of the variance or rms value of an aircraft's normal acceleration due to atmospheric turbulence characterized by the Dryden or von Karman power spectral densities is not possible if the time delay, characterizing the gust penetration effect, is approximated by the linear time-derivative description allowing the use of the gust derivatives Such a calculation is shown to be possible if a first order Pade approximation is used to describe the penetration effect In the case of other motion variables, where the linear time derivative approximation is theoretically possible, the results of the Pade approximation are in better agreement with those obtained by a pure time delay Neglecting the penetration effect (point approximation of the aircraft in the turbulent field) is shown to cause gross errors especially in the variance of the normal acceleration at points some distance away from the aircraft's center of gravity Monte Carlo simulations using analog computers and incorporating the time-derivative approximation of the gust penetration effect are shown to yield values of the variance of the normal acceleration that may be grossly in error depending, in a rather unexpected way, on the bandwidth of the electronic white noise generators used Author (ESA)

N77-13047# European Space Agency Paris (France)
INFLUENCE OF RUNWAY ROUGHNESS ON THE DYNAMIC BEHAVIOUR OF AIRCRAFT AT TAKE-OFF
Jean-Paul Drevet Oct 1976 107 p refs Transl into ENGLISH of 'Influence des Irregularites de Piste sur le Comportement Dyn des Avions , ONERA Paris Report ONERA-NT-1975-11, 1975
(ESA-TT-329 ONERA-NT-1975-11) Avail NTIS HC A06/MF A01

Runway construction criteria based on reducing as far as possible the vertical accelerations on the flight deck of aircraft during take-off are defined A mathematical model of the aircraft taking into account the nonlinearities of the landing gear was developed and programmed on a hybrid computer, making it possible to carry out a large number of take-off simulations on actual and theoretical runways It was thus possible to reveal dangerous wavelengths and to analyze the effectiveness of the criteria used up till now Some improvements are proposed Author (ESA)

N77-13048# Army Aviation Engineering Flight Activity, Edwards AFB Calif
ARMY PRELIMINARY EVALUATION YAH-1R IMPROVED COBRA AGILITY AND MANEUVERABILITY HELICOPTER, ADDENDUM Final Report
Robert L Stewart, Floyd L Dominick, Jr , and Raymond B Smith
Aug 1975 48 p refs
(AD-A024850, USAAEFA-74-33-1-Add) Avail NTIS HC A03/MF A01 CSCL 01/3

Follow-on testing of the YAH-1R helicopter was conducted subsequent to the Army Preliminary Evaluation (APE) of that aircraft In the six test flights, emphasis was placed on evaluating maneuvering stability in high-speed diving flight and on investigation of engine/rotor system static and dynamic droop characteristics This report is intended to amplify and expand the APE report and is not a rewrite of that report In a dive at 155 KIAS, the YAH-1R was found to have stable maneuvering stability at normal load factors below 1 4 and neutral maneuvering stability at load factors above 1 4 The engine/rotor system static and dynamic droop characteristics were unaltered from those described in the APE report In response to requests the Army Aviation Systems Command acted to increase the engine output shaft speed limit to 6900 rpm for 10 seconds independent of power This new proposed engine limit greatly reduces the pilot workload during rapid deceleration maneuvers however, the engine/rotor speed increase was unaltered and thus remains a shortcoming No additional deficiencies or shortcomings were determined during this evaluation the conclusions of the APE report were unaltered GRA

N77-13050# Army Aeromedical Research Lab , Fort Rucker Ala
REDUCTION OF GLARE FROM THE LANDING LIGHTS OF THE OH-58 AN EVALUATION OF FOUR POTENTIAL SOLUTIONS Final Report
Frank F Holly May 1976 18 p refs
(AD-A025779, USAARL-76-21) Avail NTIS HC A02/MF A01 CSCL 01/3

Four potential solutions to the OH-58 landing lights glare problem were evaluated The four solutions consisted of (1) placing a metal shield beneath each landing light, (2) placing shields on each side of the cockpit extending out laterally and forward from the instrument panel, (3) taping over the inside one-half of each chinbubble and (4) taping over the sides of the plexiglass sheet and light well The first three solutions were all found to be very effective but the preferred solution was the placing of shields beneath the landing lights (Solution 1) since this involved no visibility loss or extra material inside the cockpit However, the overheating of the plexiglass sheet over the light well caused by these metal shields will have to be overcome before this solution is acceptable It was also found that the tape over the inside one-half of each chinbubble is a very good field-expedient 'quick fix GRA

N77-13051# Army Aeromedical Research Lab, Fort Rucker, Ala

ATTENUATION OF LIGHT TRANSMISSION IN ARMY AIRCRAFT TRANSPARENCIES DUE TO SLANTING Final Report

Wun C Chiou Chun K Park and Chris E Moser Jun 1976 57 p refs

(DA Proj 3A0-62110-A-819)

(AD-A027664, USAARL-76-23) Avail NTIS HC A04/MF A01 CSCL 01/3

The rates of light transmission reduction due to the slanting in eight fixed wing and fourteen rotary wing aircraft transparencies have been examined It was found that the optical quality at various portions of the UH-1 transparencies and all the fixed wing samples possess similar characteristics of transmission reduction The windscreen and the armor glass of CH-54 samples are similar too But the tinted versus the clear AH-1G transparencies are quite different The tinted sample generally has 27% spectral transmission loss compared to that of the clear sample This reduction could constitute a dangerous loss of visibility for the aviator, especially during periods of reduced illumination and at night The results presented in this study enable the potential users of the optical as well as the electro-optical devices to compute the amount of transmission reduction in most of the current Army aircraft Author (GRA)

N77-13052# Douglas Aircraft Co, Inc Long Beach, Calif

MINIMIZATION OF AIRFRAME RESPONSE DURING GROUND OPERATIONS Final Report, 1 Mar - 1 Dec 1975

H L Love R M Heimbaugh, and G W Kibbee Jan 1976 182 p

(Contract F33615-75-C-3079 AF Proj 1370)

(AD-A026393, AFFDL-TR-76-13) Avail NTIS HC A09/MF A01 CSCL 01/2

This report describes an analytical study to determine practical, passive means of minimizing airplane responses during ground operations The major objective of the study is to develop a design approach that will provide desirable airplane response characteristics during ground operations and be independent of airplane size To establish the generality of the approach, the study investigates airplanes which have significantly different sizes The three airplanes chosen to provide data for the study are the KC-135, B-52 and F-4 GRA

N77-13053# Army Aviation Engineering Flight Activity, Edwards AFB Calif

INSTRUMENT FLIGHT EVALUATION AH-1G HELICOPTER Final Report, Feb 1973 - Dec. 1974

Gary L Skinner, Gary A Smith, Paul R Bonin Roger W Waddell Leslie J Hepler, Robert K Merrill, James S Reid, and Morrie E Larsen Jul 1975 123 p refs

(AD-A026633, USAAEFA-72-29) Avail NTIS HC A06/MF A01 CSCL 01/2

A limited evaluation of handling qualities and operational performance was conducted on the AH-1G helicopter to determine its suitability for operation under instrument flight conditions with the stability and control augmentation system ON and OFF are discussed Tests were conducted intermittently from February 1973 to December 1974 Ten shortcomings were identified and it is recommended that two of these should be corrected prior to release for flight in instrument conditions GRA

N77-13054# Naval Test Pilot School Patuxent River Md

INERTIALLY DERIVED FLYING QUALITIES AND PERFORMANCE PARAMETERS

W C Bowes and R V Miller 16 Jun 1976 78 p refs

(AD-A026963, TPS-76-1) Avail NTIS HC A05/MF A01 CSCL 01/2

A feasibility study was undertaken at the U S Naval Test Pilot School (USNTPS) in which an inertial navigation system in an A-7C airplane was successfully used to derive the conventional flying qualities and performance parameters which are used to describe an aircraft s motion This report presents a discussion on the theoretical and practical aspects of using an inertial navigation system in flying qualities and performance testing Also presented are some of the data obtained during the feasibility study and a discussion of the numerous advantages of using this concept for flight testing The data obtained were extremely *accurate, and the cost of instrumenting USNTPS A-7C airplanes* was reduced significantly (in terms of dollars and aircraft down time) from using the conventional flight test instrumentation method GRA

N77-13055# Calspan Corp Buffalo, N Y

THE CAPABILITY OF THE T-2 AIRCRAFT AS A HIGH ANGLE-OF-ATTACK IN-FLIGHT SIMULATOR Final Report, Jun - Dec 1975

Paul R Motyka Dec 1975 78 p

(Contract N66269-75-C-0388)

(AD-A025359, CALSPAN-AK-5759-F-1) Avail NTIS HC A05/MF A01 CSCL 01/3

This report documents the results of a conceptual control system study undertaken to determine the feasibility of employing a T-2, configured for variable stability operation, as a high angle-of-attack simulator and ascertain the envelope over which a valid simulation can be obtained A model-following control system is defined that forces the T-2 to duplicate the motions of departing aircraft which exhibit characteristics of airplanes in the Navy inventory The quality of simulation is excellent within an envelope defined by 15 deg in incremental angle of attack and + or - 15 deg in sideslip A faithful reproduction of the predeparture and initial sudden departure motions of the model aircraft is obtained within this envelope and would allow for good training transfer in the difficult-to-train incipient departure region of flight Techniques for modifying the model aircraft responses to increase the simulation capability of the variable stability T-2 are investigated Several promising methods for doing this are developed and evaluated Author (GRA)

N77-13056# National Aviation Facilities Experimental Center, Atlantic City, N J

INDEPENDENT ALTITUDE MONITOR A LITERATURE SEARCH, ANALYSIS, AND BIBLIOGRAPHY Final Report, May 1974 - Jul 1975

Jack J Shrager Aug 1976 50 p

(AD-A029541/0 FAA-NA-76-2 FAA-RD-76-127) Avail NTIS HC A03/MF A01 CSCL 01/4

A literature search of recent activity to provide an independent indication of aircraft altitude was undertaken There are several existing techniques in use which can readily be expanded to enhance altitude awareness to avoid inadvertent terrain collisions Also identified are other new potential candidate systems concepts Author

N77-13058# Naval Air Development Center, Warminster, Pa Air Vehicle Technology Dept

STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT Semiannual Summary Report

Alan M Kaniss 1 May 1976 156 p

(AD-A025182) Avail NTIS HC A08/MF A01 CSCL 01/3

This report is a specialized summary of normal acceleration data recorded by *counting accelerometers* Data are separated by calendar time and mission category Only data reported in the counting accelerometer program are included GRA

N77-13061*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

A PROGRAM FOR CALCULATING TURBOFAN-DRIVEN LIFT-FAN PROPULSION SYSTEM PERFORMANCE

Michael E Tauber Allen E Fuhs, and John A Paterson Oct 1976 26 p
(NASA-TM-X-73173, A-6776) Avail NTIS HC A03/MF A01 CSCL 21E

The performance of a turbofan-powered lift fan propulsion system for vertical takeoff and landing (VTOL) aircraft is calculated The program formulation consists of taking bleed air from a turbofan engine, heating the bleed air in an interburner and passing it through a tip turbine to drive a lift fan Two options are available bleed air from the engine exhaust or bleed air that has passed through the engine fan only This computer program will benefit persons unfamiliar with the thermodynamics of engine cycle analysis Author

N77-13062*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston, Tex
STATOR ROTOR TOOLS Patent Application
Donald D Diamond, inventor (to NASA) (Serv-Air, Inc) Filed 8 Nov 1976 13 p Sponsored by NASA
(NASA-Case-MSC-16000-1, US-Patent-Appl-SN-739915) Avail NTIS HC A02/MF A01 CSCL 21E

An apparatus and method for removing and reinserting base member segments in an arcuate slot was considered It is in an engine part where each base member separately includes blades or stators comprising holding the engine part in place It manipulates fingers on an arm into an interfitting abutting relationship with most of the blades on a base member and applies a torque force to the base of the blades to move a base member relative to such slot NASA

N77-13063*# General Electric Co , Cincinnati, Ohio
FIBER COMPOSITE FAN BLADE IMPACT IMPROVEMENT PROGRAM Final Report
T L Oller Dec 1976 179 p refs
(Contract NAS3-17836)
(NASA-CR-135078, R76AEG461) Avail NTIS HC A09/MF A01 CSCL 21E

The results of a 20-month program designed to investigate parameters which effect the foreign object damage resulting from ingestion of birds into fan blades are described Work performed on this program included the design fabrication and impact testing of QCSEE fan blades to demonstrate improvement in resistance relative to existing blades and also the design and demonstration of a pin root attachment concept Author

N77-13065*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
INTERIM PREDICTION METHOD FOR TURBINE NOISE
Eugene A Krejsa and Michael F Valerino Nov 1976 25 p refs
(NASA-TM-X-73566 E-9015) Avail NTIS HC A02/MF A01 CSCL 21E

A turbine noise prediction method for interim use in the NASA Aircraft Noise Prediction Program is selected The method predicts the level directivity and one-third octave band spectra of far field turbine noise as a function of engine parameters The selection results from a review of turbine noise data and prediction methods available in the open literature It is concluded that the state-of-the-art turbine noise prediction capability is primitive and that the selected method represents only a temporary interim approach Recommendations are made on research requirements Author

N77-13066*# Rockwell International Corp Los Angeles Calif Aircraft Div
INLET DISTORTION SCALING OF WIND TUNNEL MODEL RESULTS
Robert H Johnson Dec 1976 163 p refs
(Contract NAS4-2279)
(NASA-CR-143840 NA-76-458) Avail NTIS HC A08/MF A01 CSCL 01C

Investigation of steady-state and time-dependent inlet flow distortion data from B-1 wind tunnel model tests was conducted to determine the effects of model scale, Reynolds number and data processing Existing engine face data from 0 1-, 0 2-, and 1 0-scale models were analyzed at mach numbers of zero, 0 85 and 2 2 The results include plots of total pressure recovery, steady-state and maximum dynamic distortion indexes, and turbulence versus airflow, contour plots of steady-state pressures, dynamic pressures, and turbulence, and distortion index time histories and summary plots Additional data processing was performed to show the effect of frequency content on peak values of seven different distortion indexes pressure contours, and the time history of a distortion index Statistical analyses were made showing data stationarity and randomness Mean values and standard deviations of distortion indices were used to predict peak values Author

N77-13067# West Virginia Univ , Morgantown Dept of Aerospace Engineering
INLET AND INTERNAL AERODYNAMICS OF A VTOL THRUST AUGMENTER Final Report, 1 Jan 1975 - 31 Jan. 1976
John L Loth Subrato Chandra, and Edward H Gibbs 31 Jan 1976 96 p refs
(Contract N00014-75-C-0324 NR Proj 215-227)
(AD-A027647, ONR-CR-215-227-3F TR-49) Avail NTIS HC A05/MF A01 CSCL 01/1

A new two dimensional thrust augmenter VTOL model has been designed built and tested The model has few moving parts and possibilities for good aerodynamic performance A complete static test facility capable of supplying 30 psig air through 1 5 square inches nozzle for 2 minutes has been built for testing this model The test rig can be moved in and out of ground effect by a fork lift Instrumentation consists of strain gages to measure total lift and thrust GRA

N77-13068# Systems Technology Inc Hawthorne, Calif
IDENTIFICATION OF MINIMUM ACCEPTABLE CHARACTERISTICS FOR MANUAL STOL FLIGHT PATH CONTROL VOLUME 1 SUMMARY Final Report
Roger H Hoh Samuel J Craig and Irving L Ashkenas Jun 1976 43 p refs
(Contract DOT-FA73WA-3276)
(AD-A029249/0 TR-1035-3R-Vol-1 FAA-RD-75-123-Vol-1) Avail NTIS HC $4 00/MF A01 CSCL 01/3

Characteristics of powered lift STOL airplanes that lead to unacceptable flight path control for approach and landing are identified Most of the findings are based on the results of a piloted ground based simulator program However, a short variable stability flight test program was conducted to allow interpretation of the simulation landing results in light of a flight environment Author

N77-13069# Systems Technology, Inc Hawthorne Calif
IDENTIFICATION OF MINIMUM ACCEPTABLE CHARACTERISTICS FOR MANUAL STOL FLIGHT PATH CONTROL VOLUME 3 DETAILED ANALYSES AND TESTED VEHICLE CHARACTERISTICS Final Report
Robert H Hoh Samuel J Craig, and Irving L Ashkenas Jun 1976 205 p refs
(Contract DOT-FA73WA-3276)
(AD-A029250/8 TR-1035-3R-III-Vol-3
Rept-TR-1035-3R-Vol-3) Avail NTIS HC A10/MF A01 CSCL 01/3

Results and analysis procedures utilized to identify minimally acceptable flight path control characteristics of powered lift STOL airplanes are reported Deficiencies in flight path control are identified via closed loop analysis of describing function results obtained during the simulation Unacceptable characteristics for flare and landing are identified from correlations of pilot rating and commentary with key parameters obtained from closed loop pilot-vehicle analysis Author

N77-13070*# Massachusetts Inst of Tech Cambridge Dept of Electrical Engineering and Computer Science
A DUAL-MODE GENERALIZED LIKELIHOOD RATIO APPROACH TO SELF-REORGANIZING DIGITAL FLIGHT CONTROL SYSTEM DESIGN Final Report
15 Dec 1976 41 p refs
(Grant NsG-1112)
(NASA-CR-149317 ESL-FR-707) Avail NTIS HC A03/MF A01 CSCL 01C

Analytic techniques have been developed for detecting and identifying abrupt changes in dynamic systems The GLR technique monitors the output of the Kalman filter and searches for the time that the failure occured thus allowing it to be sensitive to new data and consequently increasing the chances for fast system recovery following detection of a failure All failure detections are based on functional redundancy Performance tests of the F-8 aircraft flight control system and computerized modelling of the technique are presented I M

N77-13071# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering
THE AUTOMATIC FLARE MANEUVER OF AN AIRLINER [DE AUTOMATISCHE AFVANGMANOEUVRE VAN EEN VERKEERSVLIEGTUIG]
J C VanderVaart Nov 1974 53 p refs In DUTCH
(VTH-182) Avail NTIS HC A04/MF A01

Results of a study on the symmetric motions during automatic landing of a medium large airliner (BAC-Super VC 10), are presented The setting of an automatic pilot for such an aircraft was investigated with an analog computer It appears that the open loop character of the control should be taken into account The effect of variations in aircraft and flight state on the two most important parameters for landing, i e , the location of the touchdown point and the descent velocity at the moment the wheels touch the ground was examined The effect of atmospheric turbulence was not considered The effect of wind and wind gradient was studied and compared with British and American airworthiness specifications ESA

N77-13073# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
THE IMPULSE RESPONSE METHOD FOR THE CALCULATION OF STATISTICAL PROPERTIES OF AIRCRAFT FLYING IN RANDOM ATMOSPHERIC TURBULENCE
J C VanderVaart Nov 1975 54 p refs
(VTH-197) Avail NTIS HC A04/MF A01

A fast and simple calculation of ensemble properties of output signals of a linear system perturbed by Gaussian stochastic input signals can be performed by the so-called impulse response method This method applied to aircraft motions due to atmospheric turbulence has been derived previously from properties in the frequency-domain The method is shown to be very directly derived using simple basic concepts of modern system theory A short recapitulation of the derivation using frequency-domain techniques is given It is shown that some minor corrections should be applied to the method as given previously A numerical example gives an impression of the effect of these corrections on the results A comparison was made with results of a rather different, digital calculation of the covariance matrix, and moreover, with results obtained by a Monte Carlo simulation Author (ESA)

N77-13074# Air Force Academy Colo
THE EFFECT OF THRUST VECTORING ON AIRCRAFT MANEUVERING Final Report, Oct 1971 - Aug 1973
Duane M Davis and Jerry D Hines Jun 1976 60 p refs
(AD-A027367, USAFA-TR-76-9) Avail NTIS HC A04/MF A01 CSCL 01/2

A 3-dimensional minimum time turn optimal control problem was used as a framework for a preliminary investigation of the effects of thrust vectoring Two basic configurations were used for aircraft in the study They were the same except that one has the thrust vector fixed along the longitudinal axis, and the thrust vector for the other is free to move in the aircraft vertical plane The effects of initial velocity, weight penalty and thrust-to-weight ratio were investigated The results show a definite advantage for the thrust vectored aircraft for most of the conditions investigated and the possibility of an advantage for the others Therefore more detailed analysis of the effect of thrust vectoring on combat maneuverability is justified Author (GRA)

N77-13075# Rockwell International Corp Columbus, Ohio Aircraft Div
DIGITAL FLY-BY-WIRE TECHNOLOGY STUDY, VOLUME 1 Final Report, 3 Jul 1975 - 2 Mar 1976
William S Andrews Mar 1976 164 p refs
(Contract N62269-75-C-0423)
(AD-A027689, NR76H-33-Vol-1) Avail NTIS HC A08/MF A01 CSCL 01/3

This report documents the study conducted to determine the benefits and penalties associated with configuring the FV-12A high performance V/STOL aircraft with a Digital Fly-by-Wire flight control system The items considered were reliability maintainability, survivability, aircraft performance mission effectiveness, and impact on life cycle costs An analysis based upon weighting factors was defined to consolidate the benefits/penalties into an overall figure of merit Author (GRA)

N77-13079# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France)
DEVELOPMENT AND TESTS OF A SIMULATOR FOR A PENDULUM ACCELEROMETER [ETUDE ET ESSAI D'UN SIMULATEUR D'ACCELEROMETRE PENDULAIRE]
Hochard 7 Jan 1976 25 p In FRENCH
(LRBA-E-410-NT-32/SYE) Avail NTIS HC A02/MF A01

A simulator for a pendulum accelerometer is presented for inclusion in a feedback loop without actually using an accelerometer The electronic circuits are described including the provisions for changing the operating frequency, velocity amplification scaling factor, simulated stiffness of hinges mechanical time constant, accelerometer bias and overall residual error ESA

N77-13087# Air Force Human Resources Lab Brooks AFB, Tex
ADVANCED SIMULATOR PERFORMANCE SPECIFICATION FOR AN F-111 TEST STATION Final Report, Feb - Oct 1975
Gary G Miller and Edward M Gardner Nov 1975 82 p refs
(AF Proj 1121)
(AD-A025853 AFHRL-TR-75-70) Avail NTIS HC A05/MF A01 CSCL 05/9

This report contains performance specifications for a maintenance simulator to be used to train operation and maintenance of the 6883 Converter/Flight Controls Test Station for the F-111 aircraft The maintenance simulator will be used in Air Force resident teaching to train techniques to perform intermediate level (I-level) maintenance tasks The performance specification is the first phase of an effort to develop a prototype simulator An improved technique for gathering task analytic data for making functional fidelity decisions is discussed The basic design approach reported herein centers around a simulator that will look like the real equipment and exhibit psychologically similar outputs, but will not require the complex internal circuitry Author (GRA)

N77-13163# Royal Netherlands Aircraft Factories Fokker Schiphol-Oost
COMPARATIVE IMPACT TESTS ON METAL HONEYCOMB SANDWICH STRUCTURES
J Koetsier 8 Jan 1975 12 p
(FOK-R-1843) Avail NTIS HC A02/MF A01

Impact test results were carried out on metal honeycomb sandwich structures to compare the present structure (i e aileron trailing edges of 0 3 mm 5 322/9 faces and honeycomb 5 453/2,

bonded with FM 123-5) to structures with heavier faces and honeycomb Impact tests on metal honeycomb sandwich structures show that application of heavier honeycomb will result in noticeable improvement of the impact resistance of the actual structures of the A300B airbus Heavier faces will result in a proportionally lower improvement Author (ESA)

N77-13165# European Space Agency Paris (France)
DEVELOPMENT AND APPLICATION POSSIBILITIES OF NEW CONSTRUCTION TECHNIQUES WITH FIBER-REINFORCED MATERIALS
Manfred Flemming Feb 1976 102 p refs Transl into ENGLISH from Entwicklung u Anwendungsmoeglichkeit von Bauweisen aus faserverstaerkten Werkstoffen ' DGLR Cologne Report DGLR-Paper-74-117 1974 Original report in GERMAN previously announced as A75-24154 Submitted for publication
(ESA-TT-267 DGLR-Paper-74-117) Avail NTIS HC A06/MF A01

The use of carbon and boron fiber reinforced materials in future aircraft design is discussed A new construction method for use in primary structures will succeed only if all technical problems are solved The many construction possibilities and the limits of fiber technology are described and weight reductions obtained are illustrated by practical examples The design and calculation for strength and rigidity superseding that of conventional structures are discussed The cost effectiveness of the new construction method is considered ESA

N77-13168# Air Force Packaging Evaluation Agency, Wright-Patterson AFB Ohio
FIBERGLASS REINFORCED PLASTIC BI-PAC VIBRATION AND ROUGH HANDLING TESTS
Richard T Gibbons 30 Dec 1975 31 p
(AD-A025783 DSPD-77-75) Avail NTIS HC A03/MF A01 CSCL 13/4

The development of a container to transport and store two auxiliary fuel tanks was initiated because the tanks are being used in pairs, logistics of tank movement are simplified and ease of deployment is increased The BI-PAC developed by Plastics Research Corporation, is capable of holding two F-4 six hundred gallon auxiliary fuel tanks in a side by side configuration Vibration and rough handling tests conducted at the Air Force Packaging Evaluation Agency (AFPEA) have shown this container to be capable of withstanding simulated environmental hazards Air Force Packaging Evaluation Agency Project no 75-P7-29 was undertaken to support ASD/4950/LGT in performing vibration and rough handling tests on a fiberglass reinforced plastic container capable of transporting and storing two 600 gallon F-4 auxiliary fuel tanks GRA

N77-13211# Royal Aircraft Establishment, Farnborough (England) Structures Dept
THE EFFECT OF GEOMETRY ON THE FATIGUE STRENGTH OF ALUMINIUM ALLOY LUGS
F E Kiddle London Aeron Res Council 1976 15 p refs Supersedes RAE-TR-75045 ARC-36216
(ARC-CP-1349, RAE-TR-75045, ARC-36216) Avail NTIS HC A02/MF A01 HMSO £1 PHI $3 90

Al 2% Cu alloy lug specimens of five different geometries chosen to represent a range of static strength values were fatigue tested under constant amplitude loading at ambient temperature It is shown that the mode of failure was the same in all lug fatigue tests in contrast to the variable mode of failure expected in static tests A comparison of the fatigue strengths of the lugs shows some correlation with the net stress concentration factor Author (ESA)

N77-13234# Air Force Aero Propulsion Lab , Wright-Patterson AFB, Ohio
THE IMPACT OF JP-4/JP-8 CONVERSION ON AIRCRAFT ENGINE EXHAUST EMISSIONS Interim Technical Report, Jul 1975 - Feb 1976
William S Blazowski May 1976 52 p refs
(AF Proj 3048)
(AD-A026546, AFAPL-TR-76-20) Avail NTIS HC A04/MF A01 CSCL 21/4

The proposed conversion of predominant Air Force fuel usage from JP-4 to JP-8 has created the need to examine the dependence of engine pollutant emission on fuel type Available data concerning the effect of fuel type on emissions has been reviewed T56 single combustor testing has been undertaken to determine JP-4/JP-8 emission variations over a wide range of simulated engine cycle operating conditions at idle In addition a J85-5 engine was tested using JP-4 and JP-8 Results of the previous and new data collectively led to the following conclusions regarding conversion to JP-8 (a) HC and CO emission changes will depend upon individual combustor design features (b) no change to NOx emission will occur and (c) an increase in smoke/particulate emissions will result It is recommended that these findings be incorporated into air quality analytical models to define the overall impact of the proposal conversion Further, it is recommended that combustor analytical models be employed to attempt prediction of the results described herein Should these models be successful analytical prediction of JP-8 emissions from other Air Force engine models may be substituted for more combustor rig or engine testing Author (GRA)

N77-13283 Ohio State Univ Columbus
ANALYSIS OF AIRCRAFT WING-MOUNTED ANTENNA PATTERNS Ph D Thesis
Ronald Joseph Marhefka 1976 216 p
Avail Univ Microfilms Order No 76-24644

High frequency radiation patterns of aircraft wing mounted antennas were analyzed Basic antenna types were studied using ray optical techniques The aircraft was modeled in its most basic form so that the study would be applicable to general-type aircraft The fuselage was modeled as a perfectly conducting finite elliptic cylinder The wings and horizontal and vertical stabilizers were modeled as perfectly conducting n sides flat plates that could be arbitrarily attached to the fuselage or to themselves The antenna locations were assumed to be on the surfaces of the wings at locations removed from engines and stores such that these effects are negligible Volumetric patterns were calculated for several aircraft The validity of the solution was shown by comparing the results against scale model measurements The application of this solution to practical airborne antenna problems demonstrated its versatility in designing antennas and predicting their radiation patterns in an accurate and efficient manner Dissert Abstr

N77-13287# National Aviation Facilities Experimental Center, Atlantic City, N J
TEST AND EVALUATION OF A PHOTOTYPE VHF LOW-INTERMODULATION AMPLIFIER Interim Report, Jan - Dec 1975
James J Coyle Sep 1976 12 p
(AD-A029848/9, FAA-NA-76-8, FAA-RD-76-119) Avail NTIS HC A02/MF A01 CSCL 17/2

The test and evaluation of a prototype very high frequency (VHF) low-intermodulation amplifier that was designed as a frequency-independent interference rejection circuit for the T-1108/GRT-21 air/ground communication transmitter is described The amplifier was developed for the Federal Aviation Administration through an interagency agreement with the United States Air Force The amplifier was tested in the Experimental Peripheral Communications Laboratory at the National Aviation Facilities Experimental Center Test results showed the amplifier could reduce T-1108/GRT-21 transmitter third-order intermodulation products at least 48 dB when aligned for a single interfering frequency condition, but the amplifier did not achieve the desired 15-dB intermodulation reduction when aligned for broadband interference cancellation across the 118-136 MHz VHF air/ground communication frequency band Author

N77-13290# Computer Sciences Corp Falls Church Va
SYSTEM DESIGN STUDY FOR VHF UNIVERSAL DATA LINK AND DATA LINK/DABS COMBINATIONS Final Report

Howard A Blank Feb 1976 331 p
(Contract DOT-FA72WA-3072)
(AD-A029547/7 FAA-RD-76-13) Avail NTIS HC A15/MF A01 CSCL 17/2

A preliminary design of a VHF universal data link system is presented Included are estimates of the design of the judicious selection of appropriate combinations of VHF data link and a discrete address beacon system (DABS) Results indicate that a VHF data universal data link system will greatly upgrade the capabilities of the current air/ground communication system The implementation cost and complexity appear favorable when compared to the increased communications benefits Author

N77-13332*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
THE DESIGN AND FABRICATION OF MICROSTRIP OMNIDIRECTIONAL ARRAY ANTENNAS FOR AEROSPACE APPLICATIONS
T G Campbell M W Appleton and Thomas K Lusby Nov 1976 67 p refs
(NASA-TM-X-73979) Avail NTIS HC A04/MF A01 CSCL 09A

A microstrip antenna design concept was developed that will provide quasi-omnidirectional radiation pattern characteristics about cylindrical and conical aerospace structures L-band and S-band antenna arrays were designed fabricated, and, in some cases, flight tested for rocket satellite, and aircraft drone applications Each type of array design is discussed along with a thermal cover design that was required for the sounding rocket applications Author

N77-13394# National Aerospace Lab Amsterdam (Netherlands) Div Structures and Materials
THE SCRATCH STRAIN GAGE AS A FATIGUE DAMAGE MONITORING SYSTEM
A Nederveen 16 Jun 1975 30 p In DUTCH ENGLISH summary
(NLR-TR-75094-U) Avail NTIS HC A03/MF A01

Test results of the Prewitt scratch strain gage and the Technology Inc strain history recorder are presented Laboratory tests of both strain gages are presented and flight tests of a military wing structure with the Prewitt gage only are discussed It is concluded that scratch gages are not suitable for the collection of data to be used in fatigue damage calculations mainly because of the difficulty of reading and interpreting strain records ESA

N77-13398# Royal Aircraft Establishment, Farnborough (England)
THE REDUCTION OF BASE STRAIN SENSITIVITY OF A TRIAXIAL ACCELEROMETER BY THE USE OF A MOUNTING PAD
M S Powell Sep 1975 20 p refs
(RAE-TM-IT-157 BR50143) Avail NTIS HC A02/MF A01, HMSO, PHI

Reduction of the base strain sensitivity of a triaxial piezoelectric accelerometer by the use of lightweight mounting pads of varying design was investigated for use in the measurement of vibration levels in aircraft instrument panels for a strain of 250 micro strain Test procedures for the measurement of base strain sensitivity followed the recommended practice of the Instrument Society of America A reduction in base strain sensitivity of 26 times was obtained for the best strain relieving mounting pad The reduction in operating frequency range resulting from the use of the mounting pad was also investigated
Author (ESA)

N77-13418* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SMOKE GENERATOR Patent
James R Rogers, inventor (to NASA) Issued 9 Nov 1976 11 p Filed 1 Oct 1975 Supersedes N75-33278 (13 - 24, p 3031)
(NASA-Case-ARC-10905-1, US-Patent-3,990,987, US-Patent-Appl-SN-618594, US-Patent-Class-252-359A US-Patent-Class-219-300, US-Patent-Class-219-304, US-Patent-Class-239-171) Avail US Patent Office CSCL 13K

A smoke generator is disclosed which is particularly suitable for mounting on the wing tips of an aircraft and for conducting airflow studies The device includes a network of thermally insulated tubes for carrying a fluid which is used to produce smoke The fluid, which need not be combustible is heated above its vaporization temperature by electric current which is passed through the fluid conduit tubes so that the tubes serve both as fluid conduits and resistance heating elements Fluid supply and monitoring systems and electrical control systems are also disclosed Official Gazette of the U S Patent Office

N77-13424+ Centre Technique des Industries Mecaniques, St Denis (France) Lab de la Turbine a Gaz
EXPERIMENTAL EXAMINATION OF TURBOMACHINE BLADE PROFILES Final Report [VERIFICATION EXPERIMENTALE DES CARACTERISTIQUES DE PROFILS D'AUBES DE TURBOMACHINES]
Michel Pluviose Oct 1975 61 p refs In FRENCH
(Contract DGRST-73-7-1247)
Avail NTIS HC A04

In order to compare theoretical and experimental results in axial turbomachine blade cascades it is necessary to experimentally reduce the wall detachment A blowing device was constructed for boundary layer control fitted downstream of the cascade under test providing an energy addition to the fluid near the walls, thus avoiding the massive flow detachment generally produced in compressor blade cascades A two-dimensional flow is established allowing tests to be made ESA

N77-13429# Thiokol Chemical Corp Brigham City, Utah Wasatch Div
DESIGN CRITERIA FOR ELASTOMERIC BEARINGS, VOLUME 1 Final Report
Mar 1976 268 p refs 4 Vol
(Contract DAAJ02-73-C-0091 DA Proj 1F1-62205-A-119)
(AD-A024766, USAAMRDL-TR-75-39-Vol-1) Avail NTIS HC A12/MF A01 CSCL 13/9

The contract with the Eustis Directorate included the evaluation development, and selection of analytic and experimental techniques required for the design and/or evaluation of elastomeric bearings for rotor head applications Axially laminated cylindrical (Type I) radially laminated cylindrical (Type II), and spherical laminated (Type III) bearings were considered This report reviews three major areas of development (1) the development and selection of experimental procedures for the determination of required design and analysis parameters, (2) the evaluation and definition of predictive techniques for stability of buckling of laminated bearings and (3) the development of procedures for predicting the service life of bearings The products of this effort are a finite-element computer code and a first edition of a design manual Author (GRA)

N77-13430# Thiokol Chemical Corp Brigham City Utah Wasatch Div
DESIGN CRITERIA FOR ELASTOMERIC BEARINGS VOLUME 2 DESIGN MANUAL Final Report
Suresh B Kulkarni Mar 1976 188 p refs 4 Vol
(Contract DAAJ02-73-C-0091 DA Proj 1F1-62205-A-119)
(AD-A024767 USAAMRDL-TR-75-39B-Vol-2) Avail NTIS HC A09/MF A01 CSCL 13/9

This design manual contains the recommended analytical approaches and engineering procedures to be followed by designers of elastomeric bearings for rotor head applications in helicopters Three bearing configurations namely axially laminated cylindrical (Type I) radially laminated cylindrical (Type II) and spherical laminated (Type III) bearings are considered Several levels of design analysis are presented closed-form operations computer-developed design curves, and finite-element computer analysis The design restraints determined by stability and

service life are also considered The material properties required for the design and the suggested experimental methods for their determination are also discussed Author (GRA)

N77-13431# Thiokol Chemical Corp Brigham City Utah Wasatch Div
DESIGN CRITERIA FOR ELASTOMERIC BEARINGS VOLUME 3 PROGRAM USER'S MANUAL *Final Report*
Don H Lee Mar 1976 79 p refs 4 Vol
(Contract DAAJ02-73-C-0091 DA Proj 1F1-62205-A-119)
(AD-A024753, USAAMRDL-TR-75-39C-Vol-3) Avail NTIS HC A05/MF A01 CSCL 13/9

This document describes the usage and input of a program that performs a stress analysis on an axisymmetric body with isotropic materials The body may have asymmetric loads in which case several passes through the program are required to obtain the complete solution The accumulation routine will accumulate all the harmonics of the Fourier expansion The program is a compressible formulation that is Poisson s ratio must be less than 5 but it may be as close to it as desired An extensive input module has been included in the program to make it as user oriented as possible This includes routines that will automatically generate bearing geometry based on basic input parameters The basic program is written in FORTRAN IV with some support routines written in IBM 370 Assembler Language Author (GRA)

N77-13432# Thiokol Chemical Corp Brigham City Utah Wasatch Div
DESIGN CRITERIA FOR ELASTOMERIC BEARINGS VOLUME 4 PROGRAMMER'S MANUAL Final Report
Don H Lee Mar 1976 60 p refs 4 Vol
(Contract DAAJ02-73-C-0091 DA Proj 1F1-62205-A-119)
(AD-A024754, USAAMRDL-TR-75-39D-Vol-4) Avail NTIS HC A04/MF A01 CSCL 13/9

This document provides information necessary to the programmer to support and modify program S3359 The general philosophy of the program and detail on some sections are contained herein Author (GRA)

N77-13442# Boeing Commercial Airplane Co , Seattle, Wash
FURTHER DEVELOPMENT OF RELIABILITY ANALYSIS APPLICATION TO STRUCTURAL FATIGUE EVALUATION Final Report, 15 Feb 1974 - 15 Oct. 1975
I C Whittaker and S C Saunders Wright-Patterson AFB, Ohio AFML Jan 1976 101 p refs
(Contract F33615-74-C-5037, AF Proj 7351 AF Proj 1367) (AD-A025365 AFML-TR-75-191) Avail NTIS HC A06/MF A01 CSCL 01/3

Three parameter symmetric distributions have been investigated for application as a fatigue life distribution model Maximum likelihood (ML) estimator and simulation procedures for maximum variance unbiased estimates and confidence bounds have been developed for analysis of censored data A technique for testing the hypothesis of two censored samples having a common parent population is also presented The effect on airplane structural reliability resulting from differing levels of fatigue performance from nominally identical structures is discussed and a preflaw model was developed and incorporated in a reliability analysis method Parametric studies were conducted using the reliability method to obtain qualitative information on the impact and interaction in terms of structural reliablity of several variables such as preflaws, loads environment material structural configuration, and designed residual strength Author (GRA)

N77-13471# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering
PREDICTION OF FATIGUE CRACK PROPAGATION IN AIRCRAFT MATERIALS UNDER VARIABLE-AMPLITUDE LOADING
J Schijve Mar 1975 27 p refs Presented at the ASTM Symp on Fatigue Crack Growth under Spectrum Loads, Montreal, 23-24 Jun 1975
(VTH-193) Avail NTIS HC A03/MF A01

A discussion on loads in service is given followed by a survey of various types of variable-amplitude loading as applied in test programs The various phenomenological aspects of fatigue damage associated with fatigue cracks are indicated Interaction effects between cycles of different magnitudes are defined Methods for measuring interaction effects examples of interaction effects, and possible explanations are reviewed Both tests with simple types of variable-amplitude loading (overloads and step loading) and more complex load-time histories (program loading, random load and flight-simulation loading) are included New evidence on crack closure is presented Various types of prediction methods are discussed Author (ESA)

N77-13479# Georgia Inst of Tech Atlanta School of Engineering Science and Mechanics
MINIMUM WEIGHT DESIGN OF STIFFENED CYLINDERS AND CYLINDRICAL PANELS UNDER COMBINED LOADS Interim Report, 1 Feb 1975 - 31 Jan 1976
George J Simitses, Jagannath Giri, and Izhak Sheinman Mar 1976 233 p refs
(Grant AF-AFOSR-2655-74, AF Proj 9782)
(AD-A027720, AFOSR-76-0930TR) Avail NTIS HC A11/MF A01 CSCL 01/3

This report is divided into two parts Parts A and B In Part A a methodology is presented for the minimum weight design of stiffened cylinders under combined loads of torsion, uniform axial compression and pressure A number of illustrative examples are included in order to demonstrate the methodology In addition the listing of the developed computer program is included and thus those interested in the program can easily use it In Part B a methodology is presented for the minimum weight design of stiffened curved plates under combined shear with uniaxial or biaxial compression This methodology is illustrated through a number of examples At the end of this second part a complete listing of the developed computer programs is included along with the associated flow charts for data preparation The load cases considered in both parts are representative of the worst possible load cases of destabilizing loads that an aircraft fuselage is expected to encounter The methods developed represent a fully automated design procedure for that portion of the fuselage which is designed primarily against general instability GRA

N77-13548# Naval Postgraduate School Monterey Calif
HYDRAULIC RAM EFFECT ON COMPOSITE FUEL CELL ENTRY WALLS M S Thesis
Alfred Nicholas Duva, Jr Mar 1976 76 p refs
(AD-A024832) Avail NTIS HC A05/MF A01 CSCL 10/2

Catastrophic failure of a partially filled aircraft fuel cell due to impact and penetration by a high speed projectile often occurs due to a phenomenon known as hydraulic ram The structural response of the fuel tank walls to hydraulic ram should be of vital concern to the designers of aircraft fuel cells Considerable research has been conducted to determine the effects of hydraulic ram on metallic fuel cells, but very little attention has been given to fuel cells made with the new advanced composite materials The purpose of this research is to examine the various effects of hydraulic ram on a graphite/epoxy wall when subjected to penetration by a 222 caliber projectile Eight hydraulic ram tests are made on a clamped 11-inch square plate 0 067 inches thick at projectile velocities between 2 600 and 2,800 fps The engineering properties of the laminate are determined both analytically and experimentally The low velocity shots caused only slight damage to the plate At the higher velocities, the hydraulic ram caused considerable damage, including total severance of the plate from its clamped support over much of the outer perimeter The results of this research illustrate the importance of the method of attachment of the composite wall at its boundaries Author (GRA)

N77-13552# Massachusetts Inst of Tech , Cambridge Aeroelastic and Structures Research Lab

WIND ENERGY CONVERSION Progress Report, 15 Jul 1975 - 15 Feb 1976

R H Miller M Martinez-Sanchez J Dugundji E Larrabee, and T Humes 15 Feb 1976 183 p refs

(Grant NSF AER-75-00826)

(PB-256198/3 ASRL-TR-184-2 NSF/RA-760160) Avail NTIS HC A09/MF A01 CSCL 10B

Testing of a wind tunnel model and aeroelastic analyses indicate the scope of the problem involved in selecting a suitable speed for a wind turbine It is proposed that at least for conventional rotor type wind turbines a constant tip speed rather than a constant ratio of tip speed to wind speed is a more satisfactory design solution The penalty involved in maintaining constant tip speed was investigated in order to determine whether control should be considered for a constant speed or for variable speed (constant tip speed ratio) wind turbine As a result of experience with aeroelastic analyses it was decided to concentrate on the constant speed configuration Airloads in the presence of wind shear and gust were also investigated GRA

N77-13761*# Massachusetts Inst of Tech Cambridge Electronic Systems Lab

PERFORMANCE AND SENSITIVITY ANALYSIS OF THE GENERALIZED LIKELIHOOD RATIO METHOD FOR FAILURE DETECTION M S Thesis

Ramon A Bueno Feb 1977 216 p refs

(Grant NsG-1112)

(NASA-CR-149272, ESL-R-706) Avail NTIS HC A10/MF A01 CSCL 12A

Results of the generalized likelihood ratio (GLR) technique for the detection of failures in aircraft application are presented and its relationship to the properties of the Kalman-Bucy filter is examined Under the assumption that the system is perfectly modeled, the detectability and distinguishability of four failure types are investigated by means of analysis and simulations Detection of failures is found satisfactory, but problems in identifying correctly the mode of a failure may arise These issues are closely examined as well as the sensitivity of GLR to modeling errors The advantages and disadvantages of this technique are discussed, and various modifications are suggested to reduce its limitations in performance and computational complexity Author

N77-13791*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards Calif

SEMIEMPIRICAL AIRFRAME NOISE PREDICTION MODEL AND EVALUATION WITH FLIGHT DATA

Alan S Hersh (Hersh Acoustical Engineering) Frank W Burcham, Jr Terrill W Putnam, and Paul L Lasagna Dec 1976 36 p refs

(Contract NAS4-2250)

(NASA-TM-X-56041 H-951) Avail NTIS HC A03/MF A01 CSCL 20A

A semiempirical maximum overall sound pressure level (OASPL) airframe noise model was derived Noise radiated from aircraft wings was modeled on the trailing edge diffractes quadrupole sound theory The acoustic dipole sound theory was used to model noise from the landing gear The model was correlated with maximum OASPL flyover noise measurements obtained for three jet aircraft One third octave band sound pressure level flyover data was correlated and interpreted Author

N77-13792*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

ACOUSTIC SIGNATURES OF A MODEL FAN IN THE NASA-LEWIS ANECHOIC WIND TUNNEL

Donald A Dietrich Marcus F Heidmann and John M Abbott 26 Jan 1977 17 p refs Presented at the 15th Aerospace Scis Meeting, Los Angeles, 24-26 Jan 1977, Sponsored by AIAA

(NASA-TM-X-73560, E-9002) Avail NTIS HC A02/MF A01 CSCL 20A

One-third octave band and narrowband spectra and continuous directivity patterns radiated from an inlet are presented over ranges of fan operating conditions tunnel velocity, and angle of attack Tunnel flow markedly reduced the unsteadiness and level of the blade passage tone, revealed the cutoff design feature of the blade passage tone, and exposed a lobular directivity pattern for the second harmonic tone The full effects of tunnel flow are shown to be complete above a tunnel velocity of 20 meters/second The acoustic signatures are also shown to be strongly affected by fan rotational speed fan blade loading, and inlet angle of attack Author

N77-13834# Vought Corp , Sterling Heights, Mich

TARGET AND BACKGROUND SIGNATURE TEST PROGRAM Final Report

L A Monicatti Apr 1976 74 p

(Contract DAAH01-75-C-0533)

(AD-A025822, Rept-7-52100/6R-9) Avail NTIS HC A04/MF A01 CSCL 17/5

The objectives of this program were to (a) design and fabricate the necessary hardware and (b) conduct a test program to obtain the infrared signature data characteristics of various targets and backgrounds The data were obtained through the use of different types of infrared seekers and/or sensors from the overhead aspect employing a U S Army UH-1 type helicopter Subsequent analysis of the data determined the characteristic signatures of the various targets and backgrounds from the vertical hemisphere The program was a joint effort between the Vought Corporation Michigan Division, the U S Army Missile Command (MICOM), and the U S Army Tank and Automotive Command (TACOM) Testing was divided into two phases that were arranged to address various environmental aspects pertaining to various ground terrains, geographical locations and climatic and seasonal characteristics of the target and background signatures The two phases were (a) Southern phase - These tests were conducted at Redstone Arsenal, Alabama in the September - October timeframe (b) Northern phase - These tests were conducted at Grayling, Michigan in January The southern test series yielded data against a medium temperature, cool grassy field background while the northern test series provided data obtained against a severe winter/snow background GRA

N77-13936# Academy of Sciences (USSR) Moscow Space Research Inst

SPECTRAL AND POLARIMETRIC INSTRUMENTATION FOR THE AIRCRAFT ASTROPHYSICAL INVESTIGATIONS IN THE RANGE 50-500mkm

G B Sholomitski, V A Soglasnova, I A Maslov, V D Gromov, M Z Khokholov and V V Artamonov 1976 24 p refs Presented at the 19th COSPAR Symp on Galactic and Extragalactic Infrared and Submillimeter Astron Philadelphia Jun 1976 (D-228) Avail NTIS HC A02/MF A01

The receiving equipment for aircraft astrophysical investigations in the far infrared was developed and flown in 1974/1975 onboard the AN-30 aircraft Four types of infrared and submillimeter detectors, mainly of the photoresistor type were used in the wavelength region from 10 mkm to 1 mm Thermal background at the detectors was limited by cooled bandpass filters and by optimal matching of the detectors with the telescope optics The spectral filters used were combinations of quasiresonance metal mesh filters of different structure and Q-factor from 2 to 7 with the Yamada cut-off powder filters A tunable Fabri-Pero interferometer, a polarimeter for linear polarization measurements and an aircraft 25 cm-telescope are described Author (ESA)

N77-13972 European Space Agency, Paris (France)

STUDY BY HYDRODYNAMIC VISUALISATIONS OF VARIOUS PROCESSES FOR CONTROLLING SEPARATED FLOWS

Henri Werle, Marc Gallon et al *In its* La Rech Aerospatiale, Bi-monthly Bull No 1976-2 (ESA-TT-352) Nov 1976 p 26-68 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1976-2, Mar -Apr 1976 p 75-94 Original report in FRENCH previously announced as A76-33745

Qualitative results including a large number of photographs of visualized flows are presented of some experiments conducted in a hydraulic test tunnel on the low-velocity flow past some simple airfoils employing various high-lift devices The tests investigated means of avoiding or eliminating flow separation, procedures employing jet flaps for elongating the models and schemes for organizing turbulent separations in order to generate extra lift Some of the schemes studied included control of the boundary layer on a deflected flap by rotating the hinge control by tangential blowing on the deflected flap (for a conventional airfoil and for a delta wing), flow past wings with lift past a semicircular wing and past a slender body with profiled nose lift-augmented by jet flaps and flow past various types of vortex generators attached to the wall or leading edge of the various profiles Author (ESA)

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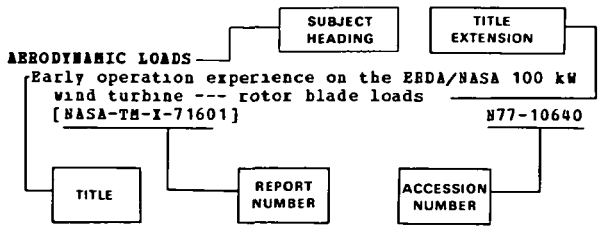

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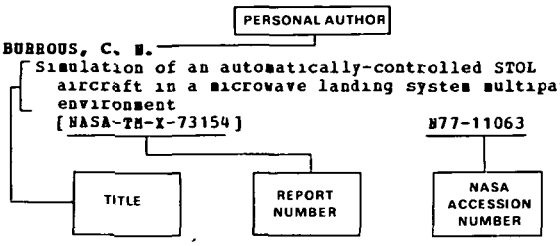

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