NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (95)
April 1978

National Aeronautics and Space Administration

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges:

STAR (N-10000 Series)	N78-13998—N78-15985
IAA (A-10000 Series)	A78-17138—A78-20614

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NASA SP–7037(95)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 95

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in March 1978 in

- *Scientific and Technical Aerospace Reports (STAR)*
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This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 383 reports, journal articles, and other documents originally announced in March 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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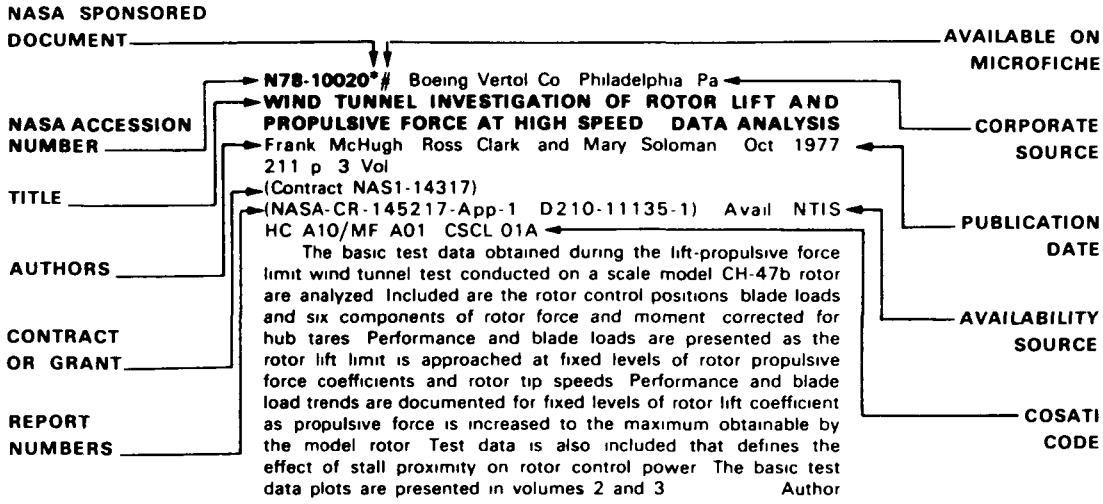

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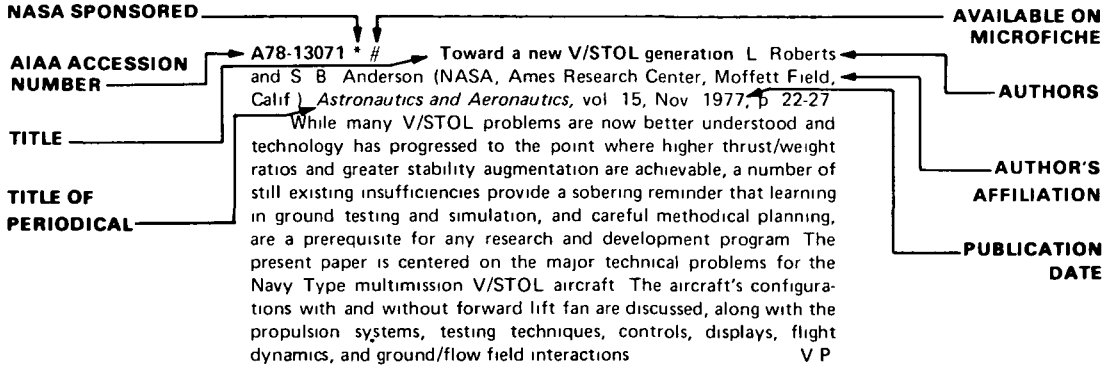

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 95)

APRIL 1978

IAA ENTRIES

A78-17196 **Moving target analysis utilizing side-looking airborne radar** C L Rosenfeld and A J Kimerling (Oregon State University, Corvallis, Ore.) *Photogrammetric Engineering and Remote Sensing*, vol 43, Dec 1977, p 1519-1522

The AN/APS-94C side-looking airborne radar (SLAR) system has the capability to distinguish signal return from stationary objects from those signals reflected by moving targets Experience has shown that vehicles traveling over 5 km/hr with a minimum spacing of 80 m will be detected, with the exact resolution limit a function of speed, direction of movement, and range The operational principle of moving target mode SLAR is discussed, as are several potential applications (Author)

A78-17253 **Applications of carbon fibre composites in commercial aircraft** A W Kitchenside (British Aircraft Corp., Weybridge, Surrey, England) In Designing with fibre reinforced materials, Proceedings of the Conference, London, England, September 27, 28, 1977 London, Mechanical Engineering Publications, Ltd., Institution of Mechanical Engineers, 1977, p 11-15 Research supported by the Ministry of Defence (Procurement Executive)

Two methods of application of carbon fiber composites to the airframe of commercial aircraft are described together with the test programs necessary for their development The design and production problems encountered are discussed The ultimate goal of these research programs is the widespread application of carbon fiber composite in airframe structure resulting in reduced aircraft operating costs (Author)

A78-17254 **The use of composites in class 1 structures in helicopters** C J Stevenson (Westland Helicopters, Ltd., Yeovil, Somerset, England) In Designing with fibre reinforced materials, Proceedings of the Conference, London, England, September 27, 28, 1977 London, Mechanical Engineering Publications, Ltd., Institution of Mechanical Engineers, 1977, p 17, 18

The operating environment and loading requirements of main and tail helicopter rotor blades are reviewed, and the design problems and manufacturing methods connected with the production of composite rotors are discussed The composite under consideration is based on unidirectional glass fibers with carbon fibers added to increase torsional stiffness Preimpregnated fibers are chosen to obtain optimum reinforcement/resin levels and to decrease the possibility of voids, the costs and processing techniques associated with press molds, autoclaves, and heated tools are also mentioned J M B

A78-17298 **The effects of vibration on an aircraft fuel density meter** A Simpson (Bristol, University, Bristol, England) and W R Reynolds (British Aerospace, Simulation Dept., Filton, Bristol, England) *Journal of Sound and Vibration*, vol 55, Nov 8, 1977, p 109 133 5 refs

During the operation of an aircraft fuel density meter, collision occurs between teeth on their opposite pressure flanks, and a succession of collisions between teeth on the quadrant and rack may be produced under certain conditions The dynamical consequences of such collisions relative to meter performance are evaluated The governing equations of motion are derived, and then solved on an analogue computer An analysis of these results suggests that the experienced rectification phenomenon is a factor of backlash and friction within the device A subharmonic response phenomenon is also noted The results obtained are valid for any dynamical system combining backlash and friction together with a weak spring or pendulum like restoring action S C S

A78-17361 **Calibration of gas turbine instrumentation** B Vesser (Tektronix, Inc., Beaverton, Ore.) In International Instrumentation Symposium, 23rd, Las Vegas, Nev., May 1 5, 1977, Proceedings Pittsburgh, Pa., Instrument Society of America, 1977, p 119-125

This paper describes the techniques and equipment for calibration of transducers commonly installed on a gas turbine's control equipment Particular emphasis is directed toward a method of coarse calibration of thermocouples and prediction of pending failures Functional descriptions of electronic modules to make up test sets and photographs of these test sets are included A modular hardware philosophy is shown upon which various types of test sets may be made up from common hardware (Author)

A78-17364 **In-flight measurement of aircraft acoustic signals** R E George (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.) and V Duffy (Federal Bureau of Investigation, Los Angeles, Calif.) In International Instrumentation Symposium, 23rd, Las Vegas, Nev., May 1 5, 1977, Proceedings Pittsburgh, Pa., Instrument Society of America, 1977, p 167 174

A new in-flight technique for measuring helicopter impulsive noise has been developed which uses a quiet fixed wing aircraft instrumented with acoustic recording equipment and flown in formation with the helicopter whose radiated noise signature is to be measured Far field acoustic waveforms and radiation patterns were easily obtained over a wide, continuous range of UH 1H helicopter 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 background noise, Doppler effects, ground reflections, time varying geometric parameters or transmission path distortions that have hindered many measurement efforts in the past B J

A78-17371 **Development and test of an airborne range instrumentation system /ARIS/** C H Leatherbury (Institute for Defense Analyses, Arlington, Va.), J S Ausman (Litton Industries,

Inc , Guidance and Control Systems Div , Woodland Hills, Calif), and H E Thompson (U S Department of Defense, Office of Director of Defense, Washington, D C) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1 5, 1977, Proceedings Pittsburgh, Pa , Instrument Society of America, 1977, p 269-278 7 refs

The paper describes an airborne range instrumentation system (ARIS) which was developed for the purpose of scoring simulated bomb drops by tactical aircraft against realistic targets The system utilizes distance measuring equipment DME-inertial pods and portable ground based transponders The operation and testing of the system are described, and ARIS bomb impact prediction is explained Although ARIS was developed for operational tests of A-6E and F-111 F radar bombing accuracy, other uses are considered M L

A78-17372 * Instrumentation complex for Langley Research Center's National Transonic Facility C H Russell (NASA, Langley Research Center, Digital Data Acquisition Section, Hampton, Va) and C S Bryant (NASA, Langley Research Center, National Transonic Facility, Hampton, Va) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1-5, 1977, Proceedings Pittsburgh, Pa , Instrument Society of America, 1977, p 279 283

The instrumentation discussed in the present paper was developed to ensure reliable operation for a 2 5-meter cryogenic high-Reynolds-number fan-driven transonic wind tunnel It will incorporate four CPU's and associated analog and digital input/output equipment, necessary for acquiring research data, controlling the tunnel parameters, and monitoring the process conditions Connected in a multipoint distributed network, the CPU's will support data base management and processing, research measurement data acquisition and display, process monitoring, and communication control The design will allow essential processes to continue, in the case of major hardware failures, by switching input/output equipment to alternate CPU's and by eliminating nonessential functions It will also permit software modularization by CPU activity and thereby reduce complexity and development time V P

A78-17373 # Conversion of a wind tunnel data acquisition system to minicomputer control T L Bradford and F C Hightower (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1-5, 1977, Proceedings Pittsburgh, Pa , Instrument Society of America, 1977, p 285-290

The data acquisition system for three wind tunnels covering a Mach number range from 1 5 to 12 was converted to minicomputer control The new data system has the capability of randomly accessing any tunnel channel independently without the sequential scan required by the previous system In addition, the minicomputer-controlled system provides for automatic sensing, limit detection and fault monitoring of tunnel conditions, automatic timing of data acquisition sequences, engineering display of tunnel parameters, automatic analog and pressure calibrations, and uncertainty analyses J M B

A78-17374 # Increasing data productivity with a minicomputer based data acquisition system J L Taylor and J R Lancaster (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1-5, 1977, Proceedings Pittsburgh, Pa , Instrument Society of America, 1977, p 291-298

A computer based data acquisition system has been used in conjunction with wind tunnel data systems to significantly increase productivity by using techniques which optimize the data acquisition rate as a function of accuracy requirements and which provide for automatic test article control Algorithms which distinguish between different data signal response characteristics have been developed to optimally control data acquisition from pneumatic commutators and other non-dynamic pressure measurement systems Automatic control of test article attitude and other central parameters has been optimized through the use of simple, yet effective, adaptive algorithms (Author)

A78-17396 * Sound separation probes for flowing duct noise measurements M T Moore (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1 5, 1977, Proceedings Pittsburgh, Pa , Instrument Society of America, 1977, p 451-459 Contract No NAS3 18021

In order to understand the propagation of broadband sound from a device such as a jet engine, it is necessary to make fluctuating pressure measurements in the ducted airstream However, in a flowing duct, fluctuating pressure energy can be due to both turbulence and sound travelling in the duct By using the principal that sound waves and turbulent flow pressure perturbations travel at different velocities, a probe has been developed that provides the data necessary to separate the energy due to sound from that due to turbulence A mini computer based FFT analysis of the probe measurements provides the overall level of the broadband sound in the duct as well as the spectral distribution of the sound energy (Author)

A78-17410 Calculation of in-flight thrust and estimation of the uncertainty for turbine powered aircraft G R Adams and W E Rudhman (USAF, Propulsion Performance/Stability Div , Wright Patterson AFB, Ohio) In International Instrumentation Symposium, 23rd, Las Vegas, Nev , May 1-5, 1977, Proceedings Symposium sponsored by the Instrument Society of America Pittsburgh, Pa , Instrument Society of America (Fundamentals of Aerospace Instrumentation Volume 9, Fundamentals of Test Measurement Volume 4), 1977, p 17-26

The paper describes a general method for calculating thrust and associated uncertainty by means of a weighted model approach The method considers the data base available for model correlation, model error determination, and a technique to handle instrumentation accuracies expected in flight test Results of the analysis of a fighter aircraft powered by an afterburning turbofan engine are presented Application of the methodology relies heavily on engineering judgment M L

A78-17427 # Aerodynamic characteristics of a rectangular wing with a tip clearance in a channel Y Sugiyama (Nagoya University, Nagoya, Japan) *ASME, Transactions, Series E - Journal of Applied Mechanics,* vol 44, Dec 1977, p 541-547 8 refs

Aerodynamic characteristics of a single, stationary wing, whose tip is in an end-wall boundary layer, are studied experimentally to determine the effects of aspect ratio, tip clearance, angle of attack and end-wall boundary layer Spanwise distributions of the lift and drag coefficient are derived and interpreted from the data obtained by chordwise pressure measurements on the wing surface The results indicate that the slope of the lift curve, the angle of zero lift and the drag coefficient reach a maximum at an optimum value of the tip clearance in a certain range of the aspect ratio Interesting information is also obtained for effects of the end-wall boundary layer on the lift and drag of the wing with a slot (Author)

A78-17483 # Account of mainstream turbulence for predicting film cooling effectiveness in gas turbine combustors G J Sturgess and J E Lenertz (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Institute of Chemical Engineers and American Society of Mechanical Engineers, Heat Transfer Conference, Salt Lake City, Utah, Aug 15-17, 1977, ASME Paper 77-HT 10* 12 p 16 refs Members, $1 50, nonmembers, $3 00

Failure to account for the degradation of film effectiveness due to mainstream turbulence in a gas turbine combustion chamber can result in overheating of the liners with consequent durability problems in service A film cooling model is functionally modified to account for such turbulence Equations and curves are presented to provide a complete description of film development when subjected

to mainstream turbulence Comparisons of predictions of the model are made with measurements from thin and thick lipped clean geometry, tangential film cooling slots over a wide range of conditions It is concluded that in rig tests of film cooling devices for gas turbine combustors where absolute values for film effectiveness are required, not only should the correct mainstream turbulence intensity be reproduced but the correct ratio of mainstream to film turbulence integral length scales should also be simulated (Author)

A78-17527 A comparison of three computerized design algorithms for control systems. T W Case, J R Mitchell, and W L McDaniel, Jr (Mississippi State University, Mississippi State, Miss) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 21 23 6 refs

Three computerized algorithms applicable to the design of missile and aircraft autopilots are compared The algorithms are the Automatic Frequency-Domain Synthesis of Multiloop Control Systems, the Compensator Improvement Program, and the Computerized Optimization of Elastic Booster Autopilots A test problem involving the design of a digital altitude control system for a ballistic missile is used to study the efficiency of the three algorithms, computer core requirements, method of finding partial derivatives, required computer solution times, and the ability to include time-varying vehicle parameters (such as fuel consumption) are also assessed for the design programs J M B

A78 17548 A millimeter wave surveillance radar for RPVs L H Kosowsky, R S Graziano (United Technologies Corp , Norden Div , Norwalk, Conn), R Wagner (U S Army, Electronics Command, Fort Monmouth, N J), and D Dunlap (U S Army, Aviation Systems Command, St Louis, Mo) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977
New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 238-243

The development of a millimeter radar intended for use on small remotely piloted vehicles (mini RPVs) is described The system will operate in adverse weather and will provide multimode radar data for tactical surveillance The radar modes include fixed target enhancement, high resolution ground map, and moving target detection Two mission scenarios based on the radar's high resolution are examined, and several system components are described The system is undergoing ground and airborne testing M L

A78-17564 A performance analysis of a radar tracking filter R L Moose and N H Gholson (Virginia Polytechnic Institute and State University, Blacksburg, Va) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 343-346 Navy-supported research

In the radar tracking of maneuvering aircraft targets a Kalman filter is frequently employed as the basic building block around which an adaptive system is designed This paper presents a performance analysis of the basic tracking filter when certain key system parameters such as sample rate, radar error correlation time constants and power levels vary Results are also presented which show the effect of ignoring, in the model, time or serial correlation of the radar measurements (Author)

A78-17569 Preventing zero-growth air transportation G A Gilbert (Glen A Gilbert and Associates, Washington, D C) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 389 393

It is urged that a mass air transportation system be developed by increasing the number of VTOL aircraft and VTOLports Bottlenecks are foreseen in the air control system that relies on conventional takeoff and landing aircraft (CTOL), of particular concern is the unlikelihood, due partly to environmental considerations, that new airports suitable for large CTOL aircraft will be constructed in the near future Procedures for increasing existing airport capacity are examined, and IFR helicopter operations are discussed A program for expanding VTOL use is proposed, goals include federal aid for air transportation and subsidies to V/STOL manufacturers M L

A78-17575 Design and operation of an airborne air quality measurement system J B Tommerdahl, R B Strong, J H White (Research Triangle Institute, Research Triangle Park, N C), and J C Mulligan (North Carolina State University, Raleigh, N C) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 430-433 U S Environmental Protection Agency Contract No 68-02-2048

An instrumentation system for use in a light, twin-engine aircraft for ambient air quality measurements in the lower troposphere is described The system includes equipment for the measurement of ozone, oxides of nitrogen, temperature and the collection of grab samples for hydrocarbon analysis The air sampling system design, the evaluation of pressure effects on the analyzers, supporting measurements such as altitude and air speed, field operational procedures, and data validation techniques are discussed A brief description of a four-month flight program, conducted during the summer of 1975, which involved around 300 hours of flight time is presented (Author)

A78-17584 Instrumentation and control for a large engine test facility J R Rickard (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn) and M W Lawley (ARO, Inc , Arnold Air Force Station, Tenn) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 511-514

The Aeropropulsion Systems Test Facility (ASTF) has been developed for ground-testing of turbojet and turbofan engines with thrust capabilities over 75,000 pounds, at simulated speeds of Mach 3 8, and at altitudes of 100,000 feet Scheduled for operation in the early 1980's, the system provides a closed-loop, adaptive control means to maintain environmental conditions (such as pressure, humidity, air flow, and temperature) in an engine test cell The ASTF control and data handling system consists of process control, test article control, and data acquisition and processing subsystems It provides three operational modes (1) a steady-state preset environment for an engine operating with steady-state power setting, (2) a constant preset test cell environment while the engine produces a transient change in its power setting, and (3) a programmed change in test cell environment while the engine maintains a constant power setting S C S

A78 17598 Automatic flightpath calculation and position reporting using a single VOR receiver and a microprocessor system W W Langley and G R Kane (Auburn University, Auburn, Ala) In Imaginative engineering thru education and experience, Proceedings of the Southeast Region 3 Conference, Williamsburg, Va , April 4-6, 1977 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 653-656

Apparatus for flight planning and position reporting is described An on board microcomputer would be interfaced to a VHF omnidirectional radio (VOR) which incorporates digital tuning and has an A/D converter The computer algorithm can perform triangulation to ascertain position with respect to two VOR transmitters The system is intended for general aviation pilots who currently use a more burdensome calculation procedure M L

A78-17612 * # **Displacement thickness distributions in transonic flows about 3-D wings** W Kordulla (NASA, Ames Research Center, Moffett Field, Calif) In Conference on Numerical Methods in Fluid Mechanics, 2nd, Cologne, West Germany, October 11-13, 1977, Proceedings Cologne, Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, 1977, p 81-88 13 refs

The transonic 3-D inviscid small-perturbation solution of Bailey and Ballhaus is combined with a finite-difference solution for Prandtl's boundary-layer equations in order to include viscous effects. The inviscid-viscous interaction is modeled by means of the displacement surface, which can be thought of as the effective body surface seen by the inviscid flow Displacement thickness, lift, and pressure distributions resulting from the combined solution are presented for transonic flows about the RAE 101 A wing and a Lockheed transport wing, both at small angles of attack The influence of changing arbitrarily the start of transition on the displacement surface and lift is discussed for the RAE wing flow (Author)

A78-17636 # **Dynamic model of a deformable aircraft for natural vibration analysis by the finite element method** Z Dzygadlo and J Blaszczyk *Journal of Technical Physics,* vol 18, no 2, 1977, p 219-229 6 refs

A method is presented for analyzing the frequencies and modes of the natural vibrations of an elastic aircraft by using a one dimensional discretization of the deformable structural units by finite elements The wing, aft fuselage, and horizontal tail assemblies are treated as deformable units with mass and stiffness parameters varying along the length The fore fuselage and vertical tail assembly are regarded as rigid bodies to which the deformable parts are attached Vibrations that are symmetric with respect to the assumed plane of longitudinal mass and elastic symmetry are studied The equations of dynamic equilibrium of the deformable units and rigid parts are derived, and conditions for the coupling of these equations are given P T H

A78-17642 # **Analysis of lateral dynamic stability of an airplane with deformable control systems II - Numerical analysis** Z Dzygadlo and E Piotrowski *Journal of Technical Physics,* vol 18, no 3, 1977, p 347 358 10 refs

Results of numerical calculations of the lateral dynamic stability of an aircraft with moving weighting control units are presented, elasticity and damping in the control system, as well as the effect of the unbalance of the ailerons and rudder, are taken into account The numerical calculations have been applied to the case of a jet trainer J M B

A78-17662 Study of a turbomachine combustor with swirling flow (Etude d'un foyer de turbomachine à ecoulement giratoire) A Mestre (ONERA, Châtillon-sous-Bagneux, Hauts-de Seine, France) *Entropie,* vol 13, no 76, 1977, p 3-17 5 refs In French Research supported by the Delegation Generale à la Recherche Scientifique et Technique

In a classical turbomachine, the flow issuing from the compressor is deflected along the axis before entering the combustor, then deflected again to attack tangentially the first rotor row These operations, with their attendant losses, could be avoided if combustion and dilution were carried out in the swirling flow issuing from the compressor Once primary combustion is obtained in such a flow, diffusion is easily performed by introducing cold air centrally, thanks to the centrifugal gravitational field On the other hand, cold air introduced at the periphery does not mix with burnt gases, and thus maintains a cool layer along the casing The article describes the experimental set up designed at ONERA and presents the very promising results obtained (Author)

A78-17663 Recent developments in automatic testing (Développements récents du contrôle automatique) G Sertour (Societe Nationale Industrielle Aerospatiale, Paris, France) *Entropie,* vol 13, no 76, 1977, p 41-51 In French

An industrial automatic testing program was developed in three fields dimensional testing, nondestructive testing, and equipment and electrical circuit testing These developments are motivated by the fact that automation permits a reduction in the cost of testing through reduction of the testing unit times, renders the work of the operator easier, and increases the reliability of the testing These advantages are reflected in the applications described in the presentation J M B

A78-17699 A close look at 7475 and 2024 aluminum for aircraft structures J M Van Orden and D E Pettit (Lockheed California Materials Laboratory, Burbank, Calif) *Metal Progress,* vol 112, Dec 1977, p 28-31 6 refs

Comparisons of mechanical properties and plane stress fracture characteristics of 2024-T3, 7075, and 7475 aluminum alloys indicate that 7475 sheet combines the high strength of 7075 with the good fracture toughness of 2024 The 2024 sheet tolerates considerably more stable crack growth before fracturing, both at room temperature and at -54 C Fracture toughness of 7475 is approximately 40% lower at -54 C than at room temperature, while that of 2024 remains essentially stable down to the lower temperature The recently developed 7475 alloy is being considered for use in the construction of aircraft components such as fuselage skins and wing skins M L

A78-17723 # **An experimental investigation into the effect of errors in blade setting on the low-speed performance of a compressor cascade** R M El Taher (King Abdul Aziz University, Jeddah, Saudi Arabia), M R A Shaalan (Riyadh University, Riyadh, Saudi Arabia), and M I Rashed (Cairo University, Cairo, Egypt) *Journal of Engineering Sciences,* vol 3, Nov 1977, p 55-61

Experiments were conducted on the effect of one-blade periodic and random errors in the blade setting on the performance of an axial compressor cascade Tests were conducted in a low-speed wind tunnel at a Reynolds number around 300,000 The effect of an angular error in the setting of the central blade is that an increase in the loading of the error blade due to positive angular error is accompanied by a decrease in the loading of adjacent blades The algebraic sum of the changes in loading of the central three blades most affected by error in the central blade setting is finite, producing a substantial change in the pitch averaged outlet angle far down stream Cascadewise error did not affect the outlet flow pattern The outlet angle traverse was asymmetrically affected by chordwise errors, although its pitch averaged value changed little P T H

A78-17737 F-16's ISAs reduce cost, weight, and leakage W O Lee (General Dynamics Corp , Fort Worth, Tex) *Hydraulics and Pneumatics,* vol 30, Dec 1977, p 51-54

F 16 integrated servoactuators (ISAs) for flight control surfaces are described and evaluated Five ISAs combine command, monitoring, logic, feedback, and actuation, and provide yaw-, pitch-, and roll-axis control ISAs are compared with a damper servo flight surface actuation system used by the YF-16 (the F-16 prototype), the ISAs advantages include over 40% cost saving of hardware, weight savings of almost 60 lb, volume savings of over 6 cu ft, reduction of 60 hydraulic connections and 20 flexible hose assemblies, significant reduction in target area for reduced vulnerability, and significant life-cycle cost savings The ISAs consist of a three stage tandem valve assembly (using hydraulic logic and mechanical rate and position feedback) mounted on a fully balanced tandem actuator Each ISA is replaceable as a unit on the flight line Command inputs, failure detection, and two separate hydraulic power systems are explained M L

A78-17764 # **Application of the method of optimal control for elimination of aeroelastic vibrations** J Pietrucha (Warszawa, Politechnika, Warsaw, Poland) and D Szelag (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland) *Zagadnienia Drgan Nieliniowych,* no 18, 1977, p 45-55 23 refs

This work is concerned with the synthesis of a system which eliminates aeroelastic vibration from a model of a wing with three degrees of freedom To this end, use is made of the Pontriagin maximum principle for a linear system with a quadratic performance index. The calculations performed in this work show that the control determined here is applicable to elimination of aeroelastic vibrations (Author)

A78-17878 Design considerations in formulating V/STOL lift plus lift/cruise supersonic fighter concepts W E Caddell (General Dynamics Corp , Convair Div , San Diego, Calif) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 13 p

Several means of providing V/STOL thrust are examined and discussed relative to their impact on the design of supersonic fighters The lift plus lift/cruise concept is discussed in more detail, specifically addressing both the advantages and concerns that exist with that system The principal concern is the operational footprint (temperature and noise) The principal advantage is its minimal impact on airframe design, aerodynamic parameters, and fuel requirements, which are the major parameters in weight growth spiral effects The conclusion is that lift plus lift/cruise advantages result from differences that are fundamental, and that this concept will generally result in the lightest weight and lowest cost supersonic fighter designed to a specific operational requirement (Author)

A78-17879 Advanced technology emphasis for a 1985 tactical supersonic cruise airplane V R Ciminera, W Giesler, and P M Schwartz (Grumman Aerospace Corp , Bethpage, N Y) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 18 p

A procedure is developed for determining optimum aerodynamics, materials, and propulsion techniques for a proposed 1985 weapons system The procedure consists of (1) the determination of mission and point performance criteria for a 1985 supercruise weapons system, (2) a computerized initial sizing estimate program applicable to a baseline airplane with 1975 state-of-the art technology, and (3) establishment of figures-of-merit for evaluating technology payoffs (including takeoff gross weight, life cycle costs, and cost effectiveness) S C S

A78-17880 V/STOL presentation R M Dunleavy (U S Navy, Washington, D C) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 9 p

The paper discusses the future role of V/STOL aircraft in the U S Navy It is suggested that the use of V/STOL aircraft will permit dispersion of ships while maintaining task force integrity It is also thought that V/STOL aircraft will facilitate flexibility in future ships designs Technological advances will, it is considered, make V/STOL aircraft feasible for naval purposes in the 1990's Multi-mission capabilities of V/STOL aircraft are planned as part of the program to reduce the number of naval aircraft The long lead-time will permit flexibility in planning V/STOL development and utilization M L

A78-17884 Weight and cost in the design arena T E Henderson (General Dynamics Corp , Fort Worth, Tex) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 15 p

The significance of aircraft weight considerations in the history of aircraft evolution is examined along with the importance of cost identification and assessment methods Life cycle costs, operations and support costs, and logistic support costs (LSC) are terms used to describe various aspects of weapon systems costs A description is presented of a model which estimates the annual steady-state operating costs for a weapons system The primary parameters of the model are related to unit equipment, utilization rate, crew ratio, and man hour/squadron/year for officers, airmen, and civilians The LSC cost model consists of 10 equations A sensitivity factor is used to assess weight change impacts on the operations and support cost (fuel cost) Relaxed manufacturing/design tolerances concepts for the Air Force have been introduced as part of an overall effort to reduce the manufacturing cost of the Air Force aircraft G R

A78-17886 Techniques for evaluating airframe structural elements and their applications to design-to-cost R E Kenyon, J M Youngs (General Dynamics Corp , Convair Div , San Diego, Calif), and R N Mueller (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 14 p

A study was conducted with the objective to develop cost estimating techniques with design-to-cost (DTC) application to evaluate cost as a design parameter DTC has been defined as a management tool for holding systems costs to rigorous cost goals by means of tradeoffs among operational capability, performance, cost, and schedule In connection with the study, a cost model was developed of techniques for evaluating airframe structural elements (TEASE) The TEASE program is based on cost-weight relationships in the cost estimating relationships (CERs) The program provides the capability to estimate trade study cost and total airframe costs CERs are entered on the cost model cards as standard FORTRAN statements or as coded entries Attention is given to a cost output example, estimating methodology, the costing process, aerodynamic surfaces rib complexity factors, a detailed industrial engineering analysis, advanced structure applications, method improvements, raw material CER modifications, airframe structure assembly CER modifications, airframe structure part commonality, production rate cost effects, airframe structure learning curve factors, and cost model changes G R

A78-17889 Why fly supersonically R D Mijares and J C Salvagio (Lockheed-California Co , Burbank, Calif) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 7 p 8 refs

Advantages of supersonic aircraft are related to a reduction of flight times to about one half of the subsonic value Drawbacks are connected with a high fuel consumption and a low payload fraction The technical problems associated with high speed flight are examined and investigations are discussed which have been conducted to explore the possibilities for solving the problems The improvements in technology which are necessary for a successful supersonic cruise vehicle (SCV) are identified Advanced engine concepts incorporating variable geometry components, more efficient cycles, advanced materials, and digital fuel controls show promise of significant improvement in performance over first generation SST turbojet engines A cost analysis reveals that the SCV may operate profitably on the North Atlantic routes with a revenue structure based on economy fares G R

A78-17890 Design problems associated with the B-1 Composite Horizontal Stabilizer L Murrin and H Erbacher (Grumman Aerospace Corp , Bethpage, N Y) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 21 p

During the design of the B 1 Composite Horizontal Stabilizer, design problems were identified in the early stages of the program by a series of coupon and element tests The remedial action invariably involved weight penalties, however, through a program of weight optimization and control, the target weight was achieved The stabilizer was successfully static and fatigue tested with failure occurring at 132% of ultimate design load (Author)

A78-17891 * The vehicle design evaluation program - A computer-aided design procedure for transport aircraft B H Oman, G S Kruse (General Dynamics Corp , Convair Div , San Diego, Calif), and O E Schrader (NASA, Langley Research Center, Hampton, Va) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 20 p

The vehicle design evaluation program is described This program is a computer aided design procedure that provides a vehicle synthesis capability for vehicle sizing, external load analysis, struc-

tural analysis, and cost evaluation The vehicle sizing subprogram provides geometry, weight, and balance data for aircraft using JP, hydrogen, or methane fuels The structural synthesis subprogram uses a multistation analysis for aerodynamic surfaces and fuselages to develop theoretical weights and geometric dimensions The parts definition subprogram uses the geometric data from the structural analysis and develops the predicted fabrication dimensions, parts material raw stock buy requirements, and predicted actual weights The cost analysis subprogram uses detail part data in conjunction with standard hours, realization factors, labor rates, and material data to develop the manufacturing costs The program is used to evaluate overall design effects on subsonic commercial type aircraft due to parameter variations M L

A78-17892 Some operational experience of Concorde weight and balance M A Peace (British Airways, Heathrow, Middx , England) and J Francis (British Aircraft Corp , Ltd , London, England) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 37 p

The external configuration and internal layout of the British Airways aircraft Concorde are described The fuel tankage and fuel system layout, together with the cockpit layout, are used to illustrate the fuel transfer and Center of Gravity (CG) control instrumentation Requirements for the use of fuel to maintain aircraft trim are also mentioned Flight Manual Take-off Weight limits are calculated for a fixed Take-off CG The importance of the Zero Fuel CG in defining Landing CG limits and Maximum Take-off fuel is described The importance of weight and CG control in flight on aircraft performance is discussed and some details of in-service experience are included with reference to payload distribution and ground handling (Author)

A78-17893 Application of the thrust augmentation wing principle for potential military use E M Petrushka and A G Winnett (Rockwell International Corp , Columbus Aircraft Div , Columbus, Ohio) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 14 p

Thrust augmentation wing (TAW) characteristics are discussed with attention to vertical, conversion, and conventional flight Military projects considered include a possible configuration of a future TAW V/STOL, the XFV-12A prototype for assessing the TAW concept, the long endurance sensor carrier (LESCA), carrier-onboard-delivery (COD), medium V/STOL transport, and omni-based aircraft TAW offers an opportunity for integrated lift, conversion, and control in a V/STOL aircraft Engine size for hover is reduced by thrust augmentation The main wing lifter and canard aircraft arrangements are explained, and TAW design features are examined M L

A78-17894 Designing to cost /DTC/LCC/ B I Rachowitz (Grumman Aerospace Corp , Bethpage, N Y) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 25 p

An overview of an aerospace corporation's design-to-cost/life cycle cost methodology is presented The methodology is intended to permit design engineers to trade cost and performance rapidly during the design process The methodology relies on manuals designed to be used in various stages of vehicle design, these manuals provide more detailed costing as the design progresses Information on fuselage relationships is presented, and the design of a fuselage panel is discussed as an example M L

A78-17895 The aerodynamic vane control for V/STOL J E Raha (Grumman Aerospace Corp , Bethpage, N Y) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 27 p

This paper is a description of Grumman's two-engine, two-fan V/STOL Design 698 for ASW/AEW missions After a brief discussion of the Nutcracker, a predecessor design, the paper presents a description of the unique configuration features of Design 698 rather than attempting to summarize the entire V/STOL program Concepts discussed include the V/STOL nacelle, composites applications, engine sizing philosophy and the conformal radar Weight statements and summaries of VTOL weight increments are included (Author)

A78-17896 Influence of mechanical transmission concepts on Navy Type 'A' operational aircraft weight R S Saint John and F G Wyatt (Vought Corp , Dallas, Tex) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 28 p

The influence of mechanical transmission concepts on Navy Type A V/STOL aircraft is studied for six different configurations, representing a variety of transmission requirements The configurations are analyzed by criteria such as thrust turning losses, suckdown, reingestion, and the use of advanced composites Comparisons are made between transmission weight and gross weight S C S

A78-17897 C 5 wing modification - Weight and design to cost status W F Young (Lockheed-Georgia Co , Marietta, Ga) *Society of Allied Weight Engineers, Annual Conference, 36th, San Diego, Calif , May 9-12, 1977, Paper* 29 p

A contract was awarded to an American aerospace company to redesign the center wing and inner wing and to modify the existing outer wing of the C-5A The proposed new structure is to provide an additional 30,000 flight hours An overview is presented of the weight and design to cost programs for the contract Attention is given to aspects of weight control, changes in the location of the center of gravity, effects on the moment of inertia, the design-to cost (DTC) estimates, the DTC organizational relationships, the determination of recurring and nonrecurring costs, operation and support cost considerations, DTC reports, and reward/penalty aspects of the DTC program It is concluded that both the weight and design to cost programs have been immensely successful in producing the maximum cost effective product conceivable for the customer G R

A78-17898 An application of the global positioning system to search and rescue and remote tracking F H Raab (Polhemus Navigation Sciences, Inc , Essex Junction, Vt), G W Board (Computer Sciences Corp , Falls Church, Va), S D Arling (Bendix Corp , Avionics Div , Fort Lauderdale, Fla), J D Dobbs (Lear-Siegler, Inc , Grand Rapids, Mich), S C Smrdel (Litton Industries, Guidance and Control Systems Div , Woodlawn Hills, Calif), and J R Waechter (Goodyear Aerospace Corp , Akron, Ohio) *Navigation,* vol 24, Fall 1977, p 216-228 13 refs Contract No F33657 74 C-0705

Retransmission of radionavigation signals enables the location of remote objects in such applications as remote tracking and search and rescue Previous retransmission systems have used low- and very-low-frequency navaids, all of which have some limitations in coverage, accuracy or ambiguities The Navstar Global Positioning System, currently under development, will provide highly accurate and unambiguous positioning which will be available continuously anywhere in the world, thereby overcoming the limitations of the low-frequency navaids The GPS will use L-band carriers which are modulated by pseudorandom noise ranging signals, thereby providing immunity to jamming and multipath interference These signals are produced by linear feedback shift register generators and are detected by correlation with locally generated codes Retransmission can be accomplished by translation, remodulation, spread spectrum multiplexing, bandwidth reduction, or preprocessing (Author)

A78-17899 Inertially aided scanning DME for area navigation W E Tanner (Charles Stark Draper Laboratory, Inc , Cambridge, Mass) *Navigation,* vol 24, Fall 1977, p 248-255 5 refs

The design of an inertially aided radio navigation system using a scanning DME interrogator set is discussed, and flight test performance data of this area navigator and of the scanning DME subsystem are presented Under poor geometric conditions and with 3 deg/sec turn maneuvers the 1-sigma position uncertainty is about 100 m In an all-DME standby mode the maximum navigation error was less than 700 m The navigation system is suitable for area

navigation on parallel airlanes Some operational problems are touched upon (Author)

A78-17903 # **Satellite-aided ATC system concepts employing the Navstar Global Positioning System** B D Elrod and A Weinberg (Mitre Corp , McLean, Va) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22 24, 1977, Paper* 40 p 10 refs (M77 59)

The Navstar Global Positioning System (GPS), designed to provide by the mid-1980s a highly accurate three-dimensional worldwide navigation capacity, is described Air traffic control applications are being considered, in these applications, surveillance and data communications as well as navigation are provided Three system concepts are reported, these systems involve the addition of civil signal package or civil signal and repeater package to the data link plus global positioning system Space, ground, and user segment configurations are explained, and performance characteristics, including spectrum requirements, channel quality, geometrical characteristics, and surveillance capacity, are examined Utilization of the global positioning system might lead to savings due to the joint use of satellites M L

A78-17904 # **Future domestic air navigation system analysis** R Braff and A N Joglekar (Mitre Corp , McLean, Va) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22 24, 1977, Paper* 29 p 5 refs (M77 52)

The feasibility of replacing the existing U S civil air navigation system (VHF Omnirange/Distance Measuring Equipment) with a Loran-C network or the Navstar-Global Positioning System (GPS) is discussed Cost to the user for a Loran receiver-navigator is put at $2000, while the cost of a GPS receiver-navigator is estimated at $2800, cumulative costs to the government of introducing a civil air navigation GPS or Loran C system are also assessed It is suggested that a transition to the Loran-C or Navstar-GPS system would accommodate more users with high performance requirements, though the more economic VHF Omnirange system could be retained for users with lower performance requirements J M B

A78-17907 # **Navigating Canada, to the end of the twentieth century** C B Jeffery (Transport Canada, Telecommunications and Electronics Bureau, Ottawa, Canada) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22 24, 1977, Paper* 11 p

The direction of development for Canadian air and marine navigation systems during the next 10 to 20 years is discussed The expansion of air traffic surveillance in the northern region of the nation is forecast, a greater area of coverage for direct surveillance and automated tracking is planned The West Coast Loran-C system is mentioned, and the possible replacement of the East Coast Decca and Loran-A chains by a Loran-C network is considered However, high cost and low traffic rates seem to rule out the possibility of expanding the Loran-C system to the Arctic regions In the interior, an increasing use of low- and medium-frequency beacons, racons and radar in conjunction with VHF direction finding equipment of the 'talk-back' type is seen J M B

A78-17908 # **Automatic continental land mobile position fixing via satellite** A F Brisken (General Electric Co , Schenectady, N Y) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 21 p 10 refs U S Department of Justice Contract No DEA-76-20

In the described approach to continent wide vehicle communications, VHF repeaters on satellites in geostationary orbits are used to relay the communications directly between the vehicles and central stations The relay can be effected over continental distances or within regional areas where present communications are either poor or nonexistent The relay could include data from a variety of automatic data collection platforms, surveillance ranging sequences, or voice from manned sites (fixed or mobile) Tests are described which clearly demonstrate land mobile-satellite communications of a quality comparable to, if not exceeding present conventional mobile communications The tests were specifically designed for operation with the only available satellites in the VHF band Commercially available land mobile communications equipment were used in the automobile and at the ground stations G R

A78-17910 # **A low cost GPS navigation set for tactical weapons** A F Schmitt (Teledyne Systems Co , Northridge, Calif) and C D DePriest (USAF, Armament Laboratory, Eglin AFB, Fla) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 14 p 7 refs

The Air Force has begun competitive development of a Global Positioning System (GPS) weapon guidance system for glide bombs and missiles The primary objective of the considered program is to develop and demonstrate a GPS weapon midcourse guidance system capable of reliable handover to any one of several terminal systems A GPS receiver navigates by making direct ranging measurements from its position to four of eight transmitting satellites in view at any time The satellites' precise positions are furnished by data contained in a navigation message superposed upon the transmission of each satellite A receiver of simplified design, designated the GPS Class M Receiver, is to function in a mother daughter approach together with the launch aircraft (the mother) G R

A78 17911 # **Remote maintenance monitor systems** J E Woodward (Wilcox Electric, Inc , Kansas City, Mo) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 11 p

The remote maintenance monitor (RMM) makes it possible to obtain data concerning the conditions and the performance of a ground facility at some point remote from the station The FAA intends to implement the involved techniques for their navigation and communications facilities to reduce maintenance costs The RMM technique provides the possibility of sampling and transmitting a large number of parameters from the equipment of the installations The recent availability of microprocessors and related LSI constitutes an important factor for the introduction of RMM techniques A relatively simple RMM system developed for monitoring VOR, DME, and ILS equipment is considered The system is designed to sample all of the parameters that are normally recorded by a maintenance technician during a site visit Analog data are digitized by a common A to-D converter G R

A78-17912 # **A single site passive collision avoidance system** P V Hwoschinsky and E J Koenke *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 30 p 5 refs

This report describes a concept for a CAS which works passively within surveillance coverage of a single ATCRBS or DABS SSR ground site The concept evolved from searching for a mathematically less complex solution than the passive BCAS currently being tested by the FAA at NAFEC This concept will be considered as a candidate element of the full capability BCAS now being developed which has a passive and active mode and provides protection against both ATCRBS and DABS transponder equipped intruders carrying altitude encoders Current passive BCAS designs have operational limitations resulting from multi-radar coverage requirements, traffic capacity and garble problems (Author)

A78-17913 # **Omega ambiguity resolution techniques** F H Raab (Polhemus Navigation Sciences, Inc , Essex Junction, Vt) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 10 p 29 refs

Techniques to extend the Omega radionavigation system ambiguity resolution for search and rescue missions are discussed The techniques rely on information present in Omega signals, such as envelope time of arrival, signal strength, dispersion, multiple intersection, unique frequencies and direction of arrival, to provide ambiguity resolution beyond the 132 km lanes yielded by the present three-frequency format of the radionavigation system In addition, other low-frequency signals (VLF, Loran-C and spherics)

may be employed in ambiguity resolution The accuracies obtained with the various methods are compared J M B

A78-17914 # **Software controlled multiranging Vortac navigation of NASA U-2 aircraft** B J Miller and K W Rhoades (Hoffman Electronics Corp , El Monte, Calif) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22-24, 1977, Paper* 23 p

The special position fixing and general navigation capabilities of the airborne software-controlled Tacan-based navigation system employed by two NASA High-Altitude Missions Branch U-2 aircraft are described The navigation systems automatically select appropriate Tacan/Vortac facilities for use in determining geodetic position, bearing to waypoint, current flight leg distance and distance to go, cross track, and course deviation information The accuracy of the system, amounting to a fraction of a mile, renders it useful for nighttime and over-water earth resources monitoring, as well as for preplanned daytime missions involving photographic or other types of sensing from altitudes of 65,000 to 70,000 feet J M B

A78 17915 # **The Interim Standard Microwave Landing System** D J Toman (Tull Aviation Corp , Armonk, N Y) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22 24, 1977, Paper* 41 p

The paper gives a description of the Interim Standard Microwave Landing System (ISMLS), which was designed to serve as a bridge between existing the VHF/UHF system and the future standard MLS As such, it features utilization of existing modulation standards (90 and 150 Hz tones as in conventional ILS) and the capability of operating into existing ILS airborne equipment with addition of a frequency converter and some receiver modification The paper describes the signal format, the frequency plan, and the modulation process A physical description of the localizer and glide slope stations is provided along with a description of the electronics for the ground station monitoring facilities and the receivers P T H

A78-17916 # **Omega Navigation System - Present status and plans 1977-1980** E R Vass (U S Naval Electronic Systems Command, Washington, D C) *Institute of Navigation, Annual Meeting, 33rd, Costa Mesa, Calif , June 22 24, 1977, Paper* 20 p

The Omega Navigation System, a very low frequency radio navigation system operating in the electromagnetic spectrum between 10 and 14 khz, is described Seven permanent and one low power temporary station are currently usable, management planning for implementation of the full system is discussed Topics include Omega-Australia, worldwide Omega calibration/validation program, signal format optimization, transfer of Omega synchroni zation responsabilities, navigational science investigations, user documentations and aids, field strength measurements, and U S Navy to U S Coast Guard system transition M L

A78-18020 * **Active controls for transports** L W Taylor, Jr (NASA, Washington, D C) *Aviation Engineering and Maintenance,* vol 1, Oct 1977, p 7, 10

It is shown that the integration of active controls into advanced commercial transport designs yields increased efficiency (by as much as 12%), reduced fuel consumption, and improved safety These conclusions are based on a NASA development program considering various design configurations, wind tunnel tests (e g , tests of static and dynamic control effects, aerodynamic loads, flutter tests, and active flutter suppression system tests), and extensive flight testing S C S

A78-18021 **Engineering methods in engine management** J W Hollaway and A K Olsen (USAF, San Antonio Air Logistics Center, Kelly AFB, Tex) *Aviation Engineering and Maintenance,* vol 1, Oct 1977, p 32, 33, 42

Attention is given to engineering procedures for engine maintenance, noting the modular design and the conditional maintenance of the F100 engine as an example The use of diagnostic equipment, rather than fixed overhauls, for component inspection is discussed The operational management methods used on the F100 engine are identified (1) the analytical condition inspection of its modules, components, and accessories, (2) the accelerated mission test which gathers data from simulated mission operating time, (3) the pacer century program which ages a sample of engines more rapidly than the fleet, and (4) material deficiency reports which investigate failure modes and causes S C S

A78-18022 **Advances in aircraft efficiency** B Walsh *Aviation Engineering and Maintenance,* vol 1, Oct 1977, p 48, 49

The paper surveys NASA's Aircraft Energy Efficiency program In particular, attention is given to its six major elements (1) engine component improvement, aimed at a 5% reduction in annual fuel consumption, (2) the energy efficient engine program, (3) the development of advanced turboprop propulsion systems, (4) the creation of advanced aerodynamics and active control technology applicable to transport aircraft, (5) the development of alternative laminar flow designs, and (6) the study of potential composite primary structures for weight reduction and fuel economy S C S

A78-18023 **The design and performance of high temperature turbines in turbofan engines** G L Wilde (Rolls-Royce Ltd , Derby, England) *(Gas Turbine Society of Japan, JSME, and ASME, Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977) Aeronautical Journal,* vol 81, Aug 1977, p 342 352

The paper discusses a number of technical and design factors that influence the choice of turbine entry temperature in a future turbofan engine for efficient civil airliner operation Attention is directed to the need to study turbo-machinery losses and how they may be reduced It is concluded that turbine entry temperatures above 1600 K would probably not be advantageous Experimental work involving turbine nozzle and blade cascade tunnel tests, model turbine rig tests, and full scale high temperature experimental engine tests is reported High turbine entry temperature effects are analyzed, and the RB 211 high-pressure turbine as well as high temperature turbine cooling development using the Adour engine high pressure spool are described The need for improvements in turbine design and materials is examined M L

A78-18034 # **Commercial aviation future progress, programs, proposals and problems - A prognosis /W Rupert Turnbull Lecture/** I S Macdonald (Air Canada, Montreal, Canada) *(Canadian Aeronautics and Space Institute, Annual General Meeting, Quebec City, Canada, May 17, 1977) Canadian Aeronautics and Space Journal,* vol 23, Nov Dec 1977, p 338-345

The prospects for Canadian commercial airlines from the present to the end of the century are assessed Noise regulation and retrofitting, active control technology, laminar flow control, regenerative turbines, and multi-blade turboprops with blades swept like wings are cited in discussing the processes of fleet replacement and acquisition The likelihood that Canadian airlines will acquire the A300 Airbus, the Concorde, or the proposed McDonnell Douglas DC-9 55, the Boeing 7N7 and 7X7, or the British Aircraft Corporation BAC X-11 is considered J M B

A78-18036 # **Some opportunities in the development of light aircraft** K Irbitis *(Canadian Symposium on Recreational and New Generation Light Aircraft, 2nd, Toronto, Canada, Sept 13-15, 1976) Canadian Aeronautics and Space Journal,* vol 23, Nov -Dec 1977, p 359 370 11 refs

In a brief review of the light aircraft development history, two early aircraft types, designed by the author, are shown as examples This is followed by a presentation of several opportunities in the development of light aircraft of advanced type They are methods of cost and drag reduction, improvements in STOL performance by utilizing most of the available aerodynamic surfaces for the genera tion of lift, as well as the use of large propellers on single engined aircraft Finally, the integration of lift and thrust, its history, and a proposal of how to approach the problem is presented The paper is illustrated with fifteen figures showing some aircraft of historic

interest as well as some proposed solutions to the presented design opportunities In conclusion, the author suggests that government agencies should support the small experimental workshops and the experimental aircraft constructors who are interested in undertaking the proposed or similar projects (Author)

A78-18058 * **Aerodynamic coefficient estimation for dynamic wind tunnel models** R L Mohr and R G Smith (Systems Control, Inc , Palo Alto, Calif) In Annual Asilomar Conference on Circuits, Systems, and Computers, 10th, Pacific Grove, Calif , November 22-24, 1976, Conference Record North Hollywood, Calif , Western Periodicals Co , 1977, p 228-233 5 refs Contract No NAS1-13938

Maximum likelihood parameter identification is used to estimate the aerodynamic coefficients of a 'flying' aircraft model which is mounted in a transonic wind tunnel by a system of cables and pulleys The model's motion is governed by both cable and aerodynamic forces, where the parameters to be identified are functions of the aerodynamic forces but cable forces greatly predominate The test data were successfully processed assuming a linear equation model in the identification procedure In one instance, the procedure was able to detect a failing measurement instrument The final parameter estimates are compared to estimates obtained in independent tests of a similar aircraft model (Author)

A78-18059 * **Robustness in linear quadratic feedback design with application to an aircraft control problem** R V Patel, B Sridhar, and M Toda (NASA, Ames Research Center, Moffett Field, Calif) In Annual Asilomar Conference on Circuits, Systems, and Computers, 10th, Pacific Grove, Calif , November 22 24, 1976, Conference Record North Hollywood, Calif , Western Periodicals Co , 1977, p 293-300 9 refs

Some new results concerning robustness and asymptotic properties of error bounds of a linear quadratic feedback design are applied to an aircraft control problem An autopilot for the flare control of the Augmentor Wing Jet STOL Research Aircraft (AWJSRA) is designed based on Linear Quadratic (LQ) theory and the results developed in this paper The variation of the error bounds to changes in the weighting matrices in the LQ design is studied by computer simulations, and appropriate weighting matrices are chosen to obtain a reasonable error bound for variations in the system matrix and at the same time meet the practical constraints for the flare maneuver of the AWJSRA Results from the computer simulation of a satisfactory autopilot design for the flare control of the AWJSRA are presented (Author)

A78-18063 **Solution of multitarget, multisensor tracking problems on the Illiac IV parallel processor** C L Morefield (Orincon Corp , La Jolla, Calif) In Annual Asilomar Conference on Circuits, Systems, and Computers, 10th, Pacific Grove, Calif , November 22-24, 1976, Conference Record North Hollywood, Calif , Western Periodicals Co , 1977, p 357-361 7 refs

This paper describes one way in which parallel computer architecture can be effectively used in multitarget, multisensor tracking The basic tracking algorithm employed in the paper is a decision process which allocates data to individual tracks in such a way that the Bayesian risk is minimized This decision process was 'parallelized' and coded on the Illiac IV with rather striking results (Author)

A78-18068 **Aircraft display design using analytical pilot models** R A Hess In Annual Asilomar Conference on Circuits, Systems, and Computers, 10th, Pacific Grove, Calif , November 22-24, 1976, Conference Record North Hollywood, Calif , Western Periodicals Co , 1977, p 463-470 17 refs

A relatively straightforward procedure for deriving model-based, pilot centered display requirements is presented A pilot model based on modern control theory serves as the backbone of the design methodology, which is specifically directed toward the synthesis of head-down, electronic cockpit display formats An analytical design example is discussed which aids in the definition of a format for the electronic display to be used in a UH-1H helicopter in a landing approach task involving longitudinal and lateral degrees of freedom (Author)

A78 18182 **Scientific ballooning in India** R T Redkar (Tata Institute of Fundamental Research, Bombay, India) In Space research XVII, Proceedings of the Open Meetings of Working Groups on Physical Sciences, June 8-19, 1976 and Symposium on Minor Constituents and Excited Species, Philadelphia, Pa , June 9, 10, 1976 Oxford and New York, Pergamon Press, 1977, p 779 793 7 refs

An account of development of large polyethylene balloons for stratospheric flights near the equator is presented The special work done in developing the black polyethylene film for survival in the equatorial tropopause where the temperatures range between 80 C and 90 C is discussed in detail Mention is also made of the special polyethylene film developed recently which has been proved to be as good as Winzen Stratofilm Facilities available at the Balloon Facility in India, the balloon performance evaluation and accomplishments over the last 20 years and present capabilities are described A brief account of work undertaken for the development of tethered balloons which can be used as elevated platforms is also presented The design and fabrication has been discussed and the values of various parameters involved have been compared with those of the IID-7A balloon developed by the Range Measurements Laboratory in the United States Our present achievements in the field are also mentioned (Author)

A78-18184 **The use of long-duration balloons for scientific research** V E Lally (National Center for Atmospheric Research, Boulder, Colo) In Space research XVII, Proceedings of the Open Meetings of Working Groups on Physical Sciences, June 8-19, 1976 and Symposium on Minor Constituents and Excited Species, Philadelphia, Pa , June 9, 10, 1976 Oxford and New York, Pergamon Press, 1977, p 805 809

Balloon flights of more than ten days, at altitudes from 10 to 40 km, are now possible using superpressure balloons The earth orbiting balloons, with a design lifetime of 100 days, of Project Boomerang are discussed, as are the Long-Lived Atmospheric Monitoring Balloons Communication to and from these balloons is to be handled via communications satellite systems (Author)

A78-18238 # **Transonic integral equation formulation for lifting profiles and wings** P Niyogi (Jadavpur University, Calcutta, India) *AIAA Journal*, vol 16, Jan 1978, p 92-94 10 refs

Various integral equations have been applied to the direct problem of steady inviscid isentropic transonic flow past thin lifting profiles, where the freestream Mach number is less than one, and the body shape is defined One of these equations, Norstrud's second formulation (1973), is discussed, noting a sign error which it contains An alternative means for obtaining the appropriate formulation for this case is given S C S

A78-18400 **Aircraft engines and gas turbines** J L Kerrebrock Cambridge, Mass , MIT Press, 1977 295 p 65 refs $25

The work provides an introduction to the engineering of aircraft propulsion systems with emphasis on the engine, rather than on the disciplines involved in its design The propulsion system is treated at successively increasing levels of sophistication, beginning with a phenomenological discussion of the processes by which energy is converted from heat to mechanical energy to thrust Several types of engines are then discussed in the framework of ideal cycle analysis, where the components of an actual engine are represented parametrically in the analysis without quantitative reference to the engine structure Attention is given to the mechanical characteristics required of each major engine component to achieve the parametric behavior assumed in the cycle analysis Engine noise mechanisms are discussed and the possibilities of air breathing propulsion at Mach numbers above 6 are examined Some of the simpler techniques of propulsion system analysis are considered B J

A78-18426 **Static and dynamic analysis of helicopter structures with the finite element method (Analyse statique et dynamique des structures d'helicoptres par la methode des elements finis)** R Audry (Societe Nationale Industrielle Aerospatiale, Division Helicopteres, Marignane, Bouches du Rhône, France) *Vertica*, vol 1, no 4, 1977, p 255-262 5 refs In French

General-purpose programs for finite element analysis of the static and dynamic response of helicopters are described The library of elements for the programs includes longitudinal sections acting in the traction/compression mode, plane surfaces acting as membranes, longitudinal sections capable of bending, plane surfaces capable of bending, and volumes The dynamic response program is limited primarily by the computing time associated with the rigidity matrix An application of the finite element programs to the SA 341 Gazelle helicopter is presented J M B

A78-18427 **A preliminary wind tunnel investigation of the aerodynamic characteristics of a simplified lift plus lift-cruise strike aircraft model in the V/STOL flight regime** P G Knott and J W Porter (British Aircraft Corp , Ltd , Military Aircraft Div , Preston, Lancs , England) *Vertica*, vol 1, no 4, 1977, p 263-269

A78-18428 **An electronic integrated pilot display is evaluated in North Sea operations** R J van der Harten (KLM Helikopters, Amsterdam, Netherlands) and P G Cooper (Kaiser Aerospace and Electronics Corp , Palo Alto, Calif) *(American Helicopter Society, Annual National Forum, 32nd, Washington, D C , May 10-12, 1976) Vertica*, vol 1, no 4, 1977 p 271 279 12 refs

An electronic integrated pilot display has been under operational evaluation in a Sikorsky S 61N helicopter since November 1975 This instrument, using a cathode ray tube as a display device, combines the data from all instruments normally scanned by the S 61 pilot during instrument takeoffs and landings It is installed in place of the conventional artificial horizon in the right-hand instrument panel Modes of operation under evaluation include instrument takeoff (adaptive to aircraft gross weight and density altitude), cruise, and approach modes The air direction finder and over-water, radar altitude hold modes are expected to contribute to improvement of limits for oil rig radar approaches Instrument landing system approaches have been satisfactorily performed to below 100 feet and 40 kt Engine parameters are continually analyzed to predict major emergencies, and situation data permit cross-check of flight director performance (Author)

A78-18429 **An appreciation of the dynamic problems associated with the external transportation of loads from a helicopter - State of the art** D F Sheldon (Military Vehicles and Engineering Establishment, Chertsey, Surrey, England) *Vertica*, vol 1, no 4, 1977, p 281-290 31 refs Research supported by the Ministry of Defence

Recent experience has shown one of the major attributes of a helicopter to be its capacity to transport external loads Usually, the complete speed range of a helicopter cannot be utilized because of the dynamic instabilities of the external load-sling arrangement This paper emphasizes the difficulties of stabilizing loads at high forward speeds on the conventional single point suspension The discussion is extended to techniques that are now being investigated to achieve dynamic stability for a broad spectrum of helicopter-underslung loads when they are transported at forward speeds of up to 150 kt (Author)

A78-18430 **Semi-analytic methods for frequencies and mode shapes of rotor blades** V Giurgiutiu and R O Stafford (Imperial College of Science and Technology, London, England) *Vertica*, vol 1, no 4, 1977, p 291 306 14 refs

The equations of motion including shear and rotary inertia are developed for coupled linear lag, flap and pitch vibrations of blades rotating at constant angular velocity in a fixed plane For uncoupled motions three ordinary differential equations are obtained for the shape functions, and a solution is obtained in terms of four independent functions, each a convergent power series These rotating beam functions are similar to classic normal beam functions, and transfer matrices are used to treat piecewise uniform blades The simplicity and accuracy of the method is illustrated with spoke diagrams and moment and shear curves of typical rotor blades (Author)

A78-18464 * **Robustness of linear quadratic state feedback designs in the presence of system uncertainty** R V Patel, M Toda (NASA, Ames Research Center, Moffett Field, Calif), and B Sridhar (Dynamics Research Corp , Wilmington, Mass) *IEEE Transactions on Automatic Control*, vol AC-22, Dec 1977, p 945-949 13 refs

In connection with difficulties concerning an accurate mathematical representation of a linear quadratic state feedback (LQSF) system, it is often necessary to investigate the robustness (stability) of an LQSF design in the presence of system uncertainty and obtain some quantitative measure of the perturbations which such a design can tolerate A study is conducted concerning the problem of expressing the robustness property of an LQSF design quantitatively in terms of bounds on the perturbations (modeling errors or parameter variations) in the system matrices Bounds are obtained for the general case of nonlinear, time-varying perturbations It is pointed out that most of the presented results are readily applicable to practical situations for which a designer has estimates of the bounds on the system parameter perturbations Relations are provided which help the designer to select appropriate weighting matrices in the quadratic performance index to attain a robust design The developed results are employed in the design of an autopilot logic for the flare maneuver of the Augmentor Wing Jet STOL Research Aircraft G R

A78-18666 **Brief ecological survey of airports and the bird hazard problem (Aperçu écologique des aérodromes et problème des risques aviaires)** J L Briot (Direction Générale de l'Aviation Civile, Service Technique de la Navigation Aerienne, Paris, France) *France Transports - Aviation Civile*, Fall 1977, p 30-32 In French

The airport can be considered as a veritable ecosystem comprising its own particular trophic network of feed chains, including producers such as grasses, cultures, and bushes and trees, primary consumers such as insects, field mice, rabbits, and vegetarian birds, secondary consumers such as insectivorous birds and beasts of prey such as foxes, weasels, and hermines, and decomposers (saprophagous bacteria) Therefore, ecological stratagems may be employed to reduce the number of birds around airports For example, at Lyon-Satolas the number of field mice was reduced by spreading grains treated with chlorophacinone (an anticoagulant), which in turn reduced the number of birds of prey At Nice-Cote d'Azur, large numbers of sea-gulls would use the airport to rest during foul weather, so a large flat area removed from the airport was cleared in order to divert the birds there P T H

A78-18502 **DFVLR studies on rotary-wing flight mechanics (DFVLR-Arbeiten zur Drehflugler-Flugmechanik)** P Hamel and B Gmelin (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) *DFVLR-Nachrichten*, Dec 1977, p 890-896 In German

The paper summarizes some of the recent activities of DFVLR pertaining to improvement of rotary wing aircraft flight charac teristics, improvement of man-machine relations, and airframe improvements A helicopter model for wind tunnel tests is described Rotor slipstream ratios were measured Helicopter system identification was carried out on the basis of flight tests and a linear model with six degrees of freedom of rigid body movement The BO 105 helicopter was identified in the medium velocity range A generalized flight test program matrix for evaluation of flight characteristics of helicopters is described P T H

A78-18503 **Calculating VOR/DME holding procedures (Berechnung von VOR/DME-Warteverfahren).** U Brokof (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut

fur Flugfuhrung, Braunschweig, West Germany) *DFVLR-Nachrichten,* Dec 1977, p 897 900 In German

The paper gives a general description of how Monte Carlo methods are being used to calculate VOR/DME holding spaces around airports The intended deterministic path of an aircraft in the nominal holding pattern is perturbed at all decision points by random error influences of the various parameters, whose distribution is usually normal or uniform In this way a number of realistic patterns are simulated, the envelope of which describes the holding space Flight tests have been conducted to verify some of the computed holding spaces for a number of different altitude levels in the case of holding away The holding spaces calculated in this way are smaller than those calculated by the standard ICAO method, the reason being that the Monte Carlo method takes better account of the interaction of the wind with other error parameters P T H

A78-18504 Flight measurement of aircraft onboard antennas (Flugvermessung von Flugzeugbordantennen) H Bothe and N Doler (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugfuhrung, Braunschweig, West Germany) *DFVLR-Nachrichten,* Dec 1977, p 900 904 In German

The paper describes a measuring system with on line data processing for carrying out in flight measurements of the radiation characteristics of the antennas on board an aircraft The general idea is that the aircraft with the antennas to be measured flies a circular pattern, maintaining a constant distance from a ground station Equipment aboard the aircraft transmits data on the flight course and aircraft attitude, while the ground receiver records the intensity from the antenna under test Position determination is done through a VOR/DME or TACAN system, and the data are transmitted over an FM-multiplex system The course and attitude information are processed along with the intensity data in real time, and an x-y plotter draws the radiation pattern P T H

A78-18505 Noise research at DFVLR with relevance for industry (Industrienahe Larmforschung in der DFVLR) H V Fuchs (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Turbulenzforschung, Berlin, West Germany) *DFVLR-Nachrichten,* Dec 1977, p 905, 906 In German

Some brief indications are given on how DFVLR, which has mainly concerned itself with the study of aircraft noise, can make its services available for industry and other types of transportation in the study of noise Emphasis is placed on the process of transmitting knowledge gained by theory and experiment to concerned industries P T H

A78-18506 Recent results on early diagnosis of damage in moving parts of aircraft engines (Neuere Ergebnisse zur Schadensfruhdiagnose bei Bewegungselementen von Flugtriebwerken) E Jantzen (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugtreib- und Schmierstoffe, Munich, West Germany) *DFVLR-Nachrichten,* Dec 1977, p 907 909 In German

A flameless method of atomic absorption spectroscopy is described, by which the presence of small amounts of abraded metal particles in samples of aircraft engine oil can be detected Over and above this spectroscopic examination, however, it is possible to separate abrasion particles from the engine oils by using polycarbonate filters treated with radionuclides With the aid of these filters, a particle size distribution can be obtained, and information on a damage process is gained For example, in engines without damage the particles are never larger than 3 microns, in damaged engines, particles in the range 3-10 microns are found, depending on the state of development of the damage Energy dispersive X-ray analysis of the particles is used to analyze the composition of the particles, and may eventually be successfully used to determine in which parts of the engine the damage is proceeding P T H

A78-18637 # A potential flow design method for multicomponent airfoil sections. J L Kennedy and D J Marsden (Alberta, University, Edmonton, Canada) *Journal of Aircraft,* vol 15, Jan 1978, p 47-52 8 refs National Research Council of Canada Grant No A-2938

A multicomponent, potential flow design method has been developed to generate an airfoil section with a specified velocity distribution on its surface The method was developed from an accurate and efficient surface vorticity analysis method An iterative approach is used to adjust the geometry of a basic airfoil section until it gives the required velocity distribution This approach allows the designer to adjust the solution to suit the practical constraints within which airfoil designers must work Examples of the results of various airfoil design problems are shown (Author)

A78-18638 * # Inlet boundary layer shapes on four aircraft forebodies at Mach 6 P L Lawing and C B Johnson (NASA, Langley Research Center, High-Speed Aerodynamics Div , Hampton, Va) *Journal of Aircraft,* vol 15, Jan 1978, p 62, 63 6 refs

Boundary layer shape measurements at the engine inlet on four different hypersonic aircraft forebody designs (with no engine on the forebody) are reported The measurements provide a qualitative assessment of the effectiveness of various forebody geometries as engine inlet precompression surfaces The designs, tested in a hypersonic tunnel at Mach 6 and a nominal freestream Reynolds number of 30,500,000, included a semiconical forebody, a configuration similar to a slab delta wing, a conical nose blended into a flat surface, and a conical, complex forebody shape Boundary layer height as a function of forebody compression is shown for each design J M B

A78-18664 The victory of the frequency-reference beam over the Doppler MLS at AWOP 6 (La victoire du faisceau battant sur le Doppler à AWOP 6) O Carel (Direction Generale de l'Aviation Civile, Paris, France) *France Transports - Aviation Civile,* Fall 1977, p 24-26 In French

The author gives an account of the various meetings of the All Weather Operation Panel, at the last of which the members, representing the U S , Canada, Australia, Great Britain, the Netherlands, the Federal Republic of Germany, France, the U S S R , IATA, and IFALPA, voted for adoption by the ICAO of development of the frequency-reference scanning beam MLS over the proposals of Great Britain, France, and Germany It is pointed out that about 90 percent of the onboard equipment and almost the same percentage of the ground equipment for both the frequency-reference scanning beam and Doppler systems is identical P T H

A78-18665 New generation of radio navigation equipment (Une nouvelle génération d'équipements de radionavigation) R Mace (Direction Générale de l'Aviation Civile, Paris, France) *France Transports - Aviation Civile,* Fall 1977, p 27 29 In French

Brief descriptions of the new features incorporated in the successors to the current ILS, VOR, and DME systems by TVT are given In the ILS LS 381, modulation will be achieved by an analog technique, and stability will be attained by means of a set of servo loops in phase and amplitude of the emitted signals The field detectors in the monitors are true receivers with IF amplification a high-level signal is detected and the temperature level of the system is vastly improved Use of programmable read-only memory in the control and test logic removes the hazards of the asynchronous logic used in the LS 371 The operational test equipment is fully automatic and cyclic The parabolic antennas will be replaced by more costly but more easily installed antenna arrays The VOR TAH 511 will be modified only with respect to the emitters The goals for the replacement of the DME 720 are modularity and total transistorizing of the landing version P T H

A78-18666 Brief ecological survey of airports and the bird hazard problem (Aperçu écologique des aérodromes et problème des risques aviaires) J L Briot (Direction Générale de l'Aviation Civile, Service Technique de la Navigation Aerienne, Paris, France) *France Transports - Aviation Civile,* Fall 1977, p 30 32 In French

The airport can be considered as a veritable ecosystem comprising its own particular trophic network of feed chains, including producers such as grasses, cultures, and bushes and trees, primary consumers such as insects, field mice, rabbits, and vegetarian birds,

secondary consumers such as insectivorous birds and beasts of prey such as foxes, weasels, and hermines, and decomposers (saprophagous bacteria) Therefore, ecological stratagems may be employed to reduce the number of birds around airports For example, at Lyon-Satolas the number of field mice was reduced by spreading grains treated with chlorophacinone (an anticoagulant), which in turn reduced the number of birds of prey At Nice-Cote d'Azur, large numbers of sea-gulls would use the airport to rest during foul weather, so a large flat area removed from the airport was cleared in order to divert the birds there P T H

A78-18668 Methodology for optimizing an air fleet (Méthodologie pour l'optimisation d'une flotte aérienne) J Meunier, J Salque (Societe Francaise d'Etudes et de Realisations d'Equipements Aéronautiques, Paris, France), and J-Y Delhaye (Direction Générale de l'Aviation Civile, Paris, France) *France Transports - Aviation Civile,* Fall 1977, p 42-44 In French

The paper describes a dynamic combinatorial model for optimization of airline fleet development over a given period of time The model is furnished with constraints ensuring coherence of successive fleets, and gives a direct optimal and global solution without intervention of the user The optimization criterion is the maximum gross profit of operations over the given period, and the basic concept is to have the fleet evolve each year as a function of traffic in such a manner as to attain maximum profit The base data are the amount of traffic on each line and the technical characteristics of the airplanes and their operating costs The constraints are the maximum filling factor, minimum and maximum frequencies, and the annual usage of the aircraft P T H

A78-18669 Current and future fuels for transport aircraft (Les carburants actuels et futurs des avions de transport) J-P Troadec (Direction Generale de l'Aviation Civile, Paris, France) *France Transports - Aviation Civile,* Fall 1977, p 46, 47 In French

Some of the basic characteristics of liquid hydrogen and methane as aircraft fuels are compared with the characteristics of the current Jet A and synthetic Jet A fuels Liquid hydrogen's advantages include an elevated ratio of calorific value to mass, its nonpolluting combustion, and the fact that it can be obtained nearly everywhere without large transportation costs Its disadvantages include the storage problem, the safety question, and its cost Liquid methane has smaller production cost and requires less energy for production than liquid hydrogen P T H

A78-18699 Backfire - The bogeyman bomber B Sweetman *Flight International,* vol 112, Dec 17, 1977, p 1810-1815

Backfire is described as a mediocre USSR strategic bomber which has a general layout with characteristics that might be expected of a much smaller aircraft The general arrangement, which includes side intakes and long ducts, indicates the ancestry of the aircraft from the experimental Tu 98 Backfin of the late 1950s through its refined Tu-102 development, which entered service as the Tu-28P Fiddler intercepter Backfire is a low risk design, inasmuch as any large swing wing aircraft is low risk It has a basic internal fuel capacity from 105,000 to 110,000 lb For the time being, Backfire is important to the Soviet forces in the central European theater because it is the only aircraft which can cover the British Isles without refuelling The absolute maximum speed of Backfire is probably close to Mach 2 G R

A78-18702 # Review of the development of small- and medium-capacity gas turbines at the Motoren- und Turbinen Union (Übersicht über die Entwicklung von Gasturbinen kleiner und mittlerer Leistung in der MTU) W Heilmann (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77-061* 30 p 9 refs In German

Small- and medium-capacity gas turbines under development for turboprop aircraft and helicopters, as well as for armored and commercial vehicle propulsion, are discussed Design problems related to axial turbines, ceramic components, regenerative gas turbines, and the optimal expansion ratios for turbines with capacities from 250 to greater than 800 kW are considered, in addition, combustion chamber technology is mentioned Prototype gas turbines with capacities of 500 to 600 kW or 800 to 1800 kW are described J M B

A78-18703 # The state of development of ceramic components for gas turbines (Stand der Entwicklung keramischer Bauteile fur Gasturbinen) K Trappmann (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77-072* 26 p 9 refs In German

The use of silicon carbide and silicon nitride ceramics for the rotor blades, guide vane rings, flame tubes and gas inlet systems of gas turbines is discussed Thermoshock testing of flame tube and gas inlet system prototypes is reported, the gas inlet system prototypes are also studied in terms of their resistance to the high temperatures typical of combustion chamber exhaust (1270 to 1670 K) The development of wholly ceramic and hybrid ceramic-metal rotor blades is reviewed, and the influence of rotor surface treatments and the inclusion of intermediate layers on the rotor performance is assessed experimentally J M B

A78-18704 # New findings in centrifugal compressor development (Neue Ergebnisse aus der Radialverdichterentwicklung) U Schmidt-Eisenlohr and P Schuster (Motoren- und Turbinen Union Munchen GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77-063* 24 p In German

A quasi-three-dimensional analysis of the flow fields generated by centrifugal compressors has been applied as a design tool in the development of a centrifugal compressor having an expansion coefficient of 4 1 1 The analysis relies on a finite difference solution for a system of differential equations describing the symmetric rotational and blade-to-blade flow fields The compressor attains an efficiency level of 83% of the specified rpm, indicating that the analytical technique is a valuable design aid, comparable to conventional measurement techniques J M B

A78-18705 # Application of new joining techniques in small gas turbines (Anwendung neuer Fugetechniken in kleineren Gasturbinen) P Adam (Motoren- und Turbinen Union Munchen GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77-070* 20 p In German

Friction and diffusion welding are discussed with reference to small gas turbine construction Good results for the friction welding of the flywheel were obtained when Waspaloy, a nickel-base alloy, was used The friction welding of a wrought hub and a cast blade attachment is described Diffusion welding and soldering are characterized, the process can be achieved with or without a liquid intermediate layer Electron ray welding is also examined The advantages and disadvantages of the welding techniques for different purposes are discussed Crack stability and cost are taken into account M L

A78-18706 # Aerodynamic behavior of an axial-flow compressor in the presence of inflow disturbances (Uber das aerodynamische Verhalten eines Axialverdichters bei Storungen der Zustromung) M Lecht (Deutsche Forschungs und Versuchsanstalt fur Luft und Raumfahrt, Cologne, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77 064* 15 p 10 refs In German

The influence of a nonuniform total pressure distribution and a nonuniform initial-whirl distribution over the periphery on the operation of an axial-flow compressor was studied on a compressor test stand The resulting load variations are analyzed for a com-

pressor stage The behavior of the compressor under these conditions is examined, and the unsteady aerodynamic processes in the rotor blading are identified V P

A78-18707 # **Improvements in the calculation of the centrifugal compressor flow by experimental study of the complex rotor flow (Fortschritte in der Berechnung der Radialverdichterstromung durch experimentelle Untersuchung der komplexen Laufradstromung)** H Krain and D Eckardt (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Cologne, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber Kleingasturbinen, Stuttgart, West Germany, Oct 11, 12, 1977, Paper 77-062* 24 p 34 refs In German Research supported by the Forschungsvereinigung Verbrennungskraftmaschinen

A calculation procedure is proposed for ascertaining the distribution of losses in the jet/dead water region of a compressor rotor The approach uses differential equations to describe conditions at flow surfaces, and empirical equations for power loss at the rotor are included in the calculation The goal of the research is fuel conservation for small gas turbines and related devices Empirical measurements are compared with calculated values for a heavy-duty rotor M L

A78 18755 # **Model study of dynamic response of landing mat** F W Kiefer, V T Christiansen, and P T Blotter (Utah State University of Agriculture and Applied Science, Logan, Utah) *American Society of Civil Engineers, Engineering Mechanics Division, Journal,* vol 103, Aug 1977, p 659-672 15 refs Contract No F29601-71-C-0129

The paper examines the failure characteristics of a reduced-scale physical model that simulates the dynamic response of AM2 landing mats during touchdown and deceleration of C-5A aircraft landings The parameters considered in the physical model include length, material stiffness, density, aircraft deceleration and velocity, coefficients of friction, tire pressure, and soil mat interaction Five runway modifications are tested (1) restraint by pretensioned bands riveted to the mat at intervals along the runway length, (2) diagonal laying pattern, (3) increased friction on the underside of the mat, (4) cleats attached to the underside of every 6th row of mats, and (5) use of longitudinal mat stiffeners The bands and the diagonal laying pattern each prevented buckling failure of the mat Increasing the friction produced little or no improvement in mat behavior Cleats delayed the buckling failure, whereas longitudinal stiffeners did not eliminate buckling failure S D

A78-18779 # **Research into effects of aircraft noise on hearing of children in exposed residential areas around an airport** L Fisch (Hearing Clinic, Heston, Middx , England) *Acoustics Letters,* vol 1, 1977, p 42, 43

One hundred children living in the preferred direction of takeoff area within one mile of Heathrow Airport, UK were given hearing tests in a sound-treated audiometric room The investigation revealed ten subjects with slight to moderate high-frequency loss of sensorineural origin In a control study of 100 children from a selected quiet area, eight were found to suffer a similar hearing deficiency, indicating that aircraft noise probably has not caused a marked increase in the rate of hearing deficiencies in the experimental group Difficulties in evaluating the prevalence and etiology of high-frequency hearing losses in children are also mentioned J M B

A78-18799 * # **Automatic flight performance of a transport airplane on complex microwave landing system paths** T M Walsh (NASA, Langley Research Center, Hampton, Va) and E F Weener (Boeing Co , Seattle, Wash) *NATO, AGARD, Symposium on Guidance and Control Design Considerations for Low Altitude and Terminal Area Flight, 25th, Dayton, Ohio, Oct 17-20, 1977, Paper* 13 p

Essential characteristics of the U S microwave landing system (MLS) and the TCV B-737 aircraft used in flight demonstrations are described, with special emphasis on the analysis of the approach paths MLS is used to provide the aircraft with guidance for automatic control on complex, curved descending paths with precision turns into short final approaches terminating in landing and rollout, even when subjected to strong and gusty tail- and cross wind components and severe wind shear The tracking performance achieved on these paths under MLS guidance is examined in detail, and the wind environment where the flights are conducted are quantified The flights demonstrate the utility of the wide-area coverage of MLS for curved, descending paths commencing with a standard RNAV approach into a terminal area and continuation of this approach throughout the MLS coverage and onto the runway S D

A78-18800 * # **Recent flight test results using an electronic display format on the NASA B-737** S A Morello (NASA, Langley Research Center, Flight Research Div , Hampton, Va) *NATO, AGARD, Symposium on Guidance and Control Design Considerations for Low Altitude and Terminal Area Flight, 25th, Dayton, Ohio, Oct 17-20, 1977, Paper* 11 p

This paper presents results of a flight evaluation of two electronic display formats for the approach-to-landing under instrument conditions The evaluation was conducted for a baseline electronic display format and for the same format with runway symbology and track information added, its evaluation was conducted during 3-deg manual straight-in approaches with and without initial localizer offsets Flight-path tracking performance data and pilot subjective comments were examined with regard to pilot's ability to capture and maintain the localizer and glide slope using both display fomats The results of the flight tests agree with earlier simulation results and show that the addition of a perspective runway symbol with an extended centerline and relative track information to a baseline electronic display format improved both lateral and vertical flight path tracking Pilot comments indicated that the mental workload required to assess the approach situation was reduced as a result of integrating the perspective runway with extended centerline along with relative track information into the vertical situation display The limited flight-test results also show that the flight-path performance with the integrated situation display format meets Category II Flight-Director performance criteria (Author)

A78-18801 * # **F-16 flutter model studies with external wing stores** J T Foughner, Jr (NASA, Langley Research Center, Hampton, Va) and C T Bensinger (General Dynamics Corp , Fort Worth, Tex) *Joint Technical Coordinating Group, Aircraft/Stores Compatibility Symposium, 4th, Fort Walton Beach, Fla , Oct 12-14, 1977, Paper* 19 p 7 refs

The flutter prevention and clearance task for the F-16 airplane is being accomplished in a combined analysis, wind-tunnel dynamic model test, and flight flutter test program This paper presents highlight results from transonic flutter model studies The flutter model was constructed to support the flutter prevention and clearance program from preliminary design through flight flutter tests The model tests were conducted in NASA's Langley Transonic Dynamics Tunnel The large full span free-flying model is shown to be an effective tool in defining airplane flutter characteristics by demonstrating freedom from flutter for most configurations and by defining optimum solutions for a few troublesome configurations (Author)

A78-18802 * # **Effects of external stores on the air combat capability of a delta wing fighter** M L Spearman and W C Sawyer (NASA, Langley Research Center, Hampton, Va) *Joint Technical Coordinating Group, Aircraft/Stores Compatibility Symposium, 4th, Fort Walton Beach, Fla , Oct 12-14, 1977, Paper* 20 p

Delta wing point-design fighters with two pylon mounted missiles and aft tail controls (similar to several Soviet designs) have been investigated for a Mach number range from about 0 6 to 2 0 Whereas minimum drag penalties that are expected with the addition of external stores do occur, the effects at higher lifts, corresponding to maneuvering flight, are less severe and often favorable The

production costs for hydrogen produced by coal gasification or for liquid methane or synthetic aviation kerosene are also assessed
J M B

A78-18843 * # Hydrogen fueled subsonic aircraft - A prospective R D Witcofski (NASA, Langley Research Center, Hampton, Va) In International Workshop on Hydrogen and its Perspectives, Liege, Belgium November 15 18,, 1976, Proceedings Volume 1 Liege, Association des Ingenieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, 1977 31 p 12 refs

The performance characteristics of hydrogen fueled subsonic transport aircraft are compared with those of aircraft using conventional aviation kerosene Results of the Cryogenically Fueled Aircraft Technology Program sponsored by NASA indicate that liquid hydrogen may be particularly efficient for subsonic transport craft when ranges of 4000 km or more are involved, however, development of advanced cryogenic tanks for liquid hydrogen fuel is required The NASA-sponsored program also found no major technical obstacles for international airports converting the liquid hydrogen fueling systems Resource utilization efficiency and fuel drag-due-to-lift factor is less with stores on although the lift curve slope is unaffected The longitudinal stability level is reduced by the addition of stores while the pitch control effectiveness is unchanged The directional stability was generally reduced at subsonic speeds and increased at supersonic speeds by the addition of stores but sufficiently high stability levels are obtainable that are compatible with the longitudinal maneuvering limits Some examples of the potential maneuvering capability in terms of normal acceleration and turn radius are included (Author)

A78-18915 An integrated computation program for polars of the finite wings of general aviation aircraft (Un programma integrato di calcolo delle polari di ali finite per velivoli dell'aviazione generale) V Losito and V P Riviello (Napoli, Universita, Naples, Italy) *L'Aerotecnica - Missili e Spazio,* vol 56, Mar 1977, p 19-30 11 refs In Italian Consiglio Nazionale delle Ricerche Contract No 75,01352,07

A completely automatic program for determining the polars of finite wings has been developed, with the aim of providing an efficient design tool for general aviation craft The aerodynamic calculations for the wings rely on the Prandtl theory, which permits assessment of the potential three-dimensional solutions, two-dimensional viscous effects are added to the potential solutions by a direct superposition technique Numerical results indicate that the integrated computer program can eliminate overestimations found in the treatment of Stevens, Goradia and Braden (1972) J M B

A78-18983 # Experimental study of wing skin friction at supersonic speeds (Eksperimental'noe issledovanie soprotivleniia kryl'ev pri sverkhzvukovykh skorostiakh) M D Brodetskii, V S Kosorygin, A A Rafeliants, and G A Cheremukhin (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* June 1977, p 47-53 8 refs In Russian

Components of the total skin resistance of thin supersonic wings with supersonic leading edge at zero angle of attack were measured by the method of weights on a series of wing models of identical shape and planform but different relative profile thickness and angle of opening of the conical bulges used for attaching the models to the rear support Experimental values are reported for the coefficients of turbulent skin friction of a trapezoidal plate and of the wave resistance of a trapezoidal wing with parabolic profile Comparison with theoretical values is made P T H

A78-19030 Recent developments in numerical solutions for equations of the boundary layer in laminar and turbulent flow (Recenti sviluppi delle soluzioni numeriche delle equazioni dello strato limite in flusso laminare e turbolento) V P Riviello (Napoli, Universita, Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30 October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 29-38 25 refs In Italian

Numerical solutions for aerodynamic problems involving compressible or incompressible flow, plane two dimensional or axisymmetric flow are evaluated, with attention given to the location of transition zones, the laminar and turbulent separations, and type and dimensions of bubbles on two-dimensional bodies in incompressible flow In general, the superiority of the finite difference analyses over integral techniques holds, among the integral techniques, that of Michel (1951) is found to be more precise than that of Granville (1968) J M B

A78-19035 The evolution of the gamma prime phase in aircraft turbine blades of Inconel 700 (Evoluzione della fase gamma prime in palette di turbina di aviogetto in Inconel 700) G Bernardini, G Cherubini, A Fioravanti, and A Olivi (Centro Applicazioni Militari dell'Energia Nucleare, Pisa, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 81-90 5 refs In Italian

The evolution of the gamma prime phase in nickel alloy aircraft turbine blades is investigated as a function of operating time The mean diameter of the precipitates is measured, and their distribution is determined with electron microscopy Electrochemical dissolution of the matrix permitted examination of the gamma prime phase samples Results of these studies are compared with those obtained through a nondestructive analysis involving the small-angle elastic diffusion of cold neutrons J M B

A78-19039 A new mathematical method for the aerodynamic smoothing of profiles (Un nuovo metodo matematico per lo smoothing aerodinamico di profili) G Serafin and S Barbero (Aeritalia S p A , Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975 p 159 168 In Italian

Direct and inverse techniques for aerodynamic smoothing of wing profiles are developed, both techniques are based on the assumption that the profiles, defined by a set of coordinates, can be modeled through use of a prescribed number of cubic arcs or high-order algebraic curves The direct method involves calculation of the first derivative and local curvature at all points on the curve defined by the set of points The inverse method permits development of a profile corresponding to a desired distribution of curvatures Applications of the aerodynamic smoothing techniques to the design of flaps and slats are given J M B

A78-19040 A numerical procedure for the solution of the direct problem of supercritical transonic wing profiles, with a hodographic method (Procedimento numerico per la soluzione del problema diretto dei profili alari transonici supercritici, con metodo odografico) G Geymonat, S Nocilla (Torino, Politecnico, Turin, Italy), and B Gabutti (CNR, Turin, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 169-178 In Italian

The paper deals with the direct problem of transonic airfoils in supercritical shock-free conditions The profile is given, as well as the asymptotic Mach number less than 1, the determination of the flow is carried out in the hodograph plane, where the problem is reduced to the study of a boundary value problem with free-boundary The numerical procedure employed for the solution of the problem is developed here for the case of symmetrical profiles without incidence (Author)

A78-19041 **Some aspects of the problem of flights in ascent (Alcuni aspetti del problema del volo in salita)** R Picardi and G Rotondi (Milano, Politecnico, Milan, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 179-188 In Italian

A graphical approach is employed to study analytical treatments of flights in steady ascent The graphical approach permits an accurate calculation of angles of climb and the associated velocities along the trajectory Furthermore, the graphical results can be used to clarify ambiguities arising in the conventional analytical treatments of ascent velocity and angle of climb J M B

A78-19042 **The possibility of installing a Microwave Landing System at the Palermo/Punta Raisi airport (Microwave Landing Sistem possibilità di installazione nell'aeroporto di Palermo-Punta Raisi)** G Ferlazzo (Palermo, Universita, Palermo, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 189 199 11 refs In Italian

The possibility of installing a Microwave Landing System (MLS) at the Palermo/Punta Raisi airport in Sicily is discussed, advantages of the system, including capability of operating with V/STOL aircraft and suitability for handling heavy traffic, civil or military, are considered In addition, the MLS avoids the multipath signal problems of an Instrument Landing System, which had been planned for the airport The angle measuring procedure of the MLS system is discussed, and the on-board and ground equipment for the system is described J M B

A78-19043 **Choice of wing flap type taking into account the noise of the approach phase (Scelta del tipo di ipersostentatore tenuto conto del rumore nella fase di avvicinamento)** L Frese (Aeritalia S p A , Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 201-211 7 refs In Italian

Single slot and double-slot wing flaps are compared with attention to their contribution to engine and airframe noise It is concluded that, when noise abatement is a design consideration, the trade-off between aerodynamic and sound characteristics will determine the choice of wing flap system M L

A78-19045 **Supersonic axial compressors with predeceleration by oblique shocks (Compressori assiali supersonici con pre-decelerazione da urti obliqui)** S Di Tommaso (Palermo, Universita, Palermo, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 225 235 8 refs In Italian

Pressure ratios and efficiencies are computed for supersonic axial compressor bladings, in which a precompression is made through an oblique shock attached to the sharp leading edge and a reflected shock followed by a normal shock compression in the downstream channel This study is performed with the hypothesis of two-dimensional, inviscid flow, for inlet Mach numbers between 1 2 and 2 8 Compression ratio, losses, efficiency at the maximum inlet shock deviation angle compatible with the supposed shock pattern are determined as functions of the inlet Mach number The study shows that good compression ratios and efficiencies can be achieved with the proposed type of bladings (Author)

A78-19050 **An auxiliary array with decelerating blades - Secondary losses and back pressure in the transonic regime (Schiera ausiliaria in palette deceleratrici - Perdite secondarie e contropressione in regime transonico)** S Di Tommaso and O Scrofani (Palermo, Universita, Palermo, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 281-290 10 refs In Italian

This study extends knowledge about the transonic flow through supersonic compressor stators made of high cambered main blades and small secondary blades With such a configuration quite high deflections have been obtained even with relatively small masses An intermittent wind tunnel was used to perform research on secondary losses and on the back pressure effect One of the results is that an application of a back pressure to a choked flow strongly influences the upstream flow conditions, this is contrary to theory and to what is generally experienced (Author)

A78-19051 **The evaluation of several finite elements for the calculation of wing structures (Valutazione di alcuni elementi finiti per il calcolo di strutture alari)** M Borri and C Cardani (Milano, Politechnico, Milan, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 291-300 6 refs In Italian

Plane-stress isoparametric triangular elements with six nodes, used in conjunction with axial elements having three nodes, are compared with several other types of elements (three node triangular, rectangular, and longitudinal) adopted for finite element calculations of wing structures The comparison involves analysis of a typical rectangular box structure with a missing section subjected to various loading conditions The isoparametric triangular elements, in conjunction with the axial elements, is found to offer an efficient and widely applicable analytical technique J M B

A78-19053 **Technical-analytical assistance now even in the field (L'assistenza tecnico-analitica ora anche sul campo)** L Arena, A Torri, and A Francioli (Aeronautica Militare, Direzione Laboratori, Rome, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30 October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 311 314 In Italian

A transportable laboratory employed for the analysis of aircraft fuel purity and the integrity of liquid oxygen supplies is described The laboratory, equipped with gas chromatographs, a colorimeter, an apparatus for determining the presence of surface active components in jet fuel, as well as devices for taking liquid oxygen samples, circulates from airport to airport to maintain quality control standards Assessments made by the laboratory include the degree of contamination in the oil used in aircraft hydraulic lines, and the amount of antifreeze and anticorrosive additives in fuels J M B

A78-19054 **Spectrometric assessments of wear-generated materials in aviation lubricants (Dosaggio spettrometrico dei materiali da usura nei lubrificanti avio)** A Giusti and G Cardini (Aeronautica Militare, Direzione Laboratori, Rome, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30 October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 315-321 5 refs In Italian

Spectrometric analysis of metallic components in the lubricating oil of aircraft engines is discussed, such analysis may provide an index of the internal condition of an enclosed mechanical system The assessments demand a detection sensitivity of about 1 ppm for elements such as Fe, Cu, Ag, Mg, Ni and Cr, emissions spectrometry is preferred to atomic absorption methods for the lubricant analysis Applications of the lubricant analysis to studies of turbojet engines and helicopter motors are mentioned J M B

A78-19055 **Current status and examples of nondestructive testing for aircraft materials (Stato attuale ed esemplificazione di controlli non distruttivi /CND/ sui materiali aeronautici).** A Tronca

and M Quaranta (Aeronautica Militare, Direzione Laboratori, Rome, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 323-333 In Italian

Inspection of fatigue cracking by means of ultrasonic and X-ray *diffraction techniques, as well as methods involving penetrating* fluorescent fluids, is discussed, emphasis is placed on the use of such inspection to evaluate critical engine components The example of a testing program applied to the first-stage compressor blades of a helicopter engine is described The testing, scheduled after every 25 hours of operation, involves either ultrasonic inspection or a technique employing eddy currents The latter method is held to be more effective in dealing with blades that may be eroded or roughened J M B

A78-19056 Erosion resistant coatings (Pitture resistenti all'erosione) L Falco and A Cuscini (Aeronautica Militare, Direzione Laboratori, Rome, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 335-344 8 refs In Italian

Apparatus for measuring the resistance of materials to erosion is examined, and a scheme for standardization of the test parameters is described Current materials being used for protecting aircraft parts from erosion are surveyed, their chief characteristics being given The superior properties of urethane coatings are pointed out The complete cycle for painting areas subject to erosion is described P T H

A78-19057 Calculation of the performance of a turbine engine in the off-design condition (Calcolo delle prestazioni di un turbomotore nella condizione di off-design) G Torella (Napoli, Università, Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30 October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 345-353 In Italian

A general program of calculations for the performance of turbine engines in the off-design phase is presented, the calculations are essentially iterative and optimization processes which determine the performance characteristics of engines with specified combustion chamber, compressor, turboshaft and turbine parameters Particular attention is given to the analysis of the thermodynamic cycle of the engine J M B

A78-19061 Numerical study of transonic profiles (Studio numerico sui profili transonici) C Cercignani, A Turi (Milano, Politecnico, Milan, Italy), and R Marazzi (Aeronautica Macchi S p A , Varese, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 383 392 In Italian

The calculation of pressure on the boundary of a lifting airfoil in a steady transonic flow is considered The equation for the transonic potential, obtained on the hypothesis of small perturbations, is solved by a finite difference method The fluid is assumed perfect and ideal P T H

A78-19063 A program for the interactive design of wing structures (Programma per il progetto interattivo di strutture alari) C Caprile, M Lanz, and L Puccinelli (Milano, Politecnico, Milan, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 403-412 7 refs In Italian

Characteristics of an effective interactive program for the design of aerospace structures are discussed, these properties include highly flexible man-machine communications, the possibility for simultaneous consideration of several loading conditions and design options, and a library of realistic design options (technologically viable and commercially available components) An application of an interactive design program to the creation of wing structures is presented The wing design program involves analyses of the stress states of sections, the static instability and the plastic behavior of materials, and a full-stress optimization for both the entire structural scheme and the longitudinal elements of the design J M B

A78-19064 Determination of the aerodynamic forces for an aeroelastic analysis of lifting surfaces (Determinazione delle forze aerodinamiche per l'analisi aero-elastica delle superfici portanti) P Mantegazza (Milano, Politecnico, Milan, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 413-422 16 refs In Italian

A numerical technique for the calculation of unsteady aerodynamic forces needed for the aeroelastic analysis of subsonic aircraft is presented The procedure is based on the doublet-lattice method which is well known and widely used in practical analysis, in this paper it is implemented through the use of a proper numerical scheme which betters the efficiency of the method Results obtained with this implementation are compared with those of other methods (Author)

A78-19065 A method for determining the induced resistance of wings with high aspect ratio in a subsonic regime (Metodo per la determinazione della resistenza indotta per ali di elevato allungamento in regime subsonico) C Carnebianca (Aeritalia S p A , Naples, Italy) In Associazione Italiana di Aeronautica e Astro nautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 1 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 423 432 In Italian

The induced lift and resistance of high aspect ratio wings in a subsonic regime are determined on the basis of a span loading curve defined by a limited set of points The set of points is expressed by a Fourier series, the coefficients of the series provide the means for computing the induced lift and resistance Lift calculations developed from a treatment which involves an elliptical loading curve are used in checking the accuracy of the Fourier series definition of the span loading curves J M B

A78-19066 The conditions of stationary flight for distributed jet helical rotors (Sulla condizione di volo stazionario dell'elica-rotore a getto distribuito) V Fiorini (Centro Ricerche Aerospaziali, Rome, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 433-444 9 refs In Italian

An optimal configuration for a jet-propelled helical rotor system is developed, the optimization procedure extends a treatment of rotors with effluent jets at the extremity of the blades to the case of rotors with distributed jets A simple aerodynamic model for helical rotors in conditions of stationary flight is reviewed, and a variational method is employed to determine the optimal distribution of the jet along the blade An application of the optimization procedure to the design of a two-blade prop-rotor system is presented J M B

A78-19071 Numerical solution of the integral equation of a subsonic lifting surface (Sulla soluzione numerica dell'equazione integrale della superficie portante subsonica) L Polito (Pisa, Universita, Pisa, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 489-498 14 refs In Italian

In the framework of the subsonic lifting surface theory, Van de Vooren's method (1967) to calculate aerodynamic actions on wings of arbitrary design seems to be very interesting On the basis of an

analysis of the methods of Van de Vooren and Zandbergen, Labrujere and Wouters (1967) for steady flows, modifications are suggested to eliminate some numerical difficulties without complicating the computer program The new formulation of the calculation procedure has given satisfactory results and seems not to have any of the difficulties observed in the other methods Some examples of results are shown (Author)

A78-19072 The aerodynamic design of cascade airfoils - A new exact method based on conformal mapping (Sul progetto aerodinamico di profili alari in schiera - Un nuovo metodo esatto basato sulla trasformazione conforme) L Polito and G Buresti (Pisa, Universita, Pisa, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 499-507 6 refs In Italian

The problem of the design of cascade airfoils with a given velocity distribution on the contour, in incompressible flow, is solved by means of an exact method based on conformal mapping Unlike Lighthill's corresponding method, the velocity distribution is prescribed directly as a function of the surface coordinate along the airfoil The treatment of the problem is connected with a former method for the design of isolated airfoils (1974) In particular it was possible in this case as well to apply an original method for the modification of the initial data (generally not consistent with the mathematical conditions of the problem) which, besides offering some advantages compared with preceding methods, yields a remarkably simple formulation of the calculation procedure A sample application of the method is shown (Author)

A78-19073 The interaction between the characteristics of the operational environment and the flight performance of second-generation STOL aircraft - Some preliminary results (Interazione fra le caratteristiche dell'ambiente operative e le qualità di volo dei velivoli STOL di seconda generazione Alcuni resultati preliminari) C Casarosa (Pisa, Universita, Pisa, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30 October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 509-518 In Italian

Research on the influence of operational environment characteristics on second-generation STOL aircraft flight performance is carried out The limitations that STOL airport dimensions impose on landing parameters such as flight-path angle, contingency coefficients in the flattening-out maneuver, approach speed, and pilot error in evaluating the initiation of the flattening-out maneuver are considered A computer program for modeling landings is employed to assess the STOL aircraft performance (Author)

A78-19075 Wind tunnel experiments on a NACA 632-A215 wing profile with boundary layer control through blowing on the leading edge (Sperimentazione in galleria del vento di un profilo NACA 632-A215 con controllo dello strato limite per soffiamento sul bordo d'attacco) L Lecce (Napoli, Universita, Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 529 538 18 refs In Italian

Wind tunnel experiments were conducted on a NACA 632-A215 wing section to determine the low-velocity variation of the maximum lift coefficient due to a pneumatic flap system which blows onto the leading edge The effect of the air slot positions near the leading edge was studied, and tests were then carried out to determine the results of pairing such a blowing device with two classic flap systems on the trailing edge 'plain flap' and 'slotted flap' (Author)

A78-19077 Noise as a source of fatigue in aeronautical structures (Il rumore come fonte di fatica nelle strutture aeronautiche) S Chiesa and G Filtri (Torino, Politecnico, Turin, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 551-562 20 refs. In Italian Consiglio Nazionale delle Ricerche Contracts No 73,00166,07, No 74,00374,07

The characterization of noise as a source of fatigue in aircraft structures is discussed, with attention paid to noise produced by turbines and compressors, jet flow, and aerodynamic sources such as vortices and boundary layers Lighthill's (1952) theory of sound generated aerodynamically is reviewed, and the theory of similarity as applied to jet noise is discussed Once values for the coefficients of similarity have been determined, information from a variety of investigations of acoustic fatigue can be coherently analyzed J M B

A78-19078 A synthesis of the effects of noise on structures (Sintesi sugli effetti del rumore sulle strutture) L Borello and E Guccini (Torino, Politecnico, Turin, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 563-572 17 refs In Italian Consiglio Nazionale delle Ricerche Contracts No 73,00166,07, No 74,00374,07

Theoretical and experimental studies of the acoustic fatiguing of structures are reviewed, and devices for testing the response of structures to acoustic excitation are described Theoretical approaches to the problem of structural response to noise, including normal mode, wave, and finite element treatments, are discussed, determinations of the vibrational modes of structures are also mentioned In addition, damping effects due to hysteresis effects in materials, in coupled systems, and in the ambient are analyzed Acoustic fatigue testing procedures, including those that involve normal-incidence, grazing-incidence, and reverberating modes of signal structure interaction are considered J M B

A78-19079 Axisymmetric flow in nozzles with or without vortices (Flusso assialsimmetrico con o senza vortice in ugelli) M Pandolfi (Torino, Politecnico, Turin, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 573-581 8 refs In Italian

The steady flow configuration in axisymmetric nozzles is achieved as the asymptotic result in time through a time-dependent technique computation The hyperbolic partial differential equations which describe the unsteady compressible flows are integrated by a finite difference method Special care is paid to the computation at the solid boundaries, and at the inlet and outlet surfaces Results are shown for subcritical and supercritical configurations, with or without swirling flow (Author)

A78-19083 The influence of engine position on aircraft noise (Influenza della posizione dei motori sul rumore di un velivolo) A Di Blasi and V M Conticelli (Aeritalia S p A , Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 615-626 9 refs In Italian

Mathematical modeling and experimental data based on studies of high bypass ratio engines are employed in evaluating noise reductions achievable by placing aircraft engines above the wing Reductions in community noise levels are defined for typical landing and takeoff maneuvers of planes having above the-wing engines Aerodynamic considerations indicate that the above-the-wing configuration may be viable for medium-range twin-engine aircraft (and especially STOL craft), but not for such designs as the Boeing 7X7 J M B

A78-19090 Effects of engine cycle parameters on the dimensions of a commercial aircraft with low community noise levels

(Effetti dei parametri del ciclo del motore sul dimensionamento di un velivolo civile a basso livello di rumore nella comunità) S Calabrò (Aeritalia S p A , Naples, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 701-712 In Italian

Engine cycle parameters, including turbine inlet temperature, bypass ratio, and separation or mixing of flow, are taken into account in studying noise reduction techniques for commercial passenger aircraft, the aim of the study is to provide a minimum-weight design (i e , minimal resort to acoustic linings) The design program deals with the case of a three-engine aircraft (two over-the-wing installations and an S-duct type motor) with a capacity of 180 passengers To attain a noise level of at least 10 EPNdB below that specified by FAA regulations, a mixed-flow engine with high turbine inlet temperature and a bypass ratio greater than five is found to be necessary J M B

A78-19097 **Instantaneous longitudinal maneuvers of aircraft - A simple expression for the first-approximation evaluation of tail load increments (Brusche manovre longitudinali dei velivoli - Un'espressione semplice per la valutazione in prima approssimazione degli incrementi di carico in coda)** P Morelli (Torino, Politecnico, Turin, Italy) In Associazione Italiana di Aeronautica e Astronautica, National Congress, 3rd, Turin, Italy, September 30-October 3, 1975, Proceedings Volume 2 Turin, Libreria Editrice Universitaria Levrotto e Bella, 1975, p 777-788 17 refs In Italian

A critical survey is presented concerning the present-day airworthiness specifications for horizontal tail maneuvering loads of aircraft, with particular reference to those specifications which impose definite values of the pitching acceleration or maximum upward or downward elevator deflection A theoretical expression of the incremental aerodynamic tail load for instantaneous unchecked maneuvers, expressed as a function of geometric, aerodynamic and mass parameters, is presented This expression is suggested as suitable for a modification of present airworthiness specifications (Author)

A78-19128 **The policy problems and economics of aircraft noise** P W Abelson (Macquarie University, North Ryde, New South Wales, Australia) *Transportation Research,* vol 11, Oct 1977, p 357-364 24 refs

The paper discusses the role of economics in decisions which affect aircraft noise, for example decisions on airport development or on land uses around airports Methods of measuring the effects of aircraft noise and of costing them are analyzed Major policy options and economic analysis of them are discussed Finally, suggestions for further research and improved policies are made (Author)

A78-19140 **Experimental analysis and selection of airborne antennas for aircraft-to-satellite communication systems** E Hormann and R Reitzig (Siemens AG, Munich, West Germany) *Frequenz,* vol 31, Nov 1977, p 336-341 7 refs Research supported by the Bundesministerium fur Forschung und Technologie

The selection of an aircraft antenna suitable for jet aircraft constitutes one of the main technical problems in connection with the design of an aircraft-to-satellite communication system A possible solution to the antenna problem is considered on the basis of the various operational, technological, and economic constraints The solution involves the use of a circular polarized antenna system Feasible antenna types include the cavity-backed spiral antenna, the crossed-slot antenna, and the slot-dipole antenna The characteristics of the three antenna types are discussed The considered antenna system will probably be installed on jet transport aircraft capable of flying across the ocean beyond the range of existing shore-based ATC installations A serious difficulty with respect to low-cost large-scale production in the case of the cavity-backed crossed-slot antenna is related to the long time required for antenna assembly The slot-dipole antenna has also certain characteristics which are not suitable for the considered application A modified Archemedean spiral antenna, on the other hand, appears to satisfy the given requirements G R

A78 19213 **The interaction of sound with a subsonic jet issuing from a semi-infinite cylindrical pipe** R M Munt (Dundee, University, Dundee, Scotland) *Journal of Fluid Mechanics,* vol 83, Dec 21, 1977, p 609 640 32 refs Research supported by the Science Research Council

The transmission of sound out of a semi-infinite circular jet pipe in the presence of subsonic flow from the pipe is investigated An unstable cylindrical vortex layer attached to the edge of the pipe is considered across which differences in mean subsonic flow, density and temperature are included A solution satisfying the Kutta condition and causality is found which possesses an instability wave term that dominates within a region of approximately 45 deg to the downstream jet axis It is shown that when an exterior flow is imposed the noise level increases upstream whilst the instability wave weakens downstream The stable part of the solution is shown to agree very well with some recent experimental results (Author)

A78-19228 # **Three-dimensional analysis of flow in axial flow turbomachines** S Prasad (College of Military Engineering, Poona, India) *Institution of Engineers (India), Journal, Mechanical Engineering Division,* vol 58, July 1977, p 31-35 6 refs

For axial flow turbomachines with blades longer than the mean diameter, the flow pattern along the radius satisfying the flow equation in meridional plane is developed using three-dimensional analysis This leads to determination of variation in the angle of blade tip in order to have shockless flow, thus aiding the design of axial flow compressors, gas turbines and low pressure stages of steam turbines, etc For solving the radial equilibrium equation, a general purpose computer programme (both for stator and rotor) has been developed for ready use by the designers by which radial variations of meridional velocity and other thermodynamic and kinematic parameters can be obtained at any stage (Author)

A78-19229 # **Transient speed response of a gas turbine** A K Mohanty and H M Balasubramanya (Indian Institute of Technology, Kharagpur, India) *Institution of Engineers (India), Journal, Mechanical Engineering Division,* vol 58, July 1977, p 48-53 6 refs

A theoretical analysis is presented for the speed response characteristics of a gas turbine power plant operating under conditions of change in fuel supply at a constant load torque An experimental study of the speed response characteristics is conducted on a specified gas turbine with a single-sided centrifugal compressor coupled to an axial-flow turbine Experimental results are found to be in good agreement with theory It is shown that the response of the gas turbine varies directly with a nondimensional parameter A delay time of about 20 sec is determined experimentally S D

A78-19230 # **Design of long blades by method of constant circulation** Z Husain and P A Tabrizi (Azarabadegan, University, Tabriz, Iran) *Institution of Engineers (India), Journal, Mechanical Engineering Division,* vol 58, July 1977, p 54-58 5 refs

A method of constant circulation involving the behavior of a fluid particle under steady-flow conditions in the space between a fixed and a moving blade is described and applied to the determination of parameters important to the design of long blades of steam and gas turbines These parameters are nozzle angle, kinematic degree of reaction, inlet angle, exit angle, ratio of blade speed to steam velocity, and relative pitch Numerical values for the variation of the parameters with respect to different variables in the governing formulas are provided in tabular form S D

A78-19294 **The status of flight recorders in modern aircraft** C A Roberts *(Annual Symposium on Back to Basics Approach to Aviation Litigation, 11th, Dallas, Tex , Mar 3-5, 1977) Journal of Air Law and Commerce,* vol 43, no 2, 1977, p 271 287 40 refs

Flight data recorders (FDR) and cockpit voice recorders (CVR) can provide an important aid in the investigation of aviation accidents All large aircraft in air carrier operations and air taxi operations must, therefore, be equipped with an approved FDR and a CVR Any aircraft type certified after Sept 30, 1969, that is required to carry an FDR must carry an expanded FDR The CVR is a four-channel, crash-survivable type unit that records all radio communications to and from the aircraft, interphone communica tions, sounds from the flight deck, and signals identifying navigation and approach aids for a period of at least thirty minutes Special devices used in the CVR lab to obtain a tape transcript are considered and approaches are discussed for improving the often very poor quality of the recordings of cockpit conversations by the omnidirectional cockpit area microphone The characteristics of various types of FDR are examined G R

A78-19402 # **Role of titanium in aerospace applications** G Thomas and M K Mukherjee (Indian Space Research Organization, Space Science and Technology Centre, Trivandrum, India) *Aeronautical Society of India, Journal*, vol 28, Feb 1976 (Sept 1977), p 11-25 22 refs

In an effort to reduce aircraft or spacecraft weight and thereby increase payload capacity, light weight, high strength materials are used Alloys based on various metals (Al, Be, Mg and Ti) are compared with respect to strength, critical temperature, density, hardness, and ductility Special attention is given to titanium and its alloys, and tables are presented outlining various characteristics of titanium alloys as they apply to use in aircraft and spacecraft components D M W

A78-19405 # **On the application of dual-phase damping to landing gears** C Venkatesan and R Krishnan (Indian Institute of Science, Bangalore, India) *Aeronautical Society of India, Journal*, vol 28, Feb 1976 (Sept 1977), p 41-47

Application of dual phase damping to a simplified model of a landing gear is investigated The inputs considered for the analysis are rounded step displacement and rounded pulse displacement Variations of the peak acceleration and displacement with the four parameters, which define the dual-phase damping, are computed Optimum values of the four parameters at which the minimum peak acceleration or minimum peak displacement occurs are then sought (Author)

A78-19411 # **Introduction of NC machines in aircraft industry** S C Keshu (Hindustan Aeronautics, Ltd , Bangalore, India) *Aeronautical Society of India, Journal*, vol 28, Feb 1976 (Sept 1977), p 109-111

The technological and economic considerations related to the introduction of Numerical Control (NC) machine tools into a moderately sized aircraft machine shop are discussed The machine shop will shortly begin production of advanced jet fighter aircraft A three axis NC mill and a lathe have been ordered for the shop, NC skin milling and integral milling, the production tooling used with the new equipment, and maintenance procedures are mentioned J M B

A78-19415 # **An investigation on the cracking of aircraft pipe line sleeves** R P Ghosh (Controllerate of Inspection /Metals/ Laboratory, Ichapore, India) and S B Choudhury (Ministry of Defence, Barrackpore, India) *Aeronautical Society of India, Journal*, vol 28, Feb 1976 (Sept 1977), p 135-137

Metallurgical investigations were conducted to ascertain the causes of crack formation in the pipelines sleeves of DC-3 aircraft hydraulic systems It was found that the copper-aluminum alloy sleeves are subject to stress corrosion cracking due to the NH3 environment, the use of aluminum base alloy sleeves is suggested as a replacement for the copper-aluminum alloy structures J M B.

A78-19427 **F-16 progress in performance flight testing using an inertial navigation unit** J N Olhausen (General Dynamics Corp , Fort Worth, Tex) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 1-1 to 1-17

An inertial navigation platform is being used successfully to obtain performance and aerodynamic data during the USAF/General Dynamics F-16 flight test program currently in progress at Edwards Air Force Base, California This paper discusses the theoretical background and practical aspects of using this instrumentation inertial reference set (IIRS) along with some results obtained to date Specific topics addressed include use of the IIRS to obtain flight path acceleration, normal load factor, rate of climb, airspeed, aerodynamic coefficients, angles of attack and sideslip, takeoff and landing velocities and distances, position error calibration informa tion through the Mach jump region, and wind information The system has proved to be invaluable on the F-16 program to date and has demonstrated many benefits over previously used performance instrumentation (Author)

A78-19431 **Getting ready for V/STOL T&E in the 80's** E Lister (U S Naval Air Propulsion Test Center, Trenton, N J) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 5-1 to 5-19 7 refs

Effective R&D options for increasing the capability of the operational V/STOL aircraft are discussed in relation to two fundamental aircraft types a subsonic V/STOL 'A' and a supersonic V/STOL 'B' It is shown that some of the major differences in these two aircraft types - as compared to today's CTOL, helicopters, and the AV8 Harrier - emerge in the propulsion system area, these differences include the relative portion of takeoff gross weight for propulsion as well as fuel and in-flight allowances for cruise/loiter Environmental impacts are also revealed with respect to sand ingestion tolerance, deck footprints, and combat survivability, all of which have propulsion implications The two major problems to be overcome are manpower shortages and development of a T&E facility plan S D

A78-19432 **The effects of atmospheric wind gradients on the motion of V/STOL aircraft near the ground** R C Nelson (Notre Dame, University, Notre Dame, Ind) and M Curtin In Flight test technology, Proceedings of the Eighth Annual Symposium, Wash ington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 6-1 to 6-19 15 refs

A review of the influence of wind gradients on the longitudinal and lateral motion of V/STOL aircraft is presented Also a simplified analysis of a wing flying into a nonuniform flow is discussed This analysis permits an examination of both the atmospheric variables as well as the wing planform characteristics on the wind shear-induced loads In the analysis the wind shear model developed by Luers is used The wind shear model accounts for the effect of surface roughness, atmospheric stability, and altitude Results are presented which show the influence of a wind shear on the aerodynamic forces and moments acting on the wing for various atmospheric, wing planform characteristics and wing orientation (bank angle) In addition, an analysis of the influence of wind gradients on the aerodynamic stability coefficients is presented The analysis shows that the lateral derivatives can be substantially modified in the presence of a wind gradient Finally an experimental technique is presented for studying the effects of wind shear on the aerodynamic characteristics of V/STOL aircraft (Author)

A78-19433 * **Flight-test measurements of ground effect - STOL airplanes** E K Parks and R C Wingrove (NASA, Ames Research Center, Moffett Field, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 7-1 to 7-13 14 refs

Powered-lift STOL aircraft exhibit special aerodynamic characteristics that necessitate changes in established procedures of flight testing Methods used in ground-effect flight testing of STOL-configured aircraft are described, with special emphasis on results obtained from tests of the YC-15 AMST prototype aircraft Ground

effect on lift and on drag is theoretically analyzed in terms of trailing vortices, bound vortex, and flight-path angle Airspeed static source position errors are induced by ground constraint and must be considered in the data reduction Flight-test results show a positive lift increment due to ground proximity S D

A78-19434 **F-4E austere heads-up display/gunsight evaluation** W W Crimmel (USAF, Flight Test Center, Edwards AFB, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 8-1 to 8-21

Flight-test results are presented for an evaluation directed at verifying the accuracy and performance of the F-4E Austere Heads-Up Display (HUD) air-to-air gunsights represented by the digital advanced lead computing optical sight (DALCOS) and an undamped historic tracer called hotline gunsight The discussion focuses on system description, feasibility testing, accuracy and performance testing, and relative sight applicability It is shown that the Austere HUD as installed in the F-4E aircraft is feasible and that both gunsights are useably accurate throughout the entire gun firing envelope of the F-4E The DALCOS is superior in long-range tracking, while the hotline gunsight is superior in the high aspect angle snapshoot situation, however, both gunsights exhibit inadequate lateral cues for high aspect angle passes S D

A78-19435 **Development of an on-board minicomputer system** R J Kerr (Rockwell International Corp , General Aviation Div , Bethany, Okla) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 9-1 to 9-19 10 refs

The paper outlines the design concept, airborne and ground-based equipment, programming and operation, data reduction procedure, and flight-test results for a cost-effective on-board minicomputer system capable of real-time display of large amounts of flight-test data in instrument-corrected engineering units The minicomputer system eliminated the postflight data assembly procedure by writing flight-test data directly onto magnetic tape in a format suitable for direct computer input on the ground, and it greatly reduced down-time due to instrument malfunctions Performance data are analyzed by a computer program to calculate points on the aircraft drag polar from three types of performance tests sawtooth climbs, level flight accelerations, and level flight cruise Fourier analysis is used to evaluate factors contributing to overall interior noise and vibration levels Future developments of the minicomputer system are mentioned S D

A78-19436 **Douglas Aircraft Company laser tracker** P D Moore and W G Price (Douglas Aircraft Co , Long Beach, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 10-2 to 10-8

A mobile automatic laser tracking system is examined in relation to operational applications, system accuracy, operational problems and corrections, system reliability, data acquisition and processing, and system improvements Design efforts resulted in a single package containing a new range computer based on fast IC logic, a data acquisition system, and a decommutator and displays A high-speed microprocessor is added to the system for real-time monitoring System problems pertain to component failures, design problems, problems in covering new requirements, and special problems Comparative data from radar systems and other camera systems are found to be in good agreement with the accuracy curve presented S D

A78-19437 **Wright-Patterson Air Force Base laser tracker** C Starr (USAF, Wright-Patterson AFB, Ohio) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 10-9 to 10-12

The paper discusses the applications and performance capability of a transportable laser tracking system - designated as the Precision Approach Area Tracking System (PAATS) - which is housed in a trailer located about 1100 ft off the centerline of the main runway The PAATS laser is mounted on a single-turn elevation-over-azimuth tracking mount PAATS finds its primary application in support of flight test projects conducted within a specified approach area Acquisition of targets is achieved by both manual (TV aided) and automatic means To implement automatic acquisition in the remode mode, PAATS is interfaced with two other aircraft tracking systems a transportable X-band instrumentation radar, and a trilateration type of tracking system called aircraft space position measurement system Problem areas are identified, including flash lamps, pulse forming network, optical encoders, and transportability Addition of digital data annotation to the TV display and development of lightweight inexpensive cast plastic sheet material with a matrix of open corner retroreflectors are also examined S D

A78-19438 **Multiple laser tracker operations** W W Steele (U S Army, Yuma Proving Ground, Ariz) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 11-1 to 11 12

A real-time data collection system for aircraft testing is presently operational at the U S Army Yuma Proving Ground The prime instrumentation for the system consists of three laser tracker systems called precision aircraft tracking systems (PATS) One project now being tested using this system is the Navstar Global Positioning System which requires high-accuracy aircraft tracking data in real time Maintenance, safety considerations, and reliability of the PATS are all suitable for range operation The accuracy of PATS trackers is exceptionally good and calibration data indicate that the PATS are as accurate as any standard range tracking system Two data reduction schemes are used to reduce PATS data real time and batch The real-time program provides a QD smoothed trajectory by the 'best' of the three PATS, while the batch program consists of a Kalman filter using data from all three PATS Future requirements of PATS are discussed and the current effort to further develop applications for the technology are described The applications are in the field of artillery projectile tracking and tracking with PATS at different wavelengths (Author)

A78-19440 **A new analysis method for determination of FAA stall speed** C S Willey (Lockheed-California Co , Burbank, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 12-1 to 12-10

FAA stall speed is by definition the minimum speed achieved when decelerating at an average rate of -1 kt/sec during the time interval between the speed 10% above the minimum speed and the minimum speed without benefit of power and at the most forward center of gravity In order to certificate an airplane, manufacturers customarily conduct in every normal configuration a series of light weight and a series of heavy weight stalls over a range of entry rates so that the minimum speed at -1 kt/sec entry rate can be defined for at least two discrete weights A new analysis method is proposed for determining stall speed for any weight at any altitude within the constraints of the test data The new analysis method eliminates the need to conduct numerous stalls at low altitudes where the test airplane may be endangered during stall recovery The new analysis method derives an empirical factor which is used to correct each stall to a nominal -1 kt/sec entry rate, so that every stall conducted can be used as a data point The new analysis method has been used to certify stall speeds for a current wide-bodied commercial jet transport (Author)

A78-19441 **Flyover noise - Measurement and analysis** J W Vogel (Lockheed-California Co , Burbank, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washing-

ton, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 13-1 to 13-16 8 refs

Present-day flyover noise testing and noise certification requirements facing flight test organizations are reviewed Emphasis is placed on identification and analysis of items related to test planning, ground-based and airborne instrumentation, and analysis and correction techniques during the development period of an aircraft A complication in determining maximum sideline noise is the fact that its location depends on elevation angle and distance from the microphone to the aircraft, ways of evaluating maximum sideline noise are discussed Because of numerous requirements imposed in terms of acceptable meteorological conditions, need for symmetrical measurement of sideline noise, sea level reference pressure, etc , it may not be suitable to perform the noise certification testing at the test site normally used for performance testing S D

A78-19442 The PIO problem - Theory and implications to flight test R H Smith (Systems Research Laboratories, Inc , Dayton, Ohio) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 14-1 to 14-11 11 refs Contracts No F33615-73-C-4155, No N33615-77-C-3011 AF Task 69

A theory for longitudinal, short-period pilot-induced oscillation (PIO) is presented which appears to explain how pitch attitude and normal acceleration modes can couple with pilot dynamics to produce large amplitude, uncontrollable oscillations The effects of control system dynamics and feel system nonlinearities are considered Example applications of this theory are summarized which indicate that the theory successfully explains the available PIO data base General implications of this theory to simulation and flight test are discussed This work represents a major departure from past studies of PIO in that the resulting theory is applicable to the prediction and avoidance of PIO problems prior to their discovery in flight test (Author)

A78-19443 Flight test of combat aircraft loads and dynamic behavior encountering aircraft trailing vortices S Rodling (Saab Scania AB, Linkoping, Sweden) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 15-1 to 15-14

The flight tests presented in this paper were performed due to a growing trend of exceeding the load factor limits, caused by aircraft trailing vortex encountering in the Swedish Air Force An instrumented AJ37 Viggen attack/fighter aircraft was flown into the vortex wake generated by another Viggen Loads and disturbances caused by the vortices were studied The test results are compared to calculated values and discussed in view of flight safety of combat aircraft (Author)

A78-19444 The fighter control configured vehicle /CCV/ program development and flight test summary R A Whitmoyer and J K Ramage (USAF, *Flight Dynamics Laboratory, Wright Patterson* AFB, Ohio) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 16-1 to 16-21

Flight testing of the Air Force Flight Dynamics Laboratory's CCV YF-16 was successfully completed on 30 June 77 Completion of this effort marks a major milestone in the development of active control technology for improving fighter aircraft mission effectiveness A total of 125 flight hours (87 flights) were logged during the CCV flight test program, which included functional checkout, envelope expansion, engineering data acquisition/assessments and an Air Force quasi-operational evaluation CCV modes evaluated during the flight test program included (1) maneuver enhancement, (2) direct lift and sideforce control, (3) independent fuselage pointing and translation, and (4) variable relaxed static stability Results from this advanced development program have provided valuable insight into the design and application of CCV concepts for modern high performance fighter aircraft This paper summarizes the CCV YF-16 design approach, system mechanizations and preliminary flight test results (Author)

A78-19445 YC-15 STOL performance flight test methods H K Cheney (Douglas Aircraft Co , Long Beach, Calif) In Flight test technology, Proceedings of the Eighth Annual Symposium, Washington, D C , August 10-12, 1977 Lancaster, Calif , Society of Flight Test Engineers, 1977, p 17-1 to 17-16 7 refs

The methods and techniques developed for evaluating performance of the YC-15 Advanced Medium STOL prototype aircraft are *presented Performance characteristics were determined by using a* variety of test maneuvers that included minimum-speed approaches, stabilized level flights, climbs, descents, level flight accelerations, takeoffs, landings and go-arounds An instrumented Inertial Navigation System (INS) provided improved accuracy for nonstabilized maneuvers The INS also provided onboard flightpath tracking information Computer programs were developed to organize the large volume of test data and to compute standardized performance parameters (Author)

A78-19446 # **B-1 progress report** R Abrams (Rockwell International Corp , Los Angeles Aircraft Div , Edwards AFB, Calif) and P S Sharp (USAF, Flight Test Center, Edwards AFB, Calif) *Society of Flight Test Engineers, Annual Symposium, 8th, Washington, D C , Aug 10-12, 1977, Paper* 6 p

Initial test flights of B-1 bomber prototypes are described Flight stability and handling characteristics at varying speeds and altitudes are evaluated, with special attention given to variable geometry wing configuration, and its effect on surface loads for flutter tests. Offensive avionics, terrain following capability, ground communication, and SRAM tests are mentioned D M W

A78-19447 # **B-1 terrain following** C W Brinkley, P S Sharp (USAF, Flight Test Center, Edwards AFB, Calif), and R Abrams (Rockwell International Corp , Los Angeles Aircraft Div , Edwards AFB, Calif) *Society of Flight Test Engineers, Annual Symposium, 8th, Washington, D C , Aug 10-12, 1977, Paper* 25 p

The purpose of this paper is to present an overview of the work accomplished to develop, test, and evaluate the B-1's terrain following system and low altitude penetration capabilities First, the B-1's mission, flight test program goals, and test philosophy will be discussed Then, the operating theory of the B-1's terrain following system, including the forward looking radar, terrain following computer, radar altimeter, terrain following/flight control system adapter, automatic throttle system, and the flight control/autopilot system, is briefly outlined, including a discussion of how these components are integrated to produce the total system performance The test techniques required to verify design concepts and operational requirements are outlined, including the types of terrain used for testing, ground tracking requirements, and types of maneuvers flown (Author)

A78-19449 # **Sikorsky YUH-60A UTTAS helicopter flight test program** R G Stutz, F Kreutz, and R R Fenaughty (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Flight Test Engineers, Annual Symposium, 8th, Washington, D C , Aug 10-12, 1977, Paper* 26 p

Strict budgetary and schedule requirements set by the U S Army have led Sikorsky to develop new test flight technology for its YUH-60A UTTAS helicopter The developments include multi discipline test aircraft, permitting interchangeable test roles, On-Line and Real-Time data analysis, permitting rapid evaluation of test results, and improved management of test flight personnel and procedure Improvements in the airborne measurement system are mentioned, stressing interchangeability of function for the measuring instruments, and quick disconnects for easy replacement of the measured components Graphs describing personnel organization and flight envelope parameters are also presented D M W

A78-19546 # **The answer to the 'engine deficiency' question** E C Simpson and R J Hill (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *Astronautics and Aeronautics*, vol 16, Jan 1978, p 52-57

Design cycles for advanced gas turbine engines are discussed Factors affecting engine life predictions, including errors in stress calculations, erosion, corrosion, oxidation embrittlement, and sulfidation are reviewed Boundary conditions, which are governed by compressor inlet temperature, pressure, and rotational speed of the rotor (which are in turn determined by the operating atmosphere, air speed, and altitude) are held to be essential for predicting engine-life consumption rate Techniques to improve engine design, such as laser holographic interferometry to determine stress-strain patterns on rotating engine blades are also mentioned J M B

A78-19547 # **The digital airplane** R Q Lee and G R England (General Dynamics Corp , Fort Worth, Tex) *Astronautics and Aeronautics*, vol 16, Jan 1978, p 58 64

Advances in digital avionics are discussed, with attention given to applications of monolithic microprocessors consisting of a central processing unit, input/output circuitry, and limited semiconductor memory, to programmable read-only semiconductor memories, and to magnetic-bubble memories and charge coupled devices Equipment based on these components, including multimode, high resolution radar, high-density focal plane array sensors, integrated fire/flight controls, and digital navigation and control processors linked to the Global Positioning System and the Joint Tactical Information Distribution System, are also described Problems associated with digital avionics, such as development of manageable software, are considered J M B

A78-19548 # **Back to the drawing board** H W Smith (Kansas, University, Lawrence, Kan) *Astronautics and Aeronautics*, vol 16, Jan 1978, p 65-68 8 refs

Scheduling of aerospace design programs is discussed A sample analysis of the design process for the main gear and tires of a supersonic transport is presented An important facet of the process is the requirement of providing newly generated data to other designers so that the program may proceed In addition, the steps in developing a typical speed/altitude specification are described J M B

A78-19580 **THREDE - A free-field EMP coupling and scattering code** R Holland (Mission Research Corp , Albuquerque, N Mex) *(Institute of Electrical and Electronics Engineers, Annual Conference on Nuclear and Space Radiation Effects, 14th, Williamsburg, Va , July 12-15, 1977) IEEE Transactions on Nuclear Science*, vol NS-24, Dec 1977, p 2416-2421 7 refs Contract No F29601-76-C-0064

THREDE is a time-domain linear finite-difference, three-dimensional EMP coupling and scattering code In its present form, it can accomodate a problem space consisting of a 30x30x30 mesh Differencing is linear Problem-space boundaries are provided with a radiating condition which does not generate fictitious mathematical echos at late times The scatterer must be a perfect conductor, although a nonideal ground plane (runway) may be close by The present article describes the mathematical basis of THREDE and shows the results of applying it to predict the response of an F-111 shell in the horizontally-polarized dipole (HPD) EMP simulator Amplitude agreement between experiment and prediction for this example is typically on the order of 20%, resonant frequencies are predicted more closely than this THREDE costs about 1 second of computer time per program cycle, most practical analyses require 500 to 1000 program cycles (Author)

A78-19626 # **Use of the vorticity method in computing the aerodynamic characteristics of a thin wing in a steady supersonic flow (Primenenie vikhrevogo metoda pri raschete aerodinamicheskikh kharakteristik tonkogo kryla v ustanovivshemsia sverkhzvukovom potoke)** V I Chubarov *TsAGI, Uchenye Zapiski*, vol 6, no 1, 1975, p 1-8 5 refs In Russian

A finite element algorithm is proposed for calculating the aerodynamic load on a thin wing of arbitrary planform in a steady supersonic flow The finite elements used are rectangular panels with a constant intensity of connected vortices In comparison with methods based on the computation of the perturbed velocity-potential, accuracy of calculating the distributed load is ensured with less expenditure of machine time and with less computer memory demand Results are presented for a thin delta wing, and derivative coefficients of lift and longitudinal and transverse moments are calculated for the wing of a supersonic passenger aircraft B J

A78-19631 # **Experimental study of the effect of angle of attack on laminar-to-turbulent boundary layer transition near the under surface of delta plates with sharp edges (Eksperimental'noe issledovanie vliianiia ugla ataki na perekhod laminarnogo pogranichnogo sloia v turbulentnyi okolo nizhnei poverkhnosti treugol'nykh plastin s ostrymi kromkami)** N A Davydova and A Ia Iushin *TsAGI, Uchenye Zapiski*, vol 6, no 1, 1975, p 48 56 7 refs In Russian

Results are presented on measurements of the Reynolds number of boundary layer transition on the under surfaces of three delta plates with delta angles of 60, 70 and 75 deg Angles of attack varied in the range 0-40 deg, Mach number was 5, the Reynolds number of unperturbed flow, computed with respect to a characteristic dimension of 1 m, was equal to 1 27 x 10 to the 7th The location of transition was determined from surface distributions of specific heat flux It is shown that transition is initially accelerated with increase of angle of attack, there is a critical value of angle of attack at which the smallest distance of the transition region to the leading edge is attained B J

A78-19633 # **The effect of aerodynamic interference of wing and horizontal tail assembly on the critical velocity of flutter of a flight vehicle (Vliianie aerodinamicheskoi interferentsii kryla i gorizontal'nogo operenia na kriticheskuiu skorost' flattera letatel'nogo apparata)** A A Rybakov *TsAGI, Uchenye Zapiski*, vol 6, no 1, 1975, p 67-71 9 refs In Russian

The paper presents numerical results on the flutter of wing and tail assembly, with consideration of the aerodynamic interference between these two structures The method used involves determination of the nonsteady state aerodynamic forces on oscillating lifting surfaces in subsonic flow, based on the numerical integration of an integral equation, relating the distribution of the normal component of velocity with pressure differences on the lifting surface The presence of a tail assembly behind the wing leads to a reduction in the critical velocity of flutter B J

A78-19639 # **Experimental study of the induced interaction of lifting propellers, positioned according to transverse and longitudinal schemes (Eksperimental'noe issledovanie induktivnogo vzaimodeistvia nesushchikh vintov, raspolozhennykh po poperechnoi i prodol'noi skhemam)** G G Ananov *TsAGI, Uchenye Zapiski*, vol 6, no 1, 1975, p 100-102 In Russian

A helicopter model was tested in a wind tunnel to determine coefficients of induced drag of helicopter propeller blades positioned according to transverse and longitudinal schemes Coefficients of induced drag interaction were obtained from experimentally determined values of propeller lift and power coefficients B J

A78-19640 # **Determination of the wave drag of an airfoil profile by means of interferometry in near-sonic flow (Opredelenie volnovogo soprotivleniia profilia metodom interferometrii pri okolozvukovom obtekanii)** V D Bokser, V B Dmitrieva, L B Nevskii, and Ia M Serebriiskii *TsAGI, Uchenye Zapiski*, vol 6, no 1, 1975, p 103-107 6 refs In Russian

The wave drag of an airfoil profile in viscous near-sonic flow (free stream M of about 0 8-0 9) was measured interferometrically in a wind tunnel, The combination of interferometry with the theory of wave drag and a weighting method allows for a quantitative evaluation of the relative contributions of wave and vortex drag to the increment of profile drag in cases of supercritical flow B J

A78-19649 # **Application of the method of matching outer and inner asymptotic expansions to the solution of problems in viscous fluid dynamics (O primenenii metoda svashchivaniia vneshnikh i vnutrennikh asimptoticheskikh razlozhenii k resheniiu zadach dinamiki viazkoi zhidkosti)** L. A. Lomakin and O. S. Ryzhov. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 16-27. 24 refs. In Russian.

The paper presents a recurrent system of paired boundary-value problems whose solution allows determination of the velocity field at large distances from a wing profile in the flow of an incompressible viscous fluid. It is assumed that the flow is plane parallel and that the wing profile is of infinite span. The outer expansion describes the potential flow across the whole surface except for the narrow parabolic region of the wake, and the flow structure is determined with the aid of the asymptotic formulas of inner expansion. It is shown that the results of asymptotic theory in the first two approximations coincide with the exact solution of flow problems if terms of suitable order are retained in that solution. S.D.

A78-19650 # **Strong interaction of a boundary layer and a hypersonic flow in the presence of local perturbations of the boundary conditions (Sil'noe vzaimodeistvie pogranichnogo sloia s giperzvukovym potokom pri lokal'nykh vozmushcheniiakh granichnykh uslovii)** A. A. Kovalenko and V. Ia. Neiland. *TsAGI Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 28-38. 14 refs. In Russian.

A steady-state problem is studied concerning the influence of sharp changes in the boundary conditions of a plate with a protuberance on the local and global flow characteristics during a strong interaction between the initial boundary layer and the outer hypersonic flow. It is shown that for a sufficiently large perturbation amplitude the major part of the boundary layer, outside a narrow viscous wall layer, behaves as a local inviscid flow. Flow regimes are classified as a function of perturbation amplitude, similarity parameters are determined, and corresponding boundary-value problems are formulated. Special attention is given to flow with large pressure perturbations, for which the boundaries of unseparated regimes of a flow past a step turned against the flow are established. A rule for solution selection on the principal part of the plate is presented. S.D.

A78-19651 # **Hypersonic flow of a viscous gas in a nozzle (Giperzvukovoe techenie viazkogo gaza v sople).** Iu. N. Ermak. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 39-47. 5 refs. In Russian.

The method of outer and inner asymptotic expansions is applied to the theoretical study of propagation of disturbances upstream in the flow of a viscous gas in an axisymmetric hypersonic nozzle in the case of moderate interaction between the boundary layer and the inviscid hypersonic flow in the flow core. The analyzed flow in the nozzle is divided into two regions: (1) a region of small supersonic Mach numbers with a thin boundary layer on the nozzle walls, having little effect on the flow in the inviscid core described by a solution for a supersonic source, and (2) a region of hypersonic Mach numbers with a thick boundary layer on the nozzle walls. In the boundary-layer equations the pressure gradient is not predetermined and is evaluated during the simultaneous integration of equations for the inviscid flow core and the boundary layer. S.D.

A78-19652 # **Calculation of rarefied-gas flow past a plate at angle of attack (Raschet techeniia razrezhennogo gaza okolo plastiny pod uglom ataki)** V. I. Vlasov. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 48-55. In Russian.

The Monte Carlo method, previously applied to a model of molecules of the Maxwellian-sphere type, is extended to an arbitrary model of monoatomic molecule for a rarefied gas with a finite collisional cross section. Computational results are presented for the flow of a rarefied gas past a plate at an angle of attack for two molecular models: pseudo-Maxwellian and spheres of constant diameter. It is shown that the aerodynamic characteristics of a hot plate are weakly dependent on the molecular model (especially in the region of strong rarefaction) for identical values of the Reynolds number, while those of a cold plate are strongly dependent on the Reynolds number. S.D.

A78-19655 # **Complete problem of matrix eigenvalues in flutter analysis (Polnaia problema sobstvennykh znachenii matrits v raschetakh na flatter)** V. G. Bun'kov. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 82-92. 10 refs. In Russian.

Methods for solving the complete problem of the eigenvalues of arbitrary matrices are improved and then employed for the determination of the complete spectrum of the free vibrations of nonconservative systems with up to 30 degrees of freedom. The following improvements are made: (1) Givens formulas (1957) for obtaining the characteristic polynomials of the matrices are simplified, (2) a new method for calculating polynomial roots is developed on the basis of the steepest descent and quadratic interpolation methods, and (3) a new technique for determining free vibration vectors from obtained values of polynomial roots is developed. As examples, the flutter analysis of various aircraft structures is considered. B.J.

A78-19656 # **Matrix methods for the synthesis of the dynamic and elastic characteristics of linear nonconservative structures (Matrichnye metody sinteza dinamicheskikh i uprugikh kharakteristik lineinykh nekonservativnykh konstruktsii)** V. D. Il'ichev. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 93-108. In Russian.

A finite element method is used to investigate the dynamic and elastic properties of the discrete linear model of an aircraft. The relationships of dynamic and elastic properties with the stress-strain state of the linear nonconservative structure and its parts is considered. Consideration is given to the synthesis of matrix frequency characteristics, dynamic stiffness matrices, and spectral matrices of the vibrational state. B.J.

A78-19657 # **The computation of self-similar three-dimensional separated flows (Raschet nekotorykh avtomodel'nykh trekhmernykh otryvnykh techenii)** G. G. Sudakov. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 109-113. 7 refs. In Russian.

The paper examines self-similar three-dimensional separated flow past a wing with power-law curvature and power-law planform. A numerical method developed by Sudakov (1974) is used to derive the basic characteristics of the flow including the geometry of vortex layers and pressure distribution on the wing surface. B.J.

A78-19658 # **Computation of inductive velocity in the plane of a lightly loaded lifting propeller (Vychislenie induktivnoi skorosti v ploskosti malonagruzhennogo nesushchego vinta)** E. D. Safronov. *TsAGI, Uchenye Zapiski*, vol. 6, no. 2, 1975, p. 114-122. 5 refs. In Russian.

A method is developed for calculating the inductive velocity at all the points of the plane of a propeller with azimuth-constant circulation. The principal part of the inductive velocity, corresponding to half its value in an infinitely distant section, is determined in a finite form, while the other part, induced by small regions of a vortex sheet impinging on the propeller, is represented in a Fourier series. Formulas of series harmonics are reduced to complete elliptic integrals of the first and second kinds directly, without the use of the theory of special functions. B.J.

A78-19668 # **Obtaining exact solutions for shock-free flow past a symmetrical airfoil profile with a local supersonic zone (Postroenie tochnykh reshenii besskachkovogo obtekaniia simmetrichnogo profilia s mestnoi sverkhzvukovoi zonoi)** V. V. Vyshinskii. *TsAGI, Uchenye Zapiski*, vol. 6, no. 3, 1975, p. 1-8. 10 refs. In Russian.

Several symmetric quasi-elliptic airfoil profiles for which the transonic flow is free of compression shocks are constructed by a method based on the continuation of the hodograph parameters into a complex four-dimensional space. It is shown that solutions possessing some prescribed properties can be obtained by varying the parameters of the corresponding boundary value problem in the required direction. The flow past one of the airfoil sections obtained is analyzed for partial load conditions. V.P.

A78-19669 # **Calculation of the flow past a vibrating airfoil section in transonic gas flow (Raschet obtekaniia kolebliushchegosia**

profilia transzvukovym potokom gaza) S I Kuz'mina *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 9 17 6 refs In Russian

In the present paper, Godunov's (1961) finite difference scheme with a movable grid is applied to the calculation of the transonic flow past a wing section with a harmonically vibrating (wing tip) aileron, and to the problem of damping the aileron vibrations It is assumed that the gas is inviscid and nonheat-conducting and that the wing section may be treated as a rigid body with three degrees of freedom Results obtained for supersonic flow are compared with linear theory V P

A78-19670 # **Sudden expansion of a supersonic jet in a cylindrical duct (Vnezapnoe rasshirenie sverkhzvukovoi strui v tsilindricheskom kanale)** V I Blagosklonov and V A Khomutov *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 18-24 10 refs In Russian

In the present paper, a numerical technique used by Ivanov et al (1972) to calculate two-dimensional supersonic flows is applied to the analysis of the propagation of a supersonic jet in a cylindrical duct whose cross section widens at some point It is assumed that the jet and duct axes coincide and that subsonic zones are absent in the duct The steady-state system of gasdynamics equations, written in the form of conservation laws, is integrated by a straight through finite-difference scheme proposed by Ivanov V P

A78-19671 # **Asymptotic theory of the onset of separation at a flap on a cooled body situated in hypersonic flow under conditions of weak hypersonic interaction (K asimptoticheskoi teorii zarozhdeniia otryva okolo shchitka pri obtekanii okhlazhdennogo tela giperzvukovym potokom na rezhime slabogo giperzvukovogo vzaimodeistviia)** V Ia Neiland and L A Sokolov *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 25 34 In Russian

The asymptotic behavior of solutions of the Navier-Stokes equations shows that, in boundary layer separation from a smooth surface in supersonic flow, the flow near the separation point is influenced primarily by a large local pressure gradient induced through interaction with the external flow In the present paper, it is shown that the parameter distribution profiles in the entire unperturbed boundary layer have a substantial influence on the flow at the points of separation The solution obtained to a problem of flow separation at a flap is shown to be completely defined by the values of two dimensionless parameters characterizing the flap angle and the degree of cooling of the body V P

A78-19681 # **Nonequilibrium reverse flow in a Laval nozzle (O neravnovesnom techenii v obratnom sople Lavalia)** A V Chirikhin *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 95-98 5 refs In Russian

The problem is examined of the influence of a nonequilibrium state of the molecular degrees of freedom on the one dimensional supersonic flow in a converging channel It is shown that compression of the flow is accompanied by nonequilibrium excitation of vibrations, while the subsequent expansion leads to freezing of the vibrational temperature (at high values) Due to these phenomena, the entropy of the flow is substantially increased Relaxation processes are shown to affect the value of the smallest cross section of a streamtube capable of transmitting a prescribed volume of gas per unit time V P

A78-19682 # **Tossing of objects by the vortex formed below an air intake (O podbrasyvanii predmetov vikhrem, obrazuiushchimsia pod vozdukhozabornikom)** N P Besedov *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 99 104 In Russian

The parameters associated with the ingestion of debris into intakes through vortex action are studied experimentally to determine the action of the vortex on an object situated symmetrically with respect to the vortex 'root' The difference between the distribution of static pressure along an ideal and an actual vortex is pointed out Formulas are derived for calculating the vertical forces acting on disk shaped and spherical objects, as a result of decreasing static pressure toward the vortex axis V P

A78-19683 # **External drag and base pressure of fuselage tail sections of various configuration (Vneshnee soprotivlenie i donnoe davlenie khvostovykh chastei fiuzeliazhei razlichnoi formy)** G N Lavrukhin *TsAGI, Uchenye Zapiski,* vol 6, no 3, 1975, p 105-111 11 refs In Russian

The wind tunnel experiments described were carried out to base pressure and external drag of tail sections with circular, elliptic, and rectangular base faces at freestream Mach numbers from 0 6 to 3 0 It is shown that for the same law of cross-sectional area variation along the length of the tail section, the external drag and base pressure of tail sections of different configuration may differ by as much as 40 to 50% A method of determining the characteristics of asymmetric tail sections by analyzing an equivalent symmetric tail section with an identical base face area is proposed V P

A78-19689 # **Some aspects of the calculation of flows with tangential discontinuities (Nekotorye voprosy rascheta techenii s tangentsial'nymi razryvami)** V F Molchanov *TsAGI, Uchenye Zapiski,* vol 6, no 4, 1975, p 1 11 7 refs In Russian

The scheme of the method of discrete vortices for calculating plane flows with tangential discontinuities is analyzed It is shown that the scatter of vortices, usually observed in the calculations, results from an incorrectness of the problem in the sense that it is ill posed on the set of growing disturbances, and also from the instability of the finite difference scheme on the set of weakening disturbances Using the theory of solving ill posed problems in combination with the theory of finite difference schemes, a method is developed which yields results with any accuracy required For illustration, the method is applied to the calculation of the nonlinear characteristics of a small aspect-ratio rectangular wing V P

A78 19691 # **Some characteristics of sonic boom propagation in an inhomogeneous atmosphere (Nekotorye osobennosti rasprostraneniia zvukovogo udara v neodnorognoi atmosfere)** Iu L Zhilin *TsAGI, Uchenye Zapiski,* vol 6, no 4, 1975, p 21-30 In Russian

The conditions are formulated under which the area on the earth's surface experiencing sonic boom from an aircraft in steady flight may be limited, unlimited, or multiply connected, and under which isolated portions of the area may be repeatedly subjected to the boom It is shown that in the analysis of the area's geometry, an atmospheric layer of a thickness of the order of 2 to 3 aircraft altitudes should be taken into consideration, and that insignificant changes in the distribution of the atmospheric parameters may result in appreciable changes in the area's width V P

A78 19693 # **Influence of the principal parameters of a high aspect ratio wing /through its construction weight/ on the magnitude of the payload (Vliianie na velichinu platnoi nagruzki osnovnykh parametrov kryla bol'shogo udlineniia /cherez ves ego konstruktsii/)** A P Sorokin and V M Frolov *TsAGI, Uchenye Zapiski,* vol 6 no 4, 1975, p 41 48 In Russian

An approximate analytical method is proposed for optimizing the payload for an aircraft with high aspect ratio wings An equation for the optimal aspect ratio is derived The relations obtained from a numerical solution of this equation makes it possible to determine the influence of the important design parameters, during the initial design phase, and to select the most rational combination of the parameters from the point of view of obtaining the maximal payload V P

A78-19696 # **Solution of the problem of three dimensional flow past a delta wing with subsonic edges by a modification of the Lax-Wendroff method (Reshenie metodom ustanovleniia zadachi o prostranstvennom obtekanii treugol'nogo kryla s dozvukovymi kromkami)** P Ia Tugazakov *TsAGI, Uchenye Zapiski,* vol 6, no 4, 1975, p 64 66 In Russian

In the present paper, no assumptions are made concerning the mechanism of the flow at the subsonic leading and trailing-edges of a delta wing in three-dimensional flow It is assumed that the gasdynamic function at the upper and lower wing surfaces exhibits a

discontinuity The interaction between the design points at the upper and lower surfaces near the edges is taken into consideration in the finite-difference calculations This leads to the identification of a certain vortex motion in the edge region, which satisfies the general equations of motion of a gas Some steady-state characteristics of the wing are obtained for various Mach numbers and angles of attack V P

A78-19707 # **Design of load-bearing structures of maximal rigidity (Proektirovanie silovykh konstruktsii maksimal'noi zhestkosti)** E K Lipin *TsAGI, Uchenye Zapiski*, vol 6, no 4, 1975, p 126-129 In Russian

The paper presents a method for determining the distribution of a given sum volume of material in elements of complex thin walled construction The method is consistent with the principle of minimum energy of deformation for conditions which satisfy stability and rigidity demands for every element forming the structure M L

A78-19709 # **The lifting force of a low aspect-ratio wing and body combination (Pod'emnaia sila kryla malogo udlineniia s korpusom)** V V Keldysh *TsAGI, Uchenye Zapiski*, vol 6, no 5, 1975, p 15-28 6 refs In Russian

In the present paper, the lifting force of a wing-body combination, where two circular arcs are mounted, one on and the other below the low-aspect-ratio wing, is calculated within the framework of slender body theory It is shown that for a pointed body, the lifting force of the combination can be substantially greater than that of an isolated wing of the same aspect ratio, and that the lifting force induced by the wing on the body may have the same or opposite direction as that of the wing, depending on the shape and position of the body V P

A78-19715 # **Experimental investigation of the supersonic gas flow past a rectangular wing (Eksperimental'noe issledovanie obtekaniia priamougol'nogo kryla sverkhzvukovym potokom gaza)** V Ia Borovoi and V N Kharchenko *TsAGI, Uchenye Zapiski*, vol 6, no 5, 1975, p 71-80 9 refs In Russian

In the present paper, various test techniques were used to study gas flows past a rectangular wing with a sharp leading edge and sharp lateral edges at a Mach number of 5 and a Reynolds number of 1 5 x 10 to the 6th The flow and heat-transfer characteristics at the upper surface of the wing are identified The flow pattern is illustrated and discussed V P

A78-19726 # **Transmission of a concentrated force to a plate (O peredache sosredotochennoi sily na plastinu)** N S Galkina and V I Grishin *TsAGI, Uchenye Zapiski*, vol 6, no 5, 1975, p 141 145 6 refs In Russian

The present study deals with the determination of the external stresses transmitted via fish plates to the skin of a monocoque wing A numerical solution is obtained to the problem of determining the stress distribution generated in a plate by an external concentrated tensile force acting on a strap about the plate The solution is obtained by the method of displacements, approximating the structure by triangular finite elements in a plane stress strain state The shape of a fish plate of variable thickness (and uniform strength) capable of eliminating the stress concentration in the plate is determined from a solution of the inverse problem V P

A78-19729 # **Determination of pressure impulses at supersonic delta wings with incident weak shock waves (Ob opredelenii impul'sov sil davleniia na treugol'nykh kryl'iakh, dvizhushchikhsia so sverkhzvukovoi skorost'iu, pri padenii na nikh slabykh udarnykh voln)** V A Kazakov *TsAGI, Uchenye Zapiski*, vol 6, no. 6, 1975, p 22-29 5 refs In Russian

A78-19730 # **Determination of the frequency characteristics of an air-intake duct (K opredeleniiu chastotnykh kharakteristik kanala vozdukhozabornika)** T D Vazhenina, V T Grin', and A N Kraiko *TsAGI, Uchenye Zapiski*, vol 6, no 6, 1975, p 30-40 10 refs In Russian

The approximate method proposed in the present paper for calculating the frequency characteristics of an air intake is based on the linearization of one-dimensional equations and of the shock relations, which describe one-dimensional unsteady flow in a duct of variable cross section For illustration, the frequency characteristics are calculated for the case of harmonic pressure fluctuations at the exit section of the duct A comparison with data obtained by numerical integration of the initial nonlinear equations shows that the frequency characteristics calculated by the method proposed are satisfactory both qualitatively and quantitatively V P

A78-19732 # **Investigation of the influence of the boundary layer's state on the aerodynamic characteristics at transonic speeds (Issledovanie vliianiia sostoianiia pogranichnogo sloia na aerodinamicheskie kharakteristiki pri okolozvukovykh skorostiakh)** V M Fomin *TsAGI, Uchenye Zapiski*, vol 6, no 6, 1975, p 48 58 In Russian

In transonic wind tunnels, the Reynolds number is known to be significantly smaller than under natural conditions Because of this, the boundary layer thickness, say, at the wing trailing edge differs for an actual aircraft and a model In the present paper, the results on an investigation are analyzed, which was carried out to study the problem of simulating actual flows in wind tunnels It is shown that the increase in boundary layer thickness on a wing and the intensified inviscid flow/boundary layer interaction during the displacement of the transition point toward the leading edge may lead to appreciable changes in the flow characteristics, in the values of the aerodynamic forces and moments, and in their dependence on the angle of attack and Mach number V P

A78-19736 # **Influence of wing-attachment stiffness on the stability of aeroelastic vibrations (O vliianii zhestkosti krepleniia kryla na ustoichivost' aerouprugikh kolebanii)** N I Baranov, A I Komarov, I M Makhlin, Iu V Ponomarev, and S P Strelkov *TsAGI, Uchenye Zapiski*, vol 6, no 6, 1975, p 82 88 In Russian

In the present paper, the stability of elastic vibrations of a swept wing in an air stream is analyzed as a function of the rigidity of the wing attachment to the fuselage It is shown that allwowance for the wing vibrations in the horizontal plane leads to the appearance of an additional instability region The stability analysis of a system with distributed parameters is reduced to the analysis of the spectrum of eigenvalues of the corresponding boundary value problem A system of fundamental particular solutions is used to solve the boundary value problem V P

A78-19741 # **Experimental investigation of gas flows in the perforated test section of a transonic effuser induction wind tunnel (Eksperimental'noe issledovanie techeniia gaza v perforirovannoi rabochei chasti okolozvukovoi aerodinamicheskoi truby s razgonom techeniia pered ezhektornoi chast'iu)** V R Bertyn', A V Poliakova, and V T Kharitonov *TsAGI, Uchenye Zapiski*, vol 6, no 6, 1975, p 104-108 In Russian

A78-19742 # **Experimental investigation of optimal balanced delta wings in viscous hypersonic flow (Eksperimental'noe issledovanie optimal'nykh s uchetom balansirovki treugol'nykh kryl'ev v viazkom giperzvukovom potoke)** S G Kriukova and V S Nikolaev *TsAGI, Uchenye Zapiski*, vol 6, no 6, 1975, p 109 113 In Russian

To balance a wing, the pitching moment with respect to the center of mass must be set equal to zero and the resultant (pressure) force must be made to pass through the center of mass In the study described, the shape of the wing surface was selected from theoretical considerations to provide maximal lift-drag ratio for a given position of the center of pressure Experimental data obtained with five optimal delta-wing models were used to determine the minimal L/D-ratio losses resulting from balancing V P

A78-19978 # **Core engine noise reduction - Definition and trends** R S Zuckerman (FAA, Systems Research and Development Service, Washington, D C) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga , Oct 3-5, 1977, Paper 77-1273* 9 p 13 refs

A78-20145 **Characterization of smokes emitted by turbojet engines (Caractérisation des fumées émises par les turboréacteurs)** M Pianko and C Verdier (ONERA, Châtillon-sous-Bagneux, Hauts de Seine, France) *L'Aéronautique et l'Astronautique,* no 67, 1977, p 21-26 7 refs In French

Two methods for evaluating smokes emitted by turbojet engines are reviewed, the Hartridge method and the SAE technique It is found that there are no correspondence laws independent of aerosol granulometry between the methods' measuring scales The Hartridge method is more applicable for dense smokes such as those emitted by diesel engines, whereas the SAE technique is more applicable for low-density smokes such as those emitted by turbojet engines S C S

A78-20146 **Boron-aluminum composite materials (Les materiaux composites bore-aluminium)** J -P Ferte (SNECMA, Evry, Essonne, France) *(Colloque sur les Matériaux Nouveaux, Bordeaux, France, Apr 20-22, 1977) L'Aéronautique et l'Astronautique,* no 67, 1977, p 27-37 26 refs In French

General methods for the manufacture of composite materials are outlined, noting the principal stages of the diffusion bonding technique The mechanical properties of boron aluminum composites are discussed with reference to elasticity coefficients, breakage resistance, and thermal fatigue Environmental effects on the material's properties are identified, such as the influence of temperature on longitudinal resistance, creep, the effects of thermal fatigue and/or thermal expansion, and impact resistance Various applications of boron-aluminum composite materials are suggested S C S

A78-20147 **Reliability of fatigue-stressed structures based on experimental results II (Fiabilite des structures en fatigue basee sur l'utilisation des resultats des essais II)** W Barrois *L'Aéronautique et l'Astronautique,* no 67, 1977, p 39-56 63 refs In French

The article discusses various aspects of the behavior of fatigue stressed structures, including the observed discrepancies between the results of laboratory simulations and actual operation results It is noted that mathematical forecasting of durability must be validated by actual fatigue tests, and that when failure probabilities are less than 1/1000, the results of mathematical calculations are not applicable S C S

A78-20188 **Fighters for the 1990s - Building on today's technology** R Braybrook *Interavia,* vol 33, Jan 1978, p 23-27

Fighter development is projected into the 1990's, with emphasis on modifications of existing aircraft rather than the development of totally new aircraft types (an exception is Rockwell International's HiMAT, Highly Manoeuverable Advanced Technology, aircraft for NASA) Special attention is given to cockpit design e g , seat geometry, head-up displays (HUD), throttle mounted controls for hands-on, eyes-out flying, and variable mode (attack/dogfight) avionics The General Dynamics F-16 is described as incorporating the very latest in cockpit design Also mentioned are refinements in airframe development, using composite materials, and the handling characteristics imparted by airframe design angle of attack capability, spin resistance, g-resistance, and overall flight stability Aircraft and cockpit design of advanced aircraft from Sweden, Israel, France, the U S , and the U S S R are compared D M W

A78-20189 **Modular radar display units - Versatility in air defence and ATC applications** R Harnisch, A Ludloff, and H Spicka (Telefunken AG, Ulm, West Germany) *Interavia,* vol 33, Jan 1978, p 54-57

Recent advances have brought about modular radar display units with easily interchangeable components, which allows a user to employ the same machine for a variety of functions Special attention is given to the AEG Telefunken MTS 3/23 display system with a 16-in screen, which is especially useful in airborne target tracking and positioning Display possibilities include primary radar video, SSR video, maps, and distance marker rings, providing easy read-out with multicolor displays of synthetic data Advanced data storage capability is mentioned, together with a brief description of the unit's operational controls Also provided is a circuit diagram of the main components of the MTS 3/23 D M W

A78-20193 **An intermittent high-Reynolds-number wind tunnel** J L Stollery (Cranfield Institute of Technology, Cranfield, Beds , England) and A V Murthy (National Aeronautical Laboratory, Bangalore, India) *Aeronautical Quarterly,* vol 28, Nov 1977, p 259 264

The paper suggests a simple method of generating intermittent reservoir conditions for an intermittent cryogenic wind tunnel Approximate performance estimates are given, and it is recommended that further studies be made because this type of tunnel could be valuable in increasing the opportunities for research at high Reynolds numbers (Author)

A78-20194 **Chordwise variation of vorticity A comparison of approximations for use in panel methods** J A H Petrie (Hawker Siddeley Aviation, Ltd , Brough, Yorks , Leeds University, Leeds, England) *Aeronautical Quarterly,* vol 28, Nov 1977, p 265 270 Research supported by the Science Research Council

Based on computing efficiency, a comparison is made among three different ways of representing the chordwise variation of bound vorticity for use in panel methods Because of expense, two dimensional analogs of three dimensional models were used, and the results assumed to hold in both situations A constant panel of vorticity is found to have inherent difficulties which make it unattractive to use A linearly varying vorticity model is found to be best, but a model using line vortices is almost as good and, moreover, simpler to use (Author)

A78-20196 **A comparison of techniques for estimating STOL aircraft response to low altitude turbulence** L D Reid, A B Markov, and W O Graf (Toronto, University, Toronto, Canada) *Aeronautical Quarterly,* vol 28, Nov 1977, p 278-292 8 refs Research supported by the National Research Council and Department of the Environment of Canada

Four techniques are described which can be applied to predict the response of an aircraft (including STOL and VTOL vehicles) to wind shear and turbulence during the landing approach A comparison among the techniques is carried out by predicting the longitudinal response of a light STOL transport to atmospheric conditions within earth's planetary boundary layer The turbulence data were generated by a boundary-layer wind tunnel and by an instrumented helicopter Of the four techniques described, the flight-path correlation technique is the most recent, having been developed to handle some of the problems facing the analysis of STOL and VTOL aircraft response The other three approaches are the power spectral-density technique, the equivalent deterministic input technique, and the in flight turbulence measurement technique The practical features of each of these are outlined, and typical response predictions are plotted as a function of height during the landing approach In general terms it is concluded that the techniques requiring the greatest amount of data collection sophistication and computation (the in flight data measurement and flight-path correlation techniques) would produce the best results (Author)

A78-20201 # **Uniqueness theorem for an integral equation of a rectangular thin-section wing (Teorema edinstvennosti dlia integral'nogo uravneniia priamougol'nogo tonkogo kryla)** R V Duduchava (Akademiia Nauk Gruzinskoi SSR, Matematicheskii Institut, Tiflis, Georgian SSR) and V G Maz'ia (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) *Akademiia Nauk Gruzinskoi SSR, Soobshcheniia,* vol 87, July 1977, p 53 56 In Russian

A78-20251 # **Aerodynamic characteristics of a small-aspect-ratio rectangular wing with tip fins at subsonic speeds (Aerodinamicheskie kharakteristiki priamougol'nogo kryla malogo udlineniia s kontsevymi shaibami pri dozvukovykh skorostiakh)** S D Ermolenko, E E Pokhval'nova, and V G Khrapovitskii *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 3-8 In Russian

A thin-section small-aspect-ratio rectangular wing with rectangular end fins arranged asymmetrically with respect to the wing plane is examined The upper and lower edges of the end fins are parallel to the wing plane, and the chords of the fins and the wing chord are identical The wing is assumed to be situated in a uniform subsonic flow at an angle of attack The problem of calculating the aerodynamic characteristics of the wing is analyzed and solved within the framework of Ermolenko's (1967) nonlinear theory of a lifting surface in subsonic flow V P

A78-20253 # **Mathematical model of the combustion-chamber filling process in a pulsating jet engine (Matematicheskaia model' protsessa napolneniia kamery sgoraniia pul'siruiushchego vozdushno-reaktivnogo dvigatelia)** E P Polevichek *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 24-33 In Russian

The combustion chamber recharging process in a pulsating jet engine with a mechanically operated inlet valve and an open nozzle is analyzed, and a mathematical model of the process is proposed In its general form, the model includes seven equations with dimensionless parameters The structure of the model is illustrated by a block diagram of the system The solutions of the mathematical model can be used to optimize the combustion-chamber recharging process by proper selection of the design and operating parameters of the chamber V P

A78-20255 # **Determination of the type of rotating stall in an axial compressor stage (K opredeleniiu tipa vrashchaiushchegosia sryva v stupeni osevogo kompressora)** G V Pavlenko and V P Gerasimenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 36-39 6 refs In Russian

In the experiments described in the present paper, the conditions leading partial and complete rotating stall in an axial compressor stage were investigated It is shown that neither the relative hub diameter nor the blade aspect ratio define uniquely the type of rotating stall In stages with a relative hub diameter of 0 5 and in isolated rotors with blades of aspect ratio of roughly 3, it proved possible to obtain complete or partial rotating stall, depending on the load distribution along the blades V P

A78-20256 # **Dynamics of a string accelerometer (K dinamike strunnogo akselerometra)** N I Brekhin, A A Kovalenko, V P Molchanov, and V T Fesenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 40-42 In Russian

The factors responsible for the observed effect of synchronization of the natural frequencies of accelerometer bracings are analyzed Some conclusions concerning the influence of the sensitive element oscillations on the synchronization of the natural frequencies are deduced from an analysis of the law governing the motion of the sensitive elements V P

A78-20259 # **Designing the elements of a structure of a given guaranteed indestructibility (K voprosu proektirovaniia elementov konstruktsii zadannoi garantii nerazrushimosti)** L A Malashenko and T P Tsepliaeva *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 49-56 7 refs In Russian

Some aspects of the feasibility of using probabilistic methods in strength and stiffness calculations are discussed An expression relating the guaranteed indestructibility to the characteristic indestructibility and the safety factor is derived The safety factor is calculated with allowance for a random normal distribution of the load parameters, mechanical characteristics, and element dimensions for various loading schemes at a certain guaranteed indestructibility V P

A78-20261 # **Checking the effectiveness of negative allowance in blush bolted joints in aircraft structures (Issledovanie effektivnosti natiaga v potainykh boltovykh soedineniiakh samoletnykh konstruktsii)** L D Arson, A G Grebenikov, and V N Zheldochenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 62-65 In Russian

A78-20262 # **Improved design for two-sided bolted joints under symmetric loading (Utochnennyi raschet dvukhsreznykh boltovykh soedinenii pri simmetrichnom nagruzhenii)** V I Riabkov, I N Volokh, and V M Riabchenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 66-71 In Russian

A78-20263 # **Experimental investigation of the abrasive wear resistance of composites (Eksperimental'nye issledovaniia kharakteristik aeroabrazivnoi iznosostoikosti kompozitsionnykh materialov)** V E Gaidachuk, A F Pil'nik, and A A Rassokha *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 71 74 In Russian

Abrasion was studied with a number of representative fiber strengthened plastics and also with some binder materials Test revealed the presence of a certain 'run in' period in which the time-dependence of abrasive wear differs from the steady state conditions, and in which the wear of a composite is defined by the properties of the binder The wear of composites is found to appreciably exceed that of the binders, hence aerobrasive wear depends essentially on the properties of the fibers and on the technological parameters of composite production Steady-state wear of both composites and binders is characterized by a linear dependence of wear on time V P

A78-20264 # **Experimental method of determining the elastic characteristics of flight vehicles (Metodika eksperimental'nogo opredeleniia uprugikh kharakteristik letatel'nykh apparatov)** A A Kirpikin and D A Pinchuk *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 80-85 In Russian

Experimental determination of rigidities and influence coefficients for actual aircraft structures is complicated by the difficulty of measuring the elastic strains In the present paper, a method is proposed for determining linear and angular elastic displacements, bending and torsional rigidities, and flexure influence coefficients from strain gage data The method holds for structures amenable to representation by the design diagram of a thin-walled beam V P

A78-20267 # **Computer aided statistical analysis of the stress-strain state of load-carrying structures (Statisticheskii analiz napriazhennogo sostoianiia nesushchikh konstruktsii s pomoshch'iu EVM)** V I Parasiuk and N A Shelomov *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 98-102 5 refs In Russian

The application of determinate mathematical models to computer-aided static testing of the load-carrying elements of complex structures is discussed The method proposed makes it possible to determine the influence of a large number of simultaneously acting random parameters on the statistical properties of the stress and strain components V P

A78-20268 # **Machine algorithm for determining the cross sectional parameters of end-fairings of wing and tail assembly (Mashinnyi algoritm opredeleniia parametrov sechenii kontsevykh obtekatelei kryla i operenia)** S M Zamalin and M A Zaidenvarg *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 102-104 In Russian

A78-20273 # **Investigation of the efficiency of dehydrating jet fuel in the monocoque fuel tank of an AN-24 aircraft while the aircraft is on the ground (Issledovanie effektivnosti obezvozhivaniia reaktivnogo topliva v bake-kessone samoleta AN-24 v nazemnykh usloviiakh)** Zh S Chernenko, V T Vasilenko, and A S Rabor-

shchuk *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 41, 1977, p 137-140 In Russian

The paper describes the testing of a procedure for dehydrating jet fuel in a wing tank while the aircraft is on the ground Dry air is bubbled through the fuel The equipment is described, and the effects of temperature, amount of moisture, and rate of air blowing are determined Conditions for satisfactory performance are explained Supplementary laboratory results are reported, and the problems caused by water in fuel are discussed M L

A78-20275 # **Aerodynamic characteristics of a system of airfoil profiles (Aerodinamicheskie kharakteristiki sistem profilei)** L G Sanzharevskii and V A Semenchin *Samoletostroenie Tekhnika Vozdushnogo Flota,* no 42, 1977, p 9 12 In Russian

Consideration is given to the potential flow past a system of airfoil profiles, the aim of the study being to determine the aerodynamic moment and lift coefficients of one of the profiles The problem is solved by a method involving superposition of a rectilinear uniform flow on a flow with vortices which are continuously distributed with a specified density along the contours of all the profiles B J

A78-20277 # **Calculation of the induction of wind tunnels (K raschetu induktsii aerodinamicheskikh trub)** V I Kholiavko *Samoletostroenie Tekhnika Vozdushnogo Flota,* no 42, 1977, p 22 27 In Russian

The theory of thin bodies and the theory of flow past optimal lifting systems are used to obtain formulas for calculating the effect of flow boundaries in the working section of a wind tunnel on aerodynamic characteristics - lift, position of the barycenter, and the force of inductive resistance The existence of two analogies is found (1) an analogy with plane shock wave problems for closed wind tunnels, and (2) an analogy of supersonic flow past an optimal body for open tunnels B J

A78-20279 # **Simplified theoretical model of combustion in the chamber of a pulsed jet engine (Uproshchennaia teoreticheskaia model' protsessa goreniia v kamere sgoraniia pul'siruiushchego vozdushno-reaktivnogo dvigatelia)** E P Polevichek *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 34-40 In Russian

In an analysis of combustion in a pulsed jet engine, it is assumed that the combustion does not take place evenly in the bulk of the cylindrical chamber, but that it is concentrated in a comparatively narrow flame front, which propagates from the ignition source through the chamber It is further assumed that the combustible mixture and the combustion products are ideal gases, that there is no heat transfer among these ideal gases, that pressure is evenly distributed in the chamber, and that the temperature of the ideal gases is constant Formulas are obtained for determining combustion pressures, rates of pressure increase, and maximum pressure B J

A78-20284 # **Fast algorithm for calculating a family of wing structures (Bystrodeistvuiushchii algoritm rascheta odnogo semeistva kryl'evykh konstruktsii)** G G Kul'chenko, V D Pervak, V M Riabchenko, and V G Stopkevich *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 68-73 6 refs In Russian

A fast finite element algorithm is proposed for calculating the aerodynamic forces (horizontal, vertical and shear) on a wing of longeron rib configuration The computation is performed in three stages (1) the static stress state is constructed on the basis of the theory of thin rods, (2) self-equilibrated stress states, localized on small sections of the wing, are chosen as extra unknowns, and (3) matrix coefficients are claculated The method developed here can be used to calculate the wing as a whole, as well as the separate substructures of a complex wing B J

A78-20286 # **Load-bearing capacity of a single-contour thin rod during the combined action of transverse force and bending moment (Nesushchaia sposobnost' odnozamknutogo tonkostennogo sterzhnia pri sovmestnom deistvii poperechnoi sily i izgibaiushchego momenta)** V K Zolotukhin and M P L'vov *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 92-96 5 refs In Russian

A78-20287 # **Finite difference equations for the computation of the stress-strain state of rib-reinforced cylindrical shells (Konechnoraznostnye uravneniia dlia rascheta napriazhenno-deformirovannogo sostoianiia rebristykh tsilindricheskikh obolochek)** G D Gavrilenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 102-106 In Russian

A78-20288 # **Method for evaluating the effect of the mass of the mechanism for actuating high-speed pneumatic machines for the pressure working of materials on the motion parameters of machine parts (Metodika otsenki vliianiia mass mekhanizma vzvedeniia vysokoskorostnykh pnevmomekhanicheskikh mashin dlia obrabotki materialov davleniem na parametry dvizheniia zven'ev mashin)** V G Kononenko, V P Tsyganov, A S Morgolenko, and G D Selivanov *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 107-116 6 refs In Russian

A78-20289 # **Determination of the constants of the diffusion theory of fatigue fracture (K opredeleniiu konstant diffuzionnoi teorii ustalostnogo razrusheniia)** V E Gaidachuk and A A Rassokha *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 117-119 In Russian

Formulas are presented describing fracture associated with static loading and long-term and fatigue damage, based on the diffusion theory (Alekseev, 1972) of fatigue fracture Relationships, obtained via a unified approach to fracture under different load conditions, make it possible to determine constants of the theory of fatigue fracture on the basis of static fracture experiments B J

A78-20290 # **Calculation of a double-thread groove seal (K raschetu vintokanavochnykh uplotnenii s dvoinoi narezkoi)** A V Dobrovol'skii *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 119-124 7 refs In Russian

A physical model is presented for fluid flow characteristics in a viscous double-thread seal for rectangular grooves Consideration is given to the effects of seal geometry on the boundary of transition from laminar to turbulent flow In application to a pump, flow in the grooves is considered to consist of Poiseuille and Coutte flows Sealing coefficients are calculated in the turbulent regime for different values of critical Reynolds number B J

A78-20291 # **Investigation of the quality of airframe force-structures and optimal technical decisions during production planning (Issledovanie kachestva sborki silovykh konstruktsii planera samoleta i vybor optimal'nykh tekhnicheskikh reshenii pri podgotovke proizvodstva)** V G Kononenko, Iu A Boborykin, A I Babushkin, and A N Bereziuk *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 136-142 In Russian

Mathematical-logic models of the preparation of airframe force-substructures for assembly are used to obtain equations coupling prescribed assembly requirements to structural quality This quality is characterized by the magnitude of assembly errors and residual stresses in the parts, as well as by such structural factors as tolerances and elastic properties of airframe parts and the parameters of assembly tooling The analysis makes it possible to establish a procedure for making optimal decisions with respect to the algorithmization and complex evaluation of factors of assembly B J

A78-20292 # **Determination of velocity fields of displacement and deformation during the forming of thin and very thin profiles (Opredelenie polei skorostei peremeshcheniia i deformatsii pri formoobrazovanii tonkostennykh i osobotonkostennykh profilei)** N M Vorontsov and A F Etenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 42, 1977, p 143-147 In Russian

A78-20301 # **Procedure for computerizing stability calculations during establishment of force element dimensions for thin-wall aircraft construction (Mekhanizatsiia rascheta na prochnost' pri ustanovlenii razmerov silovykh elementov tonkostennykh aviakonstruktsii)** Iu V Vasil'ev *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol 22, May-June 1977, p 415-429 9 refs In Russian

The paper develops applications of a calculation procedure described earlier (Vasil'ev, 1977) Logical schemes are presented for calculating semi-monocoque aircraft construction force components of the first and of the second type Numerical examples of parameter calculation for thin-wall aircraft construction are presented The concept of the mean specific weight of construction is defined, and the significance of a certain integral type for different cross sections is considered M L

A78-20372 # **A method for calculating the flow around arbitrary airfoil sections with separation** M Hayashi and E Endo (Kyushu University, Fukuoka, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions,* vol 20, Oct 1977, p 113-124 13 refs

A modified wake source method for two dimensional incompressible potential flow external to an arbitrary airfoil section and its wake is presented The wake is replaced by source flow, and the strength of sources and circulation about the airfoil are determined by conditions of separation points The flow inside the separated streamlines is ignored and the base pressure is assumed constant at the separation value By combining this method with boundary layer calculations for the attached part of the flow, the pressure distributions, the maximum lift coefficient of arbitrary airfoil sections and its dependence on Reynolds number can be calculated Comparisons of the theory with experimental data and other theories are presented for several airfoil sections (Author)

A78-20373 # **Effects of spanwise circulation distribution on a limit of circulatory lift on wings with finite span** M Sato (Osaka Prefecture, University, Sakai, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions,* vol 20, Oct 1977, p 125 137 19 refs

Earlier investigations on the theoretical maximum value of the circulatory lift for a straight wing with high aspect ratio have mostly been limited to the case of the elliptical circulation distribution along the wing span In this paper, the maximum limit value for circulatory lift and other related aerodynamic characteristics are analyzed theoretically for the cases of various spanwise circulation distribu tions and the elliptical form The results show that the maximum lift value and other characteristics are considerably influenced by the form of the spanwise circulation distribution, and in particular it may be expected that, in a slightly fuller distribution than the elliptical form, the maximum value of the circulatory lift will become larger than that in the elliptical distribution (Author)

A78-20374 # **Gust response experiments of an airplane dynamic model in the NAL gust wind tunnel** H Nishimura and H Matsushita (National Aerospace Laboratory, Tokyo, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions,* vol 20, Oct 1977, p 138-150 7 refs

A summarized report of the gust response experiments per formed in the NAL (National Aerospace Laboratory) gust wind tunnel is presented The tunnel has been constructed and operated since 1972 It has a 2-meter-by-2-meter cross section and a maximum velocity of about 50 meters per sec For the gust response experiments, a section equipped with cascade gust generator was provided, and, in the wind tunnel airstream, regulated vertical gusts from pulse to random patterns are generated As the first step, short period response simulations and related unsteady aerodynamic force measurements are carried out using a 0 1 scaled semi-similar dynamic airplane model For comparison with the experimental results, several analysis systems including a practical formula or synthesized formulas are examined From the results of both experiments and analysis, it is confirmed that the semi-free flight experiments in the wind tunnel are suitable for practical use Some other topics and problems concerning the present experiments are added in conclusion (Author)

A78-20375 # **Performance calculation for multi-element airfoil sections with separation** M Hayashi and E Endo (Kyushu University, Fukuoka, Japan) *(Symposium on Aircraft, Fukuoka, Japan, Nov 18, 1976) Japan Society for Aeronautical and Space Sciences, Transactions,* vol 20, Oct 1977, p 151 164 14 refs

A performance calculation method for multi-element airfoil sections with separation is described in this paper The potential flow analysis is based on a distributed-singularity method which uses linear-vortex and constant source distributions The wake is replaced by source flow representing its displacement effect The strength of source is given by an experimental relation derived from tangential directions at separation point The circulation about each airfoil is determined by conditions of upper and lower separation points The flow inside the separation streamlines is ignored and the base pressure is assumed constant at the separation value By combining this potential flow analysis with boundary layer calculations for the attached part of flow, the pressure distribution over airfoil surface, the maximum lift coefficient of multi-element airfoil sections, and its dependence on Reynolds number can be calculated Comparisons of the present method with experimental data and other methods are presented for several airfoil sections The predicted curves of aerodynamic coefficients for two airfoil section (one with a slat and a slotted flap) are compared with experiments (Author)

A78-20390 **Using surface plastic deformation to increase the fatigue strength of aircraft gas-turbine compressor disks** B M Agishev, A A Elantsev, and N V Moiseenkov *(Problemy Prochnosti,* Mar 1977, p 114-116) *Strength of Materials,* vol 9, no 3, Dec 10, 1977, p 363-365 Translation

Crack nucleation and propagation patterns characteristic of first stage disks made of 30 KhGSA and EI961Sh steel and of 0KhN3M-steel disks of the two last stages of low-pressure compressors are examined and are attributed to fatigue It is shown how this delinquency could be eliminated by rolling and shot peening V P

A78-20402 **Problems of rating the life of aircraft design elements in random loading** E S Pereverzev (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Dnepropetrovsk, Ukrainian SSR) *(Problemy Prochnosti,* Apr 1977, p 70 73) *Strength of Materials,* vol 9, no 4, Dec 20, 1977, p 452 457 7 refs Translation

The stability of sound waves in a polytropic atmosphere with thermal diffusion is discussed Analytical results are obtained using the quasi-adiabatic approximation, and the consequences of using the optically thin and optically thick approximations are compared An example is given of overstability with a subadiabatic temperature gradient The quasi adiabatic results are compared with fully non-adiabatic numerical results, using a model of the 5-min oscillation of the sun (Author)

A78-20459 # **Method for calculating the aerodynamic coefficients of some three-dimensional bodies of arbitrary cross section (Metod rascheta aerodinamicheskikh koeffitsientov nekotorykh ob'emnykh tel s proizvol'nym poperechnym secheniem)** G G Skiba and B N Fedotov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov Dec 1977, p 92 98 In Russian

Using the computer aided method proposed for calculating the aerodynamic coefficients of bodies of arbitrary cross section, the problem can be reduced to the solution of a nonlinear and a linear system of equations for the proper boundary conditions The procedure is illustrated by applying it to bodies of various shape and aspect ratio The results obtained by this method are shown to correlate well with the experiment V P

A78-20462 # **Asymptotic theory of a wing moving at small distances from a solid wall (Asimptoticheskaia teoriia kryla, dvizhushchegosia na malykh rasstoianiiakh ot tverdoi stenki)** K V

Rozhdestvenskii *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Nov Dec 1977, p 115 124 5 refs In Russian

In the present paper, the method of matched asymptotic expansions is applied to the approximate solution of the problem of unsteady motion of a lifting surface in ground effect The flow region is conditionally broken down into characteristic zones in which asymptotic expansions for the velocity potential are obtained in the corresponding coordinates, the expansions are then matched in regions of general validity In the first approximation (very small flight altitudes), the problem is reduced to the solution of the Poisson equation in a plane bounded by the planform of the wing for boundary conditions obtained by matching V P

A78-20469 # **Influence of acoustic reflectors on the discrete component of the noise spectrum of a supersonic jet above the critical pressure (Vliianie akusticheskikh otrazhatelei na diskretnuiu sostavliaiushchuiu v spektre shuma sverkhzvukovoi neraschetnoi strui)** A N Antonov, S P Shalaev, and M Ia Iudelovich *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Nov Dec 1977, p 157-160 7 refs In Russian

A78-20479 **In search of a better approach concept - MLS and HUD** T F Walby (Eastern Air Lines, Inc , Miami, Fla) *Aviation Research Journal*, vol 2, July 1977, p 5 16 16 refs

Attention is given to the Instrument Landing System (ILS), noting the ground equipment involved and prospects for its worldwide use by 1985 The Interim Standard Microwave Landing System (ISMLS) is proposed as a transition from the present ILS to the future Microwave Landing System (MLS) The MLS concept is also discussed in terms of navigating two-segment approaches and it is suggested that such methods may yield reduced urban noise The development of Head Up Displays (HUD), which are presently available in military aircraft, is suggested for civil aviation In conclusion, it is felt that a combined MLS-HUD system may provide an optimum approach for future very low visibility approach operations S C S

A78-20480 **The FAA Wind Shear Research and Development Program - A status report** F G Coons and E Mandel (FAA, Systems Research and Development Service, Washington, D C) *Aviation Research Journal*, vol 2, July 1977, p 17 25 9 refs

Wind shear, a weather phenomenon of considerable importance in terms of air carrier accidents, is discussed with regard to the FAA Wind Shear Program Research efforts into the meteorological conditions giving rise to hazardous low level wind shear are noted, and the factors involved when an aircraft enters a low-level wind shear are identified Two ground based wind shear detection systems are described a near-term detection technique and an advanced warning system Consideration is also given to airborne systems used in collecting data on wind shear Such programs involve airborne equipment development, manned flight simulations, and actual airborne data collection Procedures in the development of wind shear data management are reviewed along with the integration of wind shear systems and data into the National Airspace System S C S

A78-20481 **ORLY - A minicomputer-based instrument flight training simulator** G Lukas, W Feurzeig, and D Cohen (Bolt Beranek, and Newman, Inc , Cambridge, Mass) *Aviation Research Journal*, vol 2, July 1977, p 55 65 Contract No N61339-74-C-0081, No N61339 75-C-0104, No N61339-76-C 0046

The ORLY system is an instrument flight training simulator based on a minicomputer Its dynamics and display are updated ten frames per second and the simulation runs at twice actual time A student flight may be recorded on a removable plate A flexible system for flight parameter display provides the charting of various prespecified sets of measures (such as altitude, heading, airspeed, pitch, bank, etc) as a function of time Over 150 student pilot flights on ORLY have been recorded S C S

A78 20482 **A new approach to future airport planning** E M Wefati *Aviation Research Journal*, vol 2, July 1977, p 79-86 8 refs

The article provides a broad discussion of airport planning concerns with reference to statistics from various American, British, and French airports The growth in air traffic during the past two decades is described in terms of French facilities Consideration is given to the problem of access to airports, noting that airport design and operation must be integrated into other means of mass transportation S C S

A78-20523 # **A high-frequency reverse-flow fluidic self-cleaning fuel filter** G Orloff (Lucas Aerospace, Ltd , Shirley, Surrey, England) *Lucas Engineering Review*, vol 7, Sept 1977, p 9-18

Attention is given to a self-cleaning fine-filter method which supplies a subsidiary servo-control fuel flow to sensitive components Experimental pressure-test and contamination investigations are discussed, and pressure losses are analyzed It is found that the fluidic filter has significant advantages over normal velocity-cleaned filters, although further research will be needed to minimize total pressure losses and outlet pressure ripples S C S

A78-20592 # **Transient response of a rotor in damped bearings** W D Pilkey (Virginia, University, Charlottesville, Va), J S Strenkowski (Battelle Memorial Institute, Columbus, Ohio), and P Y Chang (Hydronautics, Inc , Laurel, Md) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77 DET-21* 9 p 10 refs Members, $1 50, nonmembers, $3 00 Army-supported research

The transient response of a general rotor with a finite number of in-span bearings incorporating stiffness, dampness, and mass properties is evaluated using a damped modal analysis that involves linearly superposing the mode shapes corresponding to a damped eigenvalue problem The rotating shaft is examined by modeling it as a series of lumped masses and intervening massless elastic sections and by employing transfer matrices A numerical example of a rotor on isotropic bearings subjected to a sawtooth displacement at the bearing foundation is treated S D

A78-20593 # **Some experiments on instability of rotors supported in fluid-film bearings** J Tonnesen and J W Lund (Danmarks Tekniske Hojskole, Lyngby, Denmark) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77-DET-23* 9 p 11 refs Members, $1 50, nonmembers, $3 00

Experiments are conducted on two rotors, weighing 40 and 187 5 kg, respectively, and supported in cylindrical bearings with two axial grooves The journal position in the bearing is measured by built-in capacitance displacement probes, and the dynamic behavior is monitored by pressure probes The self-excited whirl at the threshold speed of instability, as well as the influence of unbalance on the whirl frequency, is investigated in detail By adding damping at the supports, the heavier rotor is stabilized and operated up to 330 Hz Correlation with theoretical predictions is presented (Author)

A78-20595 # **Analysis and experimental investigation of the stability of intershaft squeeze film dampers II - Control of instability** D H Hibner, P N Bansal, and D F Buono (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77 DET-26* 5 p 5 refs Members, $1 50, nonmembers, $3 00

A stability analysis was developed for a dual rotor test rig with an intershaft squeeze film damper, the rig was designed to model the dynamics of a two-spool gas turbine engine Since previous evidence indicated that the rotating squeeze film could drive the two-rotor system into an incontrollable whirl amplitude, a spring in parallel with the damper was employed to drive the instability onset speed beyond the operating speed range of the rig Linearized stability analyses and experimental results demonstrated the effectiveness of the modification J M B

A78-20598 # **An experimental study of the steady-state response of oil film dampers** R K Sharma and M Botman (Pratt and Whitney Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77 DET-33* 6 p 7 refs Members, $1 50, nonmembers, $3 00 Army-supported research

An experimental study was conducted to evaluate the influence of radial clearance, unbalance and inlet oil pressure on the performance of a central groove oil-film damper for both concentric and eccentric orbits An attachment to offset the rotor radially by helical springs was included to simulate gravity effects on the vertical rotor arrangement It is shown that the effect of radial springs on the steady-state response of the damper is only significant at low speeds where it tends to increase the transmissibility, and that for deflections less than half the damper clearance any eccentricity in the orbit does not affect the loads and deflections However, dampers with a large radial clearance display lower transmissibility The low values of the damping coefficient at higher speeds are partly attributed to the reduced viscosity of oil at high temperatures S D

A78-20607 # **The rigidity and performance of a helicopter gearbox with a cantilevered housing and two taper roller bearings** M M A Taha, E M M Ettles (Imperial College of Science and Technology, London, England), and P B MacPherson (Westland Helicopters, Ltd , Yeovil, England) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26 30, 1977, Paper 77-DET 103* 7 p Members, $1 50, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

A theoretical study has been made to determine the rigidity and performance of a helicopter gearbox with a cantilevered housing and two taper roller bearings Due to the interaction of the deflection of all component parts such as gears, shafts, bearings, casings, spacers, etc , it was necessary to consider these in combination rather than individually A computer program has been developed for analyzing a typical helicopter type input pinion assembly in which the pinion is supported by a pair of taper roller bearings This program is suitable for determining the influence that various factors exert on the rigidity of the pinion and the performance of the bearings and which would be difficult to consider by other means Typically the influence of endfloat or preload, misalignment of the races, casing and shaft deflection, wall thickness of the casing and the hollow shaft, and the spacing between bearings are all considered The program is now being used as a basis for design optimization in terms of bearing lives and pinion stiffness (Author)

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STAR ENTRIES

N78-13998*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

AERODYNAMIC CHARACTERISTICS OF A SMALL-SCALE STRAIGHT AND SWEPT-BACK WING WITH KNEE-BLOWN JET FLAPS

Gilbert G Morehouse William T Eckert and Robert A Boles (Lockheed-Georgia Co Marietta) Oct 1977 125 p refs
(NASA-TM-78427 A-7161) Avail NTIS HC A06/MF A01 CSCL 01A

Two sting-mounted 50 8 cm (20 in) span knee-blown jet-flap models were tested in a large (2 1- by 2 5-m (7- by 10-ft) subsonic wind tunnel A straight- and swept-wing model were tested with fixed flap deflection with various combinations of full-span leading-edge slats The swept-wing model was also tested with wing tip extensions Data were taken at angles-of-attack between 0 deg and 40 deg at dynamic pressures between 143 6 N/sq m (3 lb/sq ft) and 239 4 N/sq m (5 lb/sq ft), and at Reynolds numbers (based on wing chord) ranging from 100 000 to 132 000 Jet flap momentum blowing coefficients up to 10 were used Lift drag and pitching-moment coefficients, and exit flow profiles for the flap blowing are presented in graphical form without analysis Author

N78-13999# General Dynamics/Convair San Diego, Calif

CALCULATIONS OF SOME UNSTEADY TRANSONIC FLOWS ABOUT THE NACA 64A006 AND 64A010 AIRFOILS Final Report, Nov 1975 - Apr 1977

R J Magnus Jul 1977 98 p refs
(Contract F33615-76-C-3018)
(AD-A046178 AFFDL-TR-77-46) Avail NTIS HC A05/MF A01 CSCL 01/3

Unsteady transonic flows over airfoils were calculated using a program based on the unsteady Euler equations The approximate numerical solutions were obtained using an explicit (Lax-Wendroff) difference scheme Calculations were made for the 64A006 airfoil at zero angle-of-attack in flows with Mach number 0 822, 0 854 and 0 875 Three unsteady flows caused by a quarter-chord flap oscillating with an amplitude on the order of one degree at specific reduced frequencies (k = omega C/U sub infinity) near 0 4 were analyzed The results were compared with other available calculations and the experimental data of Tijdeman Responses for an airfoil in a ventilated-wall wind tunnel rather than in a free-stream were also calculated Exploratory study of the changes to be expected with a weakened shock (an attempt to simulate a main effect of the interaction of the shock with airfoil boundary layer) was done for one case at Mach number 0875 Oscillatory flows over the 64A010 airfoil at zero angle-of-attack in a Mach 0 80 stream were also calculated Plunging motion at reduced frequency 0 4 and pitching motions at reduced frequencies 0 4 and 0 5 were calculated
Author (GRA)

N78-14000# Vought Corp Dallas Tex

INVESTIGATION OF A VARIABLE CAMBER WING DESIGN Final Report, Jul 1976 - May 1977

T D Beatty, W B Brooks and L D Robinson May 1977 189 p refs
(Contract N62269-76-C-0361)
(AD-A045951, NADC-76114-30 Rept-2-53300/7R-5977) Avail NTIS HC A09/MF A01 CSCL 20/4

The principal objective of this NASC sponsored investigation involved definition of the buffet free transonic maneuvering benefits derivable from an innovative skewed hingeline variable camber wing design concept These benefits have been established from comparisons of the predicted performance obtainable with this camber concept with those of conventional uncambered and fixed camber wing designs in a common aircraft application The aircraft configuration considered in these performance comparisons was selected as representative of an advanced lightweight fighter aircraft Wing aerodynamic characteristics for the differing aircraft configurations were established from analysis of experimental data available from prior test programs Analytical methods were utilized to aid in the analysis required to evaluate the influence of Reynolds number and test installation interference effects upon the experimental results For the aircraft configuration of this study program, it was found that substantial improvements to buffet-free performance could be attained from implementation of this camber concept For subsonic flight conditions the maximum buffet free performance was attained with a camber scheduling which also yielded minimum drag At transonic conditions however greatest improvements in buffet free performance was achieved only with wing camber configurations producing aircraft drag levels above the minimum GRA

N78-14001# Georgia Inst of Tech, Atlanta School of Aerospace Engineering

A NUMERICAL STUDY OF VISCOUS FLOWS AROUND AIRFOILS Interim Report

J C Wu S Sampath and L N Sankar Sep 1977 21 p refs Presented at AGARD Fluid Dyn Panel Symp on Unsteady Aerodyn, 26-28 Sep 1977 Ottawa, Canada
(Contract N00014-75-C-0249 NE Proj 061-226)
(AD-A046084) Avail NTIS HC A02/MF A01 CSCL 20/4

The application of an integro-differential approach in the numerical study of unsteady viscous flows about airfoils is described Two different procedures are presented A procedure based on a stream function-vorticity formulation and on a transformation technique is used in a study of a flow about an impulsively started 9% thick Joukowski airfoil at an angle of attack of 15 deg and a Reynolds number of 1000 Numerical results are presented and compared with available finite-difference results A second procedure based on a velocity-vorticity formulation and on a hybrid finite difference-finite element technique is used in a study of a flow about an oscillating 12% thick Joukowski airfoil at a Reynolds number of 1000 With either procedure the unique ability of the integro-differential approach to confine the solution field to the vortical region of the flow is utilized It is shown that this ability offers great computational advantages Author (GRA)

N78-14002# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Hauptabt Flugbetrieb

SUPPORTING INVESTIGATIONS DURING TESTING OF THE WDL-1 AIRSHIP IN GHANA AND UPPER VOLTA [BERICHT UEBER BEGLEITENDE UNTERSUCHUNGEN BEI DER ERPROBUNG DES LUFTSCHIFFES WDL-1 IN GHANA UND OBERVOLTA]

A Lickleder 1976 45 p refs In GERMAN
(DLR-IB-536-76/3) Avail NTIS HC A03/MF A01

Test flights were made in July and August 1976 in Ghana and the Upper Volta with an airship (blimp) with a view to using this means of transportation in countries not having sufficiently developed infrastructure A day-to-day report is given of the flight and measurements concerning hull temperature, filling gas (He) temperature and atmospheric and biological effects on hull and control surfaces are reported Operational problems are also dealt with ESA

N78-14003# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Hauptabt Flugbetrieb

CALCULATION OF HORIZONTAL TAIL LOADS IN MANEUVERING FLIGHT

Jean Skudridakis Dec 1976 129 p refs In GERMAN ENGLISH summary

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

Horizontal tail loads in maneuvering flight conditions as a result of different kinds of stabilizer inputs were calculated To achieve a reasonable approach to the problem the complete longitudinal set of equations of motion were simplified with respect to the degrees of freedom of the system which were significantly reduced from 6 to 3 or 2 degrees With these simplifications a solution of equations of motions was obtained by analog computer, numerical integration, or by Laplace transforms A detailed set of elevator input time histories and referring equations is presented The application of these sets may help to establish conditions which are as close as possible to reality for the calculation of horizontal tail loads with respect to different airworthiness standards and design instructions The influence of elasticity of the airplane structure is discussed briefly Author (ESA)

N78-14008# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Abt Theoretische Aerodynamik

THE THICKNESS DISTRIBUTION OF PROFILES FOR SHOCK-FREE FLOW WITHOUT LIFT [UNTERSUCHUNGEN UEBER DIE DICKENVERTEILUNG VON PROFILEN BEI STOSSFREIER UMSTROEMUNG OHNE AUFTRIEB]

H Hansen Jun 1977 26 p refs In GERMAN Prepared jointly with MBB Hamburg

(DLR-IB-151-77/9) Avail NTIS HC A03/MF A01

The maximum obtainable airfoil profile thickness for the simplest supercritical roof-top pressure distributions was determined using systematic exemplary calculations with the profile design method based on the integral method These thick profiles with shock-free supercritical flow are especially suitable for application to transport aircraft The maximum thickness limits found are in good agreement with empirical estimations ESA

N78-14011# Technische Hogeschool, Delft (Netherlands) Dept of Aerospace Engineering

DESCRIPTION OF A FIVE-PARAMETER PROFILE FAMILY [BESCHRIJVING VAN EEN VIJFPARAMETER PROFIELFAMILIE]

J J H Blom May 1976 115 p refs In DUTCH

(VTH-LR-220) Avail NTIS HC A06/MF A01

The five-parameter mapping method of Geckeler-Mueller, for airfoil profiles is discussed This method is based on a von Karman-Trefftz transformation of an ellipse and is simpler to handle than the von Mises method Joukowsky, von Karman-Trefftz but also S-shaped, von Mises-like profiles can be obtained depending on the choice of the available parameters These three profile families are examined The conditions the mapping function needs to satisfy as well as the requirement for steady profile behavior are discussed The two profile families designed by Mueller are analyzed ESA

N78-14015# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik

NUMERICAL CALCULATION OF UNSTEADY AERODYNAMIC PRESSURE DISTRIBUTION ON HARMONICALLY OSCILLATING WINGS IN SUBSONIC FLOW THEORY AND RESULTS FOR COMPRESSIBLE FLOW, PART 2

Wolfgang Geissler 22 Apr 1977 52 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-430)

(DLR-FB-77-15) Avail NTIS HC A04/MF A01 DFVLR Cologne DM 25 90

A numerical method to calculate the unsteady pressure and force distributions on harmonically oscillating three-dimensional wings with control surfaces in subsonic flow is presented This panel-method is based on the velocity potential and has the advantage that local unsteady lift and moment coefficients necessary for flutter investigations can be determined in a simple and sufficient way The numerical method for compressible flow is described in detail and numerous results and comparisons with other methods and with experimental data are presented Author (ESA)

N78-14017# Payne Inc Annapolis Md

DEVELOPMENT OF AN ULTRA HIGH LEVEL AIRDROP CONTAINER CONCEPT Final Report, Jun 1974 - May 1977

Peter R Payne Sep 1977 24 p

(Contract DAAK03-74-C-0197)

(AD-A046156, Working-Paper-138-11) Avail NTIS HC A02/MF A01 CSCL 13/4

A study was undertaken to determine the form and aerodynamic characteristics of an airdrop container capable of achieving a specified accuracy when dropped from ultra-high levels This study resulted in a final design for a semi-streamline aeroshell which was shown to meet the limited technical criteria on which the program was based During the program, half-scale models were dropped from helicopters at Natick, and wind-tunnel tested in the University of Maryland Glenn L Martin Wind Tunnel A six-degree-of freedom trajectory program was assembled and proven It is now available for a statistical analysis of delivery accuracy Author (GRA)

N78-14018# Naval Air Development Center Warminster Pa Dept of Crew Systems

EJECTION UNDER DECELERATION

Russell L Sanford and Kenneth L Miller 16 Aug 1977 35 p refs

(WF1451402)

(AD-A046117 NADC-77209-40) Avail NTIS HC A03/MF A01 CSCL 01/3

The objective of this test program was to investigate the phenomenon of decelerative forces on the ESCAPAC 1A-1 ejection seat installed in the U S Navy A-4A B, C and E series attack aircraft This phenomenon may be encountered for example during actual ejection attempts coincident with loss of control on take-off coupled with heavy breaking, skidding and/or failure of the nosegear or one main landing gear Decelerative forces may also be present during arrested landings on carriers as well as emergency arrestments on hard-surfaced runways It is concluded that serious attention should be given to revising the technique presently incorporated in the ESCAPAC 1A-1 ejection seat for effecting seat/man separation Particular emphasis should be placed upon possible relocation of the SNUBBER line attachment points of the ejection seat which, it is felt, contributed to the unsatisfactory seat/man separation characteristics demonstrated in this program The reason for the repeated failure of the SNUBBER weak links to function properly should also be determined Additionally, consideration should be given to replacing the present DART/SNUBBER stabilization-seat/man separation subsystem with a current state-of-the-art subsystem that relies neither upon physical connections to the aircraft nor time lapse dynamic displacement corrective momentum inputs to achieve seat stabilization GRA

N78-14019# Battelle Pacific Northwest Labs, Richland Wash

ASSESSMENT OF THE RISK OF TRANSPORTING PLUTONIUM DIOXIDE BY CARGO AIRCRAFT

T I McSweeney and J F Johnson Jun 1977 165 p refs

(Contract EY-76-C-06-1830)

(BNWL-2030) Avail NTIS HC A08/MF A01

The characteristics of the nuclear economy used in this analysis are A total of 18 metric tons (MT) of plutonium is shipped annually, via the mode being evaluated 100 kg of plutonium are transported per shipment The average shipping distance per shipment is 1 422 miles with 14 percent of the distance being by truck Plutonium dioxide was assumed to be carried exclusively in the 15-gal version of the 6M container Based on the shipping assumptions the likelihood that an aircraft carrying a shipment will be involved in an accident is estimated to be about once in 450 years For the projected shipping rate in the early 1980s the likelihood of a release of plutonium as

a result of shipment by air is one in 900 years for dioxide powder in the 6M container The comparison of the truck and air transport modes for the same material showed truck transport to have less risk At the same time the air transport of plutonium dioxide was demonstrated to have a lower risk than other commonly accepted societal risks ERA

N78-14020# Royal Aircraft Establishment Farnborough (England)
STATISTICAL AND FLIGHT DYNAMIC STUDIES ON CONFLICT DETECTION AND RESOLUTION IN CIVIL AVIATION
Otto Weber May 1977 115 p refs Transl into ENGLISH of Statistische und Flugmechanische Untersuchungen zur Visuellen Konfliktentdeckung und -Loesung im Luftverkehr Rept DLR-FB-75-71 DFVLR West Ger 1975
(RAE-Lib-Trans-1903 BR59443 DLR-FB-75-71) Avail NTIS HC A06/MF A01

Conflict detection and resolution by the see and avoid concept are considered American and German statistics on mid-air and near mid-air collisions are discussed For flights without acceleration basic geometrical and physical aspects of conflict detection are derived and details given on the angles of vision from the pilot to the other aircraft and on blind spots Horizontal evasive maneuvers are analyzed in detail and their effectiveness is presented in many graphs Two observation error models are described and their influences on the distances are estimated where horizontal evasive maneuvers are possible Vertical maneuvers are treated concisely and some tentative suggestions to the improvement of flight safety are made Author

N78-14021*# Cutler-Hammer Inc Farmingdale, N Y AIL Div
MICROWAVE SCANNING BEAM LANDING SYSTEM, GROUND STATION PERFORMANCE TEST REPORT VOLUME 1 EXECUTIVE SUMMARY
20 Aug 1977 17 p
(Contract NAS9-14543)
(NASA-CR-151582 JSC-11525-Vol-1) Avail NTIS HC A02/MF A01 CSCL 17G

Conclusions and recommendations are presented based on data evaluation as developed to date and detailed in Engineering Test Summary Reports Author

N78-14022# Lincoln Lab Mass Inst of Tech Lexington
DABS COVERAGE
S I Krich 16 Aug 1977 89 p refs
(Contracts DOT-FA72WAI-261 F19628-76-C-0002)
(AD-A045940 ATC-75 FAA-RD-77-77) Avail NTIS HC A05/MF A01 CSCL 01/2

The DABS coverage within CONUS was projected on a statistical or percent coverage basis by purely geometrical considerations Results are given for CONUS the eastern half of the U S and for the Golden Triangle Profile coverage (line-of-sight coverage down to) is given for the Boston-NYC-Washington corridor Author

N78-14023# Federal Aviation Administration Washington D C Office of Systems Engineering Management
A PRELIMINARY EVALUATION OF THE ATCRBS SIGNAL FORMAT FOR THE BCAS DATA LINK
E J Koenke P M Ebert W H Harman N A Spencer and A Weinberg Aug 1977 40 p
(AD-A046164 FAA-EM-77-9 W46-0273) Avail NTIS HC A03/MF A01 CSCL 01/2

The integrity of the ATCRBS signal format for the BCAS data link was evaluated based on measurements of the actual RF environment today simulations of sophisticated signal processors and basic calculations The conclusions reached by the task force all relate to achieving a high integrity data link tailored to the BCAS application and were derived from tests run on the DABS ground-based reply processor-they are the following Results show that (1) a data link with a high degree of error protection coding is essential, (2) multiple transmissions are essential and (3) a two-way data link is highly desirable from the point of view of the coordination logic Author

N78-14025# IIT Research Inst Annapolis Md
COMPUTER SIMULATIONS OF ATCRBS PROCESSING EQUIPMENT FOR USE WITH THE AIMS AND TRANSIENT EFFECTS PERFORMANCE PREDICTION MODELS Final Report
C Randall Crawford Jan 1976 48 p refs
(Contract DOT-FA70WAI-175 F-19628-76-C-0017 AF Proj 649E)
(AD-A046758 ECAC-PR-75-062 FAA-RD-76-102) Avail NTIS HC A03/MF A01 CSCL 17/7

The transient effects PPM is a pulse-by-pulse simulation of ATCRBS operation which was developed to assist in the investigation of the short-term or transient phenomena of ATCRBS performance The pulse-by-pulse correlation technique of the defruiter the functions of the analog decoder and the target-detection and code validation functions of the digital processor have been incorporated into these models The models which were developed for the AIMS PPM provide predictions of equipment performance in terms of probabilities of target detection and code validation Author

N78-14026# Transportation Systems Center, Cambridge Mass
AIR TRAFFIC CONTROL EXPERIMENTATION AND EVALUATION WITH THE NASA ATS-6 SATELLITE VOLUME 1 EXECUTIVE SUMMARY Final Report, Sep 1973 - Dec 1975
Sejfi Protopapa Aug 1977 43 p
(Contract DOT-TSC-707-1)
(AD-A046509 D6-44052-Vol-1 FAA-RD-75-173-Vol-1) Avail NTIS HC A03/MF A01 CSCL 17/7

The ATS 6 satellite was used in tests designed to collect satellite-aircraft signal propagation data evaluate L-band avionics hardware designs and perform preliminary satellite voice and data communications demonstration tests in support of the AEROSAT program which proposes to eliminate communication gaps between aircraft enroute in oceanic airspace and continental air traffic control facilities Technology tests described include multipath channel characterization (oceanic and overland) modem tests of voice data and ranging and aircraft antenna tests Voice modem intelligibility scores digital data bit error rates and ranging modem performance are presented parametrically as functions of C/N and S/I Experimentally derived gain and multipath rejection performance data are given for the slot-dipole phased-array and patch antennas for various aircraft/satellite geometries Author

N78-14028# National Aviation Facilities Experimental Center Atlantic City N J
BEACON COLLISION AVOIDANCE SYSTEM (BCAS), ACTIVE MODE Interim Report, Mar 1975 - Jul 1976
Maurice Cohen and Charles Richardson Oct 1977 35 p
(AD-A046757 FAA-NA-77-11 FAA-RD-77-98) Avail NTIS HC A03/MF A01 CSCL 17/7

The active mode of the beacon collision avoidance system (BCAS) through its initial phase is described as well as the hardware and theory of operation The system performance and accuracy during feasibility flight tests are discussed This is a ground-independent air-to-air system activated by airborne omnidirectional ATCRBS mode C interrogations occurring at a rate of 2 per second Range and altitude are obtained for each aircraft replying within a 32-nmi radius Range and altitude rates are computed and approaching aircraft are tracked The cockpit CAS display warns the pilot of aircraft crossing with adequate altitude separation and gives a command to climb or dive if the intruding aircraft is at or near the same altitude Warnings and/or commands are provided 30 seconds before range minimum System performance was evaluated during test encounters with 400 ft altitude separation Performance and accuracy analysis was derived from BCAS and ARTS III magnetic tape and from the tracking phototheodolites over the measurement range Author

N78-14029# Lincoln Lab Mass Inst of Tech, Lexington
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Apr - 30 Jun 1977

1 Jul 1977 13 p
(Contracts DOT-FA72WAI-261 F19628-76-C-0002 FAA Proj 034-241-012)
(AD-A046580 FAA-RD-77-107) Avail NTIS HC A02/MF A01 CSCL 17/7

Topics covered include restructuring the DABS national standard, the prototype sensor back-to-back antenna ARIES diagnostic software and all hardware site characteristic measurements and DABS netting experiments A R H

N78-14031*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
WIND-TUNNEL INVESTIGATION OF THE AERODYNAMIC PERFORMANCE, STEADY AND VIBRATORY LOADS, SURFACE TEMPERATURES AND ACOUSTIC CHARACTERISTICS OF A LARGE-SCALE TWIN-ENGINE UPPER-SURFACE BLOWN JET-FLAP CONFIGURATION
Nov 1975 163 p refs
(NASA-TM-X-72794) Avail NTIS HC A08/MF A01 CSCL 01C

Tests have been conducted in full-scale tunnel to determine the aerodynamic performance, steady and vibratory aerodynamic loads surface temperatures and acoustic characteristics of a large scale twin turbofan engine upper surface blown jet-flap configuration The tests were made for an angle of attack range from -6 deg to 28 deg and a thrust coefficient range from 0 to 4 for trailing edge flap deflections of 32 deg and 72 deg Author

N78-14032# Royal Aircraft Establishment Farnborough (England)
ICING PROBLEMS ON HELICOPTER ROTORS
H Bestek Jun 1977 11 p Transl into ENGLISH from DFVLR Nachrichten (West Germany) Apr 1972 p 236-238
(BR59303 RAE-Trans-1912) Avail NTIS HC A02/MF A01

Water trapping at any particular point on a rotor blade is influenced by atmospheric conditions as well as by flow characteristics at the blade The shape of the ice deposits is determined mainly by the equilibrium temperature at the blade surface The effects of icing on the flying properties of helicopters is discussed and the effectiveness of anti-icing and deicing systems are explored The use of plastic coatings for blade surface treatment to reduce the adhesion of ice deposits is assessed A R H

N78-14033# Federal Aviation Administration Moffett Field Calif Flight Simulation Branch
CERTIFICATION STUDY OF A DERIVATIVE MODEL OF A SMALL JET TRANSPORT AIRPLANE USING A PILOTED RESEARCH SIMULATOR Final Report
Raymond D Forrest Jun 1977 86 p refs
(AD-A046442 FAA-RD-77-105) Avail NTIS HC A05/MF A01 CSCL 01/3

The flight simulator for advanced aircraft at Ames Research Center was used to evaluate the flying qualities of a small jet transport and those of a derivative model of that airplane Technical criteria that piloted simulations must meet to enable their increased use for demonstrating compliance with transport category aircraft airworthiness requirements were defined Flying-qualities data were obtained for numerous test configurations and conditions using conventional certification flight test procedures These data correlated well with the basic airplane data from the manufacturer s certification test report Analysis of the simulator data show valid results in critical test cases such as the demonstration of static longitudinal stability and minimum control speed with confidence that all influencing and limiting factors were identified An important aspect was the accurate simulation of the control force-feel qualities of the reversible flight control system The simulator was judged to have duplicated actual flight results with a high degree of confidence Author

N78-14035# Boeing Commercial Airplane Co Seattle Wash
DESIGN AND ANALYSIS OF WINGLETS FOR MILITARY AIRCRAFT, PHASE 2 Final Report, Jun - Nov 1976
K K Ishimitsu and D F Zanton May 1977 131 p refs
(Contract F33615-75-C-3123)
(AD-A046152 D6-45090 AFFDL-TR-77-23) Avail NTIS HC A07/MF A01 CSCL 01/3

A study of the design and analysis of winglets for military aircraft has been completed This study is a continuation of the work reported in AFFDL-TR-76-6 The program consisted of investigating analytically the AFFDL/Boeing winglet on the take-off and landing configuration of the KC-135A Also investigated analytically were the effect of a wing leading-edge device on the performance of the AFFDL/Boeing winglet and the design of a compromise high-speed/low-speed winglet Two wind tunnel tests were conducted by the NASA-Langley Research Center 8-foot transonic tunnel A high-speed and low-speed test were conducted to determine the effect of the AFFDL/Boeing winglets on the KC-135A s aerodynamic performance and longitudinal and lateral-direction stability A preliminary plan for a KC-135A winglet retrofit program was developed and its cost estimated Based on a 1979 program start the retrofit costs would be recovered by the start of 1984 GRA

N78-14037# Hughes Helicopters Culver City Calif
FLIGHT TEST OF A COMPOSITE MULTI-TUBULAR SPAR MAIN ROTOR BLADE ON THE AH-1G HELICOPTER VOLUME 1 MATERIALS, DESIGN AND TEST Final Report, Jun 1974 - Jan 1977
Robert E Head Aug 1977 327 p refs
(Contract DAAJ02-74-C-0055 AY968263)
(AD-A046176, HH-76-281-Vol-1
USAAMRDL-TR-77-19A-Vol-1) Avail NTIS HC A15/MF A01 CSCL 01/3

The objectives of this program were to design a composite main rotor blade in the multi-tubular spar configuration to be directly interchangeable (in pairs) with the production metal (540) blades on the AH-1G helicopter have increased fatigue life invulnerability to the 23mm ballistic threat, low radar cross section and low fabrication cost Manufacturing technology was developed and described in a Process Specification Laboratory ground and flight tests demonstrated that the wet-filament wound co-cured blade met, and in some cases surpassed all objectives and could be adapted for Army service Author (GRA)

N78-14038# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
INCREASING THE SURVIVABILITY OF COMBAT AIRCRAFT
A Tumanov 1 Feb 1977 13 p Transl into ENGLISH from Aviatsiya i Kosmonavtika (USSR) no 4 Apr 1968 p 51-53
(AD-A045910 FTD-ID(RS)I-0094-77) Avail NTIS HC A02/MF A01 CSCL 01/3

It was only possible to armor aircraft after a new type of armor was created This was a lighter form of armor which was considerably more bullet-resistant than that for tanks and ships GRA

N78-14041# National Swedish Road and Traffic Research Inst Linkoeping
ROLLING RESISTANCE OF AIRCRAFT WHEELS IN DRY SNOW
Bo Kihlgren 1977 36 p In SWEDISH ENGLISH summary
(VTI-128) Avail NTIS HC A03/MF A01

Measurements were carried out for the rolling resistance of an aircraft wheel caused by dry snow The wheel was equipped with a tire of the dimension 12 50-16 which is used on aircrafts of types CV-440 and N-262 The measurements were carried out at a static wheel load of 38 800 N (3 960 kp) and a tire air pressure of 410 kPa (60 psi) and 550 kPa (80 psi) respectively Speed during the measurements was 50 km/h The rolling resistance seems to increase approximately proportionally to the increase of the snow depth at a constant tire air pressure Increased tire air pressure causes a decrease of the rolling resistance This effect indicates that tires with high air pressure should be used on aircraft wheels when taking off from snow-covered areas, even if the load on the wheels does not require a high tire air pressure Measurements were also carried out for the rolling resistance of a tire of the dimension 7 50-14 caused by dry

snow at different speeds This tire is especially intended for friction measurements (ASTM tire) These measurements were performed at a static wheel load of 4 800 N (490 kp) and at speeds of 50 65 and 80 km/h The rolling resistance seems to increase proportionally to the increase of the speed within the interval of speed used The influence of the speed on the rolling resistance seems to be greater in deep snow than in thin snow Author (ESA)

N78-14042# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept

LOW-SPEED WIND-TUNNEL TESTS OF THE LONGITUDINAL STABILITY CHARACTERISTICS OF SOME SWEPT-WING QUIET AIRBUS CONFIGURATIONS

D A Kirby and A G Hepworth London Aeron Res Council 1977 93 p refs Supersedes RAE-TR-76029 ARC-36825 (ARC-R/M-3801 RAE-TR-76029 ARC-36825) Avail NTIS HC A05/MF A01 HMSO £7 PHI $26 85

Measurements of lift drag and pitching moment were made on model configurations representing rear-engined layouts with large nacelles so positioned that both wing and tailplane will make a contribution to noise shielding Only round nacelles were used with a high-wing model but both round and flat types of nacelle were tested on a low-wing model The investigation concentrated on the effects of the large lifting surfaces of the nacelles on the longitudinal stability and performance under the high-lift conditions appropriate to take-off and landing the nacelles were not powered so the influence of the jet efflux was excluded The results show that the influence of the nacelles on the downwash at the tailplane is such as to offset the lift losses and longitudinal stability changes incurred by adding the nacelles to models without tailplane so that for the complete models the stability changes were small and the effects on performance only became appreciable when the flat nacelles were tilted several degrees nose down with a landing-flap setting Included in the test program were measurements of the distribution of total head at a hypothetical engine face inside the round nacelles for a number of model configurations and conditions Author (ESA)

N78-14043# Bristol Univ (England) Dept of Aeronautical Engineering

CONSTRUCTION AND TESTING OF A CARBON FIBRE PRIMARY STRUCTURE FOR A MAN-POWERED AIRCRAFT WING B S Thesis

P G M Heppel and E C Leaver Jun 1977 67 p refs (BU-208) Avail NTIS HC A04/MF A01

A box framework typical of that found in the wing of a man-powered aircraft was built using carbon fiber reinforced sandwich members The structure was analyzed as a pin-jointed frame using the finite element method and the results were compared with those obtained from a statically determinate solution Aeroelastic problems such as wing divergence and aileron reversal were also studied The framework was found to be 32% lighter than the equivalent one in spruce When tested the structure failed at a load which was 23% lower than anticipated Suggestions are made for improving the strength of the structure Author (ESA)

N78-14044# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Flugmechanik der Flaechenflugzeuge

DETERMINATION OF DYNAMIC CHARACTERISTICS FROM FLIGHT TEST DATA

Martin Marchand 20 Jun 1977 23 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT-434)

(DLR-FB-77-26) Avail NTIS HC A02/MF A01 DFVLR Cologne DM 13 20

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

N78-14045# Arizona State Univ Tempe Dept of Educational Psychology

ASSESSING INSTRUMENT SENSITIVITY FOR HEADING AND ATTITUDE INFORMATION Interim Report

Raymond W Kulhavy Richard F Schmid and Raymond S Dean Aug 1977 15 p refs

(Contract F41609-75-C-0028)

(AD-A046065 AFHRL-TR-77-2) Avail NTIS HC A02/MF A01 CSCL 01/4

The three studies described in this report concerned the assessment of procedures which influence instrument sensitivity in military flight instruction The ability to determine the relative location of an in-flight vehicle from a set of dial indicators was influenced more by students expectations than by context Sensitivity to heading and attitude information was increased when learners were supplied with overt attention control The teaching of instrument sensitivity appears best facilitated by employing publicly observable responses during training and seems to be a function of the degree to which the learner can be directed to use a spacial processing mechanism during initial encoding Author (GRA)

N78-14046# Elliott-Automation Space and Advanced Military Systems Ltd , Camberley (England)

AVIONICS AND THE MRCA

J E Daboo 1977 27 p Presented at I E E 16 Mar 1977 Avail NTIS HC A03/MF A01

A broad description of the avionics system of the Multi Role Combat Aircraft (MRCA) now known as the Tornado is given and some aspects of the avionics development activities and of the management organization in the multinational environment are mentioned The emphasis is on the avionics for the primary interdiction/strike role The MRCA project has been undertaken jointly by the United Kingdom the Federal Republic of Germany and Italy The major facilities provided by the avionics system are navigation weapon delivery, automatic flight control communications/identification navigation/approach aids defensive aids recording and checkout/monitoring ESA

N78-14047*# Solar Turbines International San Diego, Calif

WIDE RANGE OPERATION OF ADVANCED LOW NOx COMBUSTORS FOR SUPERSONIC HIGH-ALTITUDE AIRCRAFT GAS TURBINES Technical Report, Nov 1975 - Aug 1977

P B Roberts and R J FioRito Oct 1977 44 p

(Contract NAS3-19770)

(NASA-CR-135297 RDR-1817-22) Avail NTIS HC A03/MF A01 CSCL 21E

An initial rig program tested the Jet Induced Circulation (JIC) and Vortex Air Blast (VAB) systems in small can combustor configurations for NOx emissions at a simulated high altitude, supersonic cruise condition The VAB combustor demonstrated the capability of meeting the NOx goal of 1 0 g NO2/kg fuel at the cruise condition In addition the program served to demonstrate the limited low-emissions range available from the lean, premixed combustor A follow-on effort was concerned with the problem of operating these lean premixed combustors with acceptable emissions at simulated engine idle conditions Various techniques have been demonstrated that allow satisfactory operation on both the JIC and VAB combustors at idle with CO emissions below 20 g/kg fuel The VAB combustor was limited by flashback/autoignition phenomena at the cruise conditions to a pressure of 8 atmospheres The JIC combustor was operated up to the full design cruise pressure of 14 atmospheres without encountering an autoignition limitation although the NOx levels in the 2-3 g NO2/kg fuel range, exceeded the program goal Author

N78-14048# Advisory Group for Aerospace Research and Development Paris (France)

TECHNICAL EVALUATION REPORT ON THE 49TH(B) PROPULSION AND ENERGETICS SPECIALISTS MEETING ON POWER PLANT RELIABILITY

G P Sallee (Pratt and Whitney Aircraft Group East Hartford Conn) Nov 1977 11 p refs Meeting held at The Hague 31 Mar - 1 Apr 1977

(AGARD-AR-110 ISBN-92-835-0207-8) Avail NTIS HC A02/MF A01

The following observations reflect the tone of the meeting and the major results (1) Engine reliability is not satisfactory in either commercial or military services In particular the newer commercial engines are not living up to operators expectations (2) It seems that civil and military authorities are considering the promulgation of more stringent requirements and standards concerning the development certification/qualification and acquisition of future engines with respect to the reliability requirements that must be met (3) Manufacturers are designing for improved maintainability and employing improved testing techniques to expose problems early Further progress is contingent on the availability of engineering data on actual engine usage in military service Detailed part failure data is needed to determine the causes for part failure with respect to usage and the relationships that exist between the various modes of failure (4) The economic impact of military engine unreliability has not been discussed The cost consequences of premature engine removals aborts, part failures etc are needed to establish the role of engine reliability in engine life cycle cost (5) The growth of engine health monitoring in the commercial airlines and the increased experimentation of such approaches in the military are indicative of the serious consequences of poor engine reliability The future growth/potential for such techniques is impressive Author

N78-14049# Douglas Aircraft Co , Inc Long Beach Calif
STUDY TO IMPROVE AIRFRAME TURBINE ENGINE ROTOR BLADE CONTAINMENT Final Report
C O Gunderson Jul 1977 234 p
(Contract DOT-FA76WA-3843)
(AD-A046255 MDC-J7615 FAA-RD-77-44) Avail NTIS HC A11/MF A01 CSCL 21/5

Energies and trajectories for a range of fan, compressor and turbine blade fragments from high bypass ratio fan engines used in typical 3 and 4 engine wide body airplanes were evaluated The weight for local armor was established The effects of fan blade fragment impacts for areas up to 30 deg forward of the fan plane of rotation were investigated Simulated titanium blade fragments and various inlet and nacelle materials were used in tests to determine energy absorption capabilities The effects of fragment impact angles size and rotation and penetration characteristics with steel and aluminum honeycomb sheet steel multiple steel layers and Kevlar aramid fiber material containment systems were explored The effect of added weight for airframe installed armor on fuel burned and fuel cost was estimated In view of the adequacy of prevailing installation practices further armor for the range of fragments considered would not appear to significantly enhance flight safety Author

N78-14050# North Carolina State Univ , Raleigh Engineering Design Center
EFFECT OF INLET DISTORTION ON PERFORMANCE OF A COMPRESSOR STAGE PART 1 PNEUMATIC DATA
L W Hardin, W C Griffith, J N Perkins and F O Carta Apr 1977 117 p
(Contract F44620-76-C-0055)
(AD-A046055 NCSU/EDC-77-1, AFOSR-77-1238TR) Avail NTIS HC A06/MF A01 CSCL 13/7

An experimental investigation into the effects of inlet distortion on an isolated turbomachine rotor was conducted The data obtained from pneumatic instrumentation was analyzed to gain insight into both the overall stage performance and the flow field of an individual rotor blade The results indicate that the unsteadiness introduced by the distortion increases blade normal force and stage pressure rise While undergoing inlet distortion it was found that the rotor does not locally follow the undistorted pressure loss characteristic Entry into rotating stall results in an abrupt decrease in the stage pressure rise A definite hysteresis loop is evident for the stalling and unstalling of the rotor A more complete understanding of the inlet distortion and rotating stall phenomena requires unsteady measurements which will be discussed in a subsequent report Author (GRA)

N78-14051# Southwest Research Inst , San Antonio Tex Army Fuels and Lubricants Research Lab
ENGINE LUBRICANT REQUIREMENTS FOR REMOTELY PILOTED VEHICLES (RPV) Final Report
H W Marbach Jr and John A Russell Sep 1977 28 p refs
(Contract DAAK02-73-C-0221)
(AD-A046238, AFLRL-85) Avail NTIS HC A03/MF A01 CSCL 11/8

The Army is exploring the feasibility of using Remotely Piloted Vehicles (RPV s) in a multi-mission role Powerplants for these RPV s are to be small two-stroke air-cooled reciprocating engines which require a fuel/oil mix for operation As no federal or military specification lubricant exists for this application, this report details results of an analytical/experimental investigation to evaluate the suitability of existing MIL SPEC lubricant classes for Army RPV use GRA

N78-14052# Advisory Group for Aerospace Research and Development, Paris (France)
TECHNICAL EVALUATION REPORT ON THE 49TH(A) PROPULSION AND ENERGETICS PANEL SPECIALISTS' MEETING ON SECONDARY FLOWS IN TURBOMACHINES
K Papailiou (Ecole Centrale de Lyon) Nov 1977 11 p refs Meeting held at The Hague, 28-30 Mar 1977
(AGARD-AR-109 ISBN-92-835-1263-4) Avail NTIS HC A02/MF A01

Problems dealing with secondary flows in turbomachinery were investigated in a total of fifteen invited papers and seven short presentations followed by a round table discussion Theoretical works covered earlier research on secondary flow effects in compressors and turbines Most of the presentations described experimental results Techniques used include probe surveys, laser velocimetry, and several forms of flow visualization Author

N78-14053 Princeton Univ N J
EFFECTS OF CONTROL AND DISPLAY PARAMETERS ON PILOTED VTOL DECELERATING INSTRUMENT APPROACH Ph D Thesis
Jean Victor Lebacqz 1977 252 p
Avail Univ Microfilms Order No 77-19176

The influence of aircraft control system and displayed information characteristics on VTOL descending decelerating instrument transitions is discussed The guidance relationships for a representative terminal area VTOL task consisting of a constant (0 05g) decelerating transition on a steep glide slope (7 5 degrees) from 100 knots to the hover completely on instruments are developed including the need for and design of velocity commands which switch from air-referenced to ground-referenced and a configuration change command It is found that a trade-off in terms of pilot rating exists between control system complexity and display sophistication for generic levels of each that explicit display of translational velocity information is required for satisfactory flying qualities regardless of control augmentation and that an angular-rate-augmentation-only control system is unsatisfactory regardless of displayed information level Dissert Abstr

N78-14054*# Lehigh Univ Bethlehem Pa Dept of Mechanical Engineering and Mechanics
AIRCRAFT MODEL PROTOTYPES WHICH HAVE SPECIFIED HANDLING-QUALITY TIME HISTORIES Final Report
S H Johnson Jan 1978 51 p refs
(Grant NsG-4005)
(NASA-CR-143848) Avail NTIS HC A04/MF A01 CSCL 01C

Several techniques for obtaining linear constant-coefficient airplane models from specified handling-quality time histories are discussed The pseudodata method solves the basic problem yields specified eigenvalues and accommodates state-variable transfer-function zero suppression The algebraic equations to be solved are bilinear at worst The disadvantages are reduced generality and no assurance that the resulting model will be airplane like in detail The method is fully illustrated for a fourth-order stability-axis small motion model with three lateral handling quality time histories specified The FORTRAN program which obtains and verifies the model is included and fully documented Author

N78-14055*# Boeing Commercial Airplane Co Seattle Wash
FLIGHT CONTROL ELECTRONICS RELIABILITY/ MAINTENANCE STUDY
W W Dade R H Edwards G T Katt K L McClellan and H A Shomber Dec 1977 364 p refs
(Contract NAS1-13654)
(NASA-CR-145271 D6-46346) Avail NTIS HC A16/MF A01 CSCL 01C

Collection and analysis of data are reported that concern the reliability and maintenance experience of flight control system electronics currently in use on passenger carrying jet aircraft Two airlines B-747 airplane fleets were analyzed to assess the component reliability system functional reliability and achieved availability of the CAT II configuration flight control system Also assessed were the costs generated by this system in the categories of spare equipment schedule irregularity and line and shop maintenance The results indicate that although there is a marked difference in the geographic location and route pattern between the airlines studied there is a close similarity in the reliability and the maintenance costs associated with the flight control electronics Author

N78-14056# Aeronautical Systems Div Wright-Patterson AFB Ohio
MILITARY TRANSPORT (C-141) FLY-BY-WIRE PROGRAM Final Report, Sep 1972 - May 1974
James A Lackey Mar 1977 63 p
(AD-A046163 ASD-TR-77-8) Avail NTIS HC A04/MF A01 CSCL 01/3

The C-141 Fly-By-Wire Test Program was an in depth study of the control laws and parameters governing large transports handling qualities The test aircraft was C-141A S/N 61-2779 belonging to the 4950th Flight Test Wing Wright-Patterson Air Force Base Ohio This aircraft was modified to include a dual redundant Fly-By-Wire Flight Control System in parallel with the standard manual flight control system The aircraft was flown using a side stick controller located on the copilot s right armrest The FBW Flight Control System was a two axes system pitch and roll No yaw control was provided except through the auto-pilot where coordinated roll to yaw inputs to the FBW Flight Control System were made The C-141 FBW system had three modes of operation a rate command mode and two attitude hold modes attitude command and control-stick steering GRA

N78-14057# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
AN EXPOSITION ON AIRCRAFT RESPONSE TO ATMOSPHERIC TURBULENCE USING POWER SPECTRAL DENSITY ANALYSIS TECHNIQUES Final Technical Report, Oct 1975 - Aug 1976
Elijah W Turner May 1977 73 p refs
(AF Proj 1367)
(AD-A046108 AFFDL-TR-76-162) Avail NTIS HC A04/MF A01 CSCL 01/3

The traditional power spectral density design procedure is reviewed The evolution of modeling atmospheric turbulence is traced from the discrete gust to the present continuous representation The modeling of an aircraft structure as a lumped parameter linear system excited by oscillatory air forces is outlined and solutions to the resulting equations of motion are indicated Expressions for the number of exceedances of specified load levels are presented and compared for stationary Gaussian turbulence and for stationary Gaussian patch turbulence The motivation for modeling atmospheric turbulence as a nonstationary process is addressed and several models for nonstationary turbulence are reviewed Author (GRA)

N78-14058# Instrument Flight Center Randolph AFB Tex
THREE-CUE HELICOPTER FLIGHT DIRECTOR EVALUATION
Jul 1977 89 p
(AD-A046261 USAFIFC-TR-77-3) Avail NTIS HC A05/MF A01 CSCL 01/4

This report covers the work accomplished during an inflight investigation concerning the evaluation of the changes in pilot performance control activity and biochemical changes while flying with various display configurations of a helicopter Three-Cue Flight Director System Flights were conducted in the TH-1F helicopter The subject pilots participating in the study consisted of both instructor pilots and pilots attending the Instrument Pilot Instructor School (IPIS) GRA

N78-14059# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Dynamik der Flugsysteme
CONTROL LAW DESIGN TECHNIQUES
W Hofmann G Kreisselmeier and R Sharma May 1977 36 p refs Presented at the AGARD Lecture Ser No 89 on Task-oriented Flight Control Systems London, 9-10 Jun 1977 and Dayton Ohio 14-15 Jun 1977
(DLR-IB-552-77/15) Avail NTIS HC A03/MF A01

The high performance demands of modern flight systems require the design of task-oriented flight control systems In this contribution several control law design techniques which can be applied to the design of linear flight controllers are reviewed Typical considerations and constraints which have to be taken into account by the flight control designer are stated Frequency domain and state-space based time domain design techniques are discussed with special regard to their facilities and limitations The design of longitudinal flight controllers is treated as an example Author (ESA)

N78-14062# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
THE GENERATION OF MOTION CUES ON A SIX-DEGREES-OF-FREEDOM MOTION SYSTEM
M Baarspul Jun 1977 110 p refs
(VTH-LR-248) Avail NTIS HC A06/MF A01

The mathematical formulation of motion cue generation on a six-degree-of-freedom motion base is described From the mathematical model of the simulated aircraft the specific forces and rotational accelerations at the aircraft c g are determined as primary control inputs to the motion drive laws Because the specific forces act on the pilot inside the simulator cockpit they should be transformed to the centroid location of the motion system As the motion possibilities of the moving platform are constrained filtering of the specific forces and rotational accelerations is necessary As far as possible, tilt angles are used to reproduce sustained specific forces providing the motion system with coordinated washout The scaled equations as programmed in the digital computer including values for the time constants and damping ratio of the motion filters as applied to the KSS B-747 flight simulator are presented The listing of the main motion program for the SDS Sigma 2 computer of this flight simulator is also given Author (ESA)

N78-14150# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
BRAKE-PLATES FOR AEROPLANES
Dong Sheng Lee 31 May 1977 8 p Transl into ENGLISH from Hang Kung Chih Shih (Peking), no 4 1976 p 8
(AD-A045932 FTD-ID(RS)T-0819-77) Avail NTIS HC A02/MF A01 CSCL 01/3

Brake-plates made from asbestos-plastics material in the past do not meet the needs of the modern high performance airplanes They are replaced by brake-plates made by means of powder metallurgy and other methods that guarantee excellent heat-resistance, durability operational stability and reliability This paper discusses a type of brake-plates made by means of powder metallurgy GRA

N78-14158# Royal Aircraft Establishment Farnborough (England) Structures Dept
EFFECTS OF HEAT ON FATIGUE IN AIRCRAFT STRUCTURE
J R Heath-Smith and F E Kiddle London Aeron Res Council

1977 35 p refs Presented at the 8th ICAF Symp on Probl with Fatigue in Aircraft, Lausanne Switz 2-4 Jun 1975 Supersedes RAE-TR-75131 ARC-36724
(ARC-R/M-3798 RAE-TR-75131, ARC-36724) Avail NTIS HC A03/MF A01 HMSO £14 PHI $15 30

The understanding in the UK of the effects of kinetic heating on fatigue in a'uminum alloy aircraft structure is reviewed How heating can affect subsequent fatigue at ambient temperature by softening strain-hardened material and redistributing local stress by creep is described Also discussed is 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 (ESA)

N78-14173# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
EPOXY AND POLYURETHANE PAINT COMPOSITIONS FOR AGRICULTURAL AIRPLANES
Wojciech Poninski 16 Mar 1977 28 p refs Transl into ENGLISH from Prace Inst Lotnictwa (Poland), no 62 1975 p 81-93
(AD-A045914, FTD-ID(RS)I-0198-77) Avail NTIS HC A03/MF A01 CSCL 11/9

In the article there has been presented the progress in paint materials used for agricultural airplanes that has been attained in this country in the course of twenty years In connection with the development in the world of polyurethane paint materials there have been carried through comparative investigations of the epoxy compositions currently being used with three different polyurethane compositions There has been described the methodology of the tests which included also investigations of selected materials for protecting plants (insecticides etc) as also under conditions that imitated the atmospheric influences The results achieved point to the better properties of the polyurethane compositions in comparison with the epoxy ones equally also in the presence the action of atmospheric factors as also the action of means of protecting plants (insecticides etc)
Author (GRA)

N78-14183# Army Engineer Waterways Experiment Station Vicksburg, Miss
ENGINEERING BEHAVIOR OF PAVEMENT MATERIALS STATE OF THE ART Final Report
Yu T Chou Feb 1977 414 p refs
(Contract DOT-FA73WAI-377 DA Proj 4A7-62719-AT-04)
(AD-A045272/2 AEWES-TR-S-77-9 FAA-RD-77-37) Avail NTIS HC A18/MF A01 CSCL 13/2

Pavement materials are evaluated with respect to highway and aircraft loadings and environmental conditions The materials covered are bituminous mixtures, portland cement concrete granular materials chemically stabilized soils and fine grained soils Basic properties of each are discussed For bituminous mixtures, emphasis is placed on the characteristics of permanent deformation, fatigue and rheological properties and the application to pavement design of accumulative damage theory For portland cement concrete, concrete strengths determined by various tests are discussed The fatigue property of concrete and its relationship to pavement design are elaborated For granular materials the resilient and plastic properties are analyzed Constitutive stress-strain relations consist of resilient, plastic, shear and dynamic stresses and strains For soil stabilization the mechanisms of stabilization are explained which include soil-cement soil lime lime-fly ash and lime-cement-fly ash and bituminous materials Factors influencing engineering properties and properties of stabilized soils with respect to strength modulus and fatigue are discussed Author

N78-14188# European Space Agency Paris (France)
MEAN NUMBER OF LOADS AND ACCELERATIONS IN ROLL OF AN AIRCRAFT FLYING IN TURBULENCE
Gabriel Coupry *In its* La Rech Aerospatiale, Bi-monthly Bull No 1976-6 (ESA-TT-406) Oct 1977 p 58-69 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1976-6 Nov-Dec 1976 p 333-338 Original report in FRENCH previously announced as A76-43142

Avail NTIS HC A06/MF A01

The effect of the spanwise distribution of isotropic turbulence on the mean number of loads and accelerations in roll of an airplane which is assumed to be perfectly rigid is dealt with Attention is devoted to the derivation of a transverse coherence function of turbulence, associated with the usual spectra which explains most of the discrepancies that appear in the comparison of measured and calculated transfer functions of aircraft to turbulence The use of this transverse coherence function, associated with unsteady aerodynamic theory makes it possible to calculate the Rice s integrals related to the mean number of loads and roll acceleration without any further assumption Very simple approximate formulas are proposed and comparisons of predicted and measured numbers of loads are presented for Caravelle flights Author (ESA)

N78-14212# Lincoln Lab Mass Inst of Tech Lexington
L-BAND AIR-TO-AIR MULTIPATH MEASUREMENTS
A R Paradis 6 Sep 1977 100 p refs
(Contracts DOT-FA77WAI-727 F19628-76-C00002 FAA Proj 034-241-012)
(AD-A045941 ATC-77 FAA-RD-77-87) Avail NTIS HC A05/MF A01 CSCL 20/14

A series of air to air earth scattered L-Band multipath measurements were obtained by transmitting RF pulses between two instrumented general aviation aircraft flying coaltitude diverging paths over a variety of terrain and water surfaces Multipath data were collected over grazing angles ranging from approximately 5 deg to 75 deg These measurements were used to characterize the multipath environment in which beacon based airborne collision avoidance (BCAS) equipment would operate and to investigate the merits and limitations of various degrees of antenna diversity in the rejection of multipath Author

N78-14336# Cranfield Inst of Technology (England) Aerodynamics Div
LEADING EDGE TRANSITION ON SWEPT WINGS
D I A Poll *In* AGARD Laminar-Turbulent Transition Oct 1977 11 p refs
Avail NTIS HC A17/MF A01

The behavior of the swept wing attachment line boundary layer has been studied experimentally Two dimensional trip wires and turbulent flat plate boundary layers have been used as sources of disturbance and a wide range of conditions has been covered, ensuring that the results are directly applicable to full scale flight situations Simple criteria have been deduced and those allow the state of the attachment line boundary layer to be determined for a given geometry and free stream conditions The validity of some of the principal results has been extended to high Mach numbers for the adiabatic wall case Sample calculations show that most of the present generation of civil aircraft have turbulent attachment lines in the cruise condition Although some benefit may be gained by a removal of root disturbances and the maintenance of a smooth leading edge the tolerable roughness heights are so small that it seems unlikely that turbulence can be prevented without some form of boundary layer suction Author

N78-14347# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
MOVEMENT OF A TILTED WING NEAR A SCREEN
V G Belinskiy 7 Feb 1977 17 p Transl into ENGLISH from Gidrodinamika Bolshikh Skorostey (USSR) no 4 1968 p 84-90
(AD-A045920 FTD-ID(RS)I-0040-77) Avail NTIS HC A02/MF A01 CSCL 20/4

Movement of a tilted wing under a free surface of liquid and the movement of a tilted wing with optimum circulation distribution have been studied The present work presents the results of the study of the effect of a screen on the hydrodynamic characteristics of a tilted wing An examination is made of the

linear problem of stable movement at a rate V sub zero and with an angle of attack alpha of a thin airfoil tilted at an angle beta to a plane solid screen The problem was solved using the method of the potential of acceleration GRA

N78-14348# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div

MOVEMENT OF A WING WITH A SMALL ASPECT RATIO NEAR THE INTERFACE OF FLUIDS WITH DIFFERENT DENSITIES

S I Putilin 31 Jan 1977 12 p refs Transl into ENGLISH from Gidroaerodinam Nesushchikh Poverkhn (USSR), 1966 p 61-68

(AD-A045921 FTD-ID(RS)I-0042-77) Avail NTIS HC A02/MF A01 CSCL 20/4

The problem of the movement of a wing with a small aspect ratio below a free fluid surface has been studied The integral equation for a wing with a small aspect ratio moving above the interface of fluids with different densities was obtained in a similar manner But these studies did not determine the distribution of the load over the wing chord This report will solve the problem which makes it possible to find the load distribution over the wing chord when condition lambda F r squared approaches zero is satisfied the Froude number being calculated for the wing span GRA

N78-14379# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

THE USE OF PYRANOMETERS ONBOARD AIRCRAFT

Hans P Fimpel 3 Jun 1977 40 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT-433)

(DLR-FB-77-24) Avail NTIS HC A03/MF A01 DFVLR Cologne DM 18 50

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

N78-14408# Royal Aircraft Establishment, Farnborough (England)

FATIGUE STRENGTH OF JOINTS WITH SPECIAL FASTENERS, PART 2

J J Gerharz and D Schuetz Mar 1977 25 p refs Transl into ENGLISH of 'Die Schwingfestigkeit von Feugungen mit Sonderbefestigungselementen Rept LBF-TM-74/75 Lab fuer Betriebsfestigkeit Darmstadt West Ger

(RAE-Lib-Trans-1920 BR58376 LBF-TM-74/75) Avail NTIS HC A02/MF A01

Results of fatigue tests on three types of joints made with various fatigue resistant fasteners are discussed The tests were carried out using both block program and flight simulation loading sequences The results were analyzed and the factors which influenced fatigue lives of the joints are elaborated Author

N78-14409# Royal Aircraft Establishment Farnborough (England)

THE EFFECT OF DESIGN AND PRODUCTION PARAMETERS ON THE FATIGUE STRENGTH OF JOINTS

D Shuetz and J J Gerharz May 1977 16 p refs Transl into ENGLISH of Der Einfluss von Fertigungsparametern auf die Schwinfestigkeit von Fuegungen Rept LBF-TM-72/73 Lab fuer Betriebsfestigkeit Darmstadt, West Ger

(RAE-Lib-Trans-1921 BR58839 LBF-TM-72/73) Avail NTIS HC A02/MF A01

Fatigue strengths of shear joints are studied with particular reference to local stresses and associated mechanisms The joint parameters discussed include those associated with the fastener system both geometric and assembly effects hole preparation and joint surface effects The influence of individual parameters are analyzed qualitatively, but little attempt has been made to access many of the interactive effects between the parameters Author

N78-14411# Air Force Systems Command, Wright-Patterson AFB, Ohio

HEAT-RESISTANT EQUIPMENT FOR BENDING SHAPED MATERIAL WITH ELECTRICAL HEATING

I V Korchagina and V G Borisov 21 Jan 1977 13 p Transl into ENGLISH from Tr Kaz Aviats Inst (Kazan), no 152 1973 p 15-18

(AD-A045909, FTD-ID(RS)I-1857-76) Avail NTIS HC A02/MF A01 CSCL 13/8

The improvement of airplanes has lead to expanded use in designs of shaped material of high-strength alloys which as a rule, are hard to work This has made it necessary to develop and implement new forming processes One of the most promising forming processes for shaped parts which drastically reduces labor sent in bending and finishing operations and which increases the precision of the part, is bending with tension using electrical contact heating of the billet Optimal temperature forming intervals are for aluminum and magnesium alloys 200-400 C titanium alloys OT4 500-700 C VT14 600-750 C VT20 700-900 C high-strength stainless steels 800-900 C Author (GRA)

N78-14449# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

APPLICATION OF FAILURE ANALYSIS IN AVIATION

E A B DeGraaf 19 Jan 1977 55 p refs In DUTCH, ENGLISH summary Presented at the Conf on Non-Destructive Analysis Twenthe, Neth 13-14 Apr 1977

(NLR-MP-77002-U) Avail NTIS HC A04/MF A01

The role of service failure analysis in defining new inspection procedures and adapting existing ones is illustrated by case histories It appears that in some cases this leads to a different design or choice of material The examples all taken from failure analyses conducted by the National Aerospace Laboratory NLR, include failures detected during inspections prescribed by the manufacturer failures discovered after having learned about the experience of other operators of the same type of aircraft failures discovered after an accident, and failures discovered more or less by chance Examples are also presented of supplementary investigations aimed at extending and improving the available techniques for service failure analysis Author (ESA)

N78-14691# Defense Documentation Center Alexandria Va

ENVIRONMENTAL POLLUTION NOISE POLLUTION-NOISE EFFECTS ON HUMAN PERFORMANCE

Jun 1977 325 p Supersedes DDC-TAS-71-39-1 and DDC-TAS-73-69

(AD-A041600 DDC/BIB-77/077) Avail NTIS HC A14/MF A01 CSCL 06/19

This bibliography is a selection of unclassified and unlimited distribution references on Noise Pollution-Noise Effects on Human Performance These citations of reports present information on noise effects on human performance such as motor reactions hearing speech sleep perception nervous systems visual signals and fatigue Corporate Author-Monitoring Agency Subject Title and Personal Author are provided Author (GRA)

N78-14763# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

TEST REPORT ON THE APPLICATION OF THE LINDE FOG REMOVAL EQUIPMENT AT THE ERDING AIR BASE [ERPROBUNGSBERICHT UEBER DEN EINSATZ DER LINDE-ENTNEBELUNGSAPPARATUR AUF DEM FLIEGERHORST ERDING]

H Willeke and F Katheder May 1975 59 p refs In GERMAN Sponsored by Bundesamt fuer Wehrtech u Beschaffung

(DLR-IB-75/8) Avail NTIS HC A04/MF A01

With the Linde apparatus atmospheric air is dried and heated It was found that wind has the strongest influnece because it

carries away the purified air masses With a head wind or cross wind of 2 knots the apparatus is effective only for short stretches necessitating the need for fog removal equipment at both sides of the runway Under calm conditions a 50 m large runway can be kept free of fog over 200 to 250 meters ESA

N78-14874# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering

DESCRIPTION OF NOISE MEASUREMENT AND ANALYSIS PROCEDURES DEVELOPED FOR LIGHT GENERAL AVIATION AIRCRAFT

D W Andrews and D W Durenberger Apr 1977 82 p refs (VTH-LR-246) Avail NTIS HC A05/MF A01

The equipment flight test procedures, and analysis methods used in the aircraft noise research program at the university are described It is intended as a summary of techniques and a guide for establishing future programs In this program the idea has been to make accurate, systematic sound measurements of representative general aviation aircraft during level and climbing flyovers to determine sound time histories and calculate peak noise levels and other sound related parameters The results of these measurements are given in other Delft memorandums and may be useful in affecting design or operational changes in light aircraft Author (ESA)

N78-14895# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

SOME RESULTS OF TESTS ON THE HELICOPTER-TANK AND TANK-HELICOPTER VISIBILITY UNDER IDEALIZED CONDITIONS

H -E Hoffmann and R H Buell 11 Jun 1975 35 p refs In GERMAN, ENGLISH summary

(DLR-IB-553-75/9) Avail NTIS HC A03/MF A01

The maximum detection range and the maximum recognition range air-to-ground and ground-to-air were determined A Leopard tank a radio truck and a special test board were oberved from a Bell UH 1D helicopter and a Do 27 airplane The maximum detection range ground-to-air was between 6 and 12 km larger than the maximum detection range air-to-ground For the maximum detection range ground-to-air values between 9 and 16 km and for the maximum detection range air-to-ground values between 2 and 4 km were obtained The maximum recognition range air-to-ground was up to 2 km smaller than the maximum detection range At observation of the special test board the maximum detection range was smaller than the obervation of the radio truck The tests took place at horizontal standard visibilities between 36 and 57 km Author (ESA)

N78-14986# European Space Agency Paris (France)

CONVECTION AND REFRACTION OF ACOUSTIC WAVES IN AN OPEN WIND TUNNEL FLOW

Sebastien Candel and Alain Guedel *In its* La Rech Aerospatiale, Bi-monthly Bull No 1976-5 (ESA-TT-405) Oct 1977 p 31-63 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1976-5 Sep -Oct 1976 p 269-288 Original report in FRENCH previously announced as A77-16147

Avail NTIS HC A06/MF A01

Experimental and theoretical results of a study of acoustic propagation in an open wind tunnel are described The analysis is principally concerned with the modification of source radiation by a uniform flow and the refraction effects occurring in the shear layer due to the existence of a mean velocity gradient These phenomena are characterized experimentally by measuring the mean field phase and amplitude Analysis of the phase functions indicates the geometrical nature of the propagation and justifies the reliance on the geometrical approximation for the prediction of the sound field For the sound source submerged in the wind tunnel jet this method, combined with an analysis of the modification of the radiation pattern inside the flow is used to calculate the amplitude distributions outside the flow Author (ESA)

N78-14992# European Space Agency Paris (France)

RESEARCH ON UNSTEADY TURBULENT BOUNDARY LAYERS

Jean Cousteix Andre Desopper, and R Houdeville *In its* La Rech Aerospatiale, Bi-monthly Bull No 1977-3 (ESA-TT415) Sep 1977 p 71-96 refs Transl into ENGLISH from La Rech Aerospatiale, Bull Bimestriel (Paris), no 1977-3, May-Jun 1977 p 167-177 Original report in FRENCH previously announced as A77-28936

Avail NTIS HC A08/MF A01

The unsteady-state turbulent boundary layer on a fixed wall subjected to a pulsating external flow was studied in an experimental setup involving a periodic flow produced by a rotating butterfly located in the diffuser of an Eiffel type subsonic wind tunnel A statistical treatment of the experimental data permits separate analysis of the periodic component and the turbulent fluctuation of the velocity which are measured by hot wire anemometry A numerical method is presented for solving the local equations by means of a mixing length scheme or a system of transport equations An integral method of prediction was also developed Theoretical results are compared to experimental findings and to other prediction methods Author (ESA)

N78-14995 Georgia Inst of Tech Atlanta

A THEORY OF THE SUPERSONIC TURBULENT AXISYMMETRIC NEAR WAKE BEHIND BLUFF-BASE BODIES Ph D Thesis

Gopal Krishna Mehta 1977 117 p

Avail Univ Microfilms Order No 77-21188

An integral method is presented for the solution of the near wake problem in supersonic flight for the case tof fully turbulent axially symmetric flow behind bluff-base bodies The model is for the case of adiabatic flow and involves the investigation of the corner region the inviscid outer region, and the inner viscous region The solution of the corner region provides the initial conditions for the solution of the wake downstream of the base A simple model is proposed and used The outer inviscid region, which is partially rotational and partially irrotational is treated by an approximate method of characteristics The inner region is represented by the integrated boundary layer equations Dissert Abstr

N78-14997*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

IMPROVEMENT OF MANEUVER AERODYNAMICS BY SPANWISE BLOWING

Gary E Erickson (George Washington Univ) and James F Campbell Dec 1977 68 p refs

(NASA-TP-1065 L-11642) Avail NTIS HC A04/MF A01 CSCL 01A

Spanwise blowing was used to test a generalized wind-tunnel model to investigate component concepts in order to provide improved maneuver characteristics for advanced fighter aircraft Primary emphasis was placed on performance, stability, and control at high angles of attack and subsonic speeds Test data were obtained in the Langley high speed 7 by 10 foot tunnel at free stream Mach numbers up to 0 50 for a range of model angles of attack jet momentum coefficients and leading and trailing edge flap deflection angles Spanwise blowing on a 44 deg swept trapezoidal wing resulted in leading edge vortex enhancement with subsequent large vortex induced lift increments and drag polar improvements at the higher angles of attack Small deflections of a leading edge flap delayed these lift and drag benefits to higher angles of attack In addition, blowing was more effective at higher Mach numbers Spanwise blowing in conjunction with a deflected trailing edge flap resulted in lift *and drag benefits that exceeded the summation of the effects* of each high lift device acting alone Asymmetric blowing was an effective lateral control device at the higher angles of attack Author

N78-14998*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

COLD-AIR PERFORMANCE OF A TIP TURBINE DESIGNED TO DRIVE A LIFT FAN

Jeffrey E Haas Milton G Kofskey, and Glen M Hotz Jan 1978 23 p refs
(NASA-TP-1126 E-9293) Avail NTIS HC A02/MF A01 CSCL 20E

Performance was obtained over a range of speeds and pressure ratios for a 0 4 linear scale version of the LF460 lift fan turbine with the rotor radial tip clearance reduced to about 2 5 percent of the rotor blade height These tests covered a range of speeds from 60 to 140 percent of design equivalent speed and a range of scroll inlet total to diffuser exit static pressure ratios from 2 6 to 4 2 Results are presented in terms of equivalent mass flow equivalent torque equivalent specific work and efficiency Author

N78-15001*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
CONSIDERATIONS IN THE DESIGN OF TIP-COUPLED AIR-TRANSPORT SYSTEMS
Harry H Heyson Jan 1978 33 p refs
(NASA-TM-78645) Avail NTIS HC A03/MF A01 CSCL 01A

It is shown that the lift-drag ratio of tip-coupled systems can be expressed as a simple multiple of the lift-drag ratio of the isolated units comprising the system When operated for maximum lift-drag ratio the extent of the coupled system is limited by maximum lift coefficient high-altitude engine characteristics and degraded performance of the isolated unit climbing to couple into the system When operated at constant altitude the gain from coupling is severely limited If the cruise altitude is that for best performance of the isolated unit the system lift-drag ratio can be no better than twice that of the isolated unit even when an infinite number of units are coupled System performance may be further degraded since span-load distributions which yield good performance for the individual units reduce the efficiency of the coupled system Coupling a pair of modern transport aircraft results in only about half the expected gain because of a poor span-distribution across the coupled pair The control deflections required to maintain roll and pitch equilibrium further degrade the possible gain Author

N78-15002*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
NONLINEAR AEROELASTIC EQUATIONS FOR COMBINED FLAPWISE BENDING, CHORDWISE BENDING, TORSION, AND EXTENSION OF TWISTED NONUNIFORM ROTOR BLADES IN FORWARD FLIGHT
Krishna Rao V Kaza (NASA Lewis Res Center) and Raymond G Kvaternik Aug 1977 112 p refs
(NASA-TM-74059) Avail NTIS HC A06/MF A01 CSCL 01A

The second-degree nonlinear aeroelastic equations for a flexible, twisted, nonuniform rotor blade which is undergoing combined flapwise bending, chordwise bending, torsion and extension in forward flight are developed using Hamilton s principle The equations have their basis in the geometric nonlinear theory of elasticity and are consistent with the small deformation approximation in which the elongations and shears are negligible compared to unity, and the square of the derivative of the extensional deformation of the elastic axis is negligible compared to the squares of the bending slopes No assumption is made regarding the coincidence of the elastic, mass and tension axes of the blade although the elastic and aerodynamic center axes are assumed coincident at the blade quarter chord The blade aerodynamic loading is obtained from strip theory based on a quasi-steady approximation of two-dimensional incompressible unsteady airfoil theory The resulting equations are compared with several of those existing in the literature These comparisons indicate several discrepancies with the present equations particularly in the nonlinear terms The reasons for these discrepancies are explained Author

N78-15003# Cranfield Inst of Technology (England) Aerodynamics Div
AN ANALYSIS OF THE FORCE SYSTEM OF A PROPELLER
M E Eshelby Apr 1977 45 p refs
(Cranfield-Aero-33) Avail NTIS HC A03/MF A01

Propeller operation was analyzed by the strip theory relating the propeller operation to aircraft flight conditions of variable incidence with speed Propeller performance was produced for a specific case of an aircraft - engine - propeller combination which showed characteristics of the performance as functions of power and flight conditions which can be used to predict the power effects of propellers on aircraft handling qualities Author

N78-15004# Cranfield Inst of Technology (England) Aerodynamics Div
THE INFLUENCE OF RUNNING PROPELLERS ON LOW SPEED LONGITUDINAL STATIC STABILITY TRIM CURVES
M E Eshelby Apr 1977 30 p refs
(Cranfield-Aero-34) Avail NTIS HC A03/MF A01

The thrust and normal force characteristics of a propeller were calculated for a particular aircraft as functions of engine power and flight conditions and the findings were used to calculate the propeller contribution to the longitudinal static stability trim curves from which handling qualities are assessed It was shown that the propeller can be considered to be similar to a canard wing producing a general destabilization The effect becomes more severe as speed is reduced and as power is increased leading to a deterioration of the handling qualities as the power on stall is approached The analysis showed that the propeller characteristics calculated are capable of accounting for these effects to a considerable degree and confirm that the propeller performance is being reasonably predicted Author

N78-15005# Weapons Research Establishment, Salisbury (Australia)
SUBSONIC, INVISCID FLOW BY THE FINITE ELEMENT METHOD
C A J Fletcher Aug 1977 35 p refs
(WRE-TR-1858(W) AR-000-933) Avail NTIS HC A03/MF A01

Galerkin and least squares finite element formulations in terms of the primitive variables were applied to equations governing compressible inviscid flow A finite element representation for the groups of variables occurring linearly in the conservation form of the governing equations, led to a relatively sparse stiffness matrix The Galerkin formulation was used in conjunction with Newton s method but solutions for the flow about circular cylinders were only obtained with freestream Mach numbers less than 0 32 The least squares formulation was applied in conjunction with an iterative scheme of the successive over-relaxation type Solutions were obtained for the flow about circular and elliptic cylinders a 6% circular arc air foil and air foil at zero angle of attack Author

N78-15006# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
MOVEMENT OF A SOLID PROFILE NEAR A SOLID BOUNDARY
B S Berkovskiy 10 Feb 1977 32 p Transl into ENGLISH from Zadachi i Metody Gidrodinamiki Podvodnykh Krylyev i Vintov (Kiev) 1966 p 17-27
(AD-A045926, FTD-ID(RS)I-0134-77) Avail NTIS HC A03/MF A01 CSCL 20/4

Studies on aerodynamic bodies moving near a solid or fluid boundary became very important after the development of aircraft which use the screen effect air cushion aircraft wing and ground effect vehicles etc This area of research is also of interest for creating vertical take-off and landing (VTOL) aircraft and low-wing aircraft, as well as for solving problems of changes in stability during movement near the ground The aerodynamic characteristics of an isolated wing with an infinite span moving near a solid boundary are determined in this report GRA

N78-15007# Douglas Aircraft Co , Inc Long Beach, Calif
NOISE AND SONIC FATIGUE OF HIGH LIFT DEVICES AEROACOUSTIC LOADS Final Report, Mar 1975 - May 1977

H L Leve M A Yeneriz C M Ho and D A Plocher Jul 1977 489 p refs
(Contract F33615-75-C-3057)
(AD-A045950 AFFDL-TR-77-40) Avail NTIS HC A21/MF A01 CSCL 20/4

An extensive experimental program applicable to externally blown flaps (EBF) of STOL vehicles was conducted providing detailed information on the surface loads produced during jet impingement Test specimens used in the program were varied from a simple flat plate to a complicated wing-flaps configuration An underlying premise concerning the test specimen selection was that simple plate specimens can provide useful data for wing-flaps configurations The test specimens included flat and curved plates and a wing-flaps model Data collected from the test cases for each specimen included static pressures and single and two-point statistics of the fluctuating pressures In addition temperature data were obtained in flat plate cases for heat transfer studies These results for each test case are tabulated on layouts of the specimen surfaces showing them in their proper spatial relation to each other The results are also plotted for ease in recognizing trends produced from parametric variations The more pronounced trends are discussed along with possible reasons for them GRA

N78-15008# Washington Univ Seattle Dept of Aeronautics and Astronautics
LIMITS ON LOW SPEED WIND TUNNEL TESTS OF ROTORS Final Report, 1 May 1972 - 30 Jun 1977
William H Rae Jr and Shojiro Shindo 27 Sep 1977 25 p refs
(Grant DA-ARO(D)-31-124-72-G019)
(AD-A046086 ARO-10655 1-E) Avail NTIS HC A02/MF A01 CSCL 20/4

The low speed test limit of V/STOL aircraft wind tunnel testing has been investigated and two wall correction theories currently in use have been analyzed The models used were either rotors or propellers acting as a rotor In general the test limit based on tail data is more stringent than limits based on rotors Corrections using Heyson s X sub eff are more accurate than traditional wall corrections Author (GRA)

N78-15010# Naval Ship Research and Development Center Bethesda Md
STATIC STABILITY DERIVATIVES IN PITCH AND ROLL OF A MODEL CIRCULATION CONTROL ROTOR Final Report, May 1973 - Dec 1976
Joseph B Wilkerson Jan 1977 23 p refs
(AD-A046710 DTNSRDC-77-0066) Avail NTIS HC A02/MF A01 CSCL 01/3

Static stability derivatives of a circulation control rotor (CCR) were obtained from wind tunnel evaluation of a model rotor The derivatives show general characteristics similar to those of a conventional rotor in the advance ratio range 0 20 < or = mu < or = 0 30 The conventional characteristic of a destabilizing static-speed-stability term for hingeless rotors appears to be magnified for low advance ratios in the CCR system At higher advance ratios the static-speed-stability term becomes neutral and then strongly stable for CCR Other derivatives show the same tendency toward neutral stability as speed is increased beyond an advance ratio of 0 30 GRA

N78-15012# Pennsylvania State Univ , University Park Applied Research Lab
FLOW MEASUREMENTS BEHIND A ROTOR OPERATING IN A BOUNDARY LAYER
M L Billet 12 Oct 1976 34 p refs
(Contract N00017-73-C-1418)
(AD-A046359, TM-76-260) Avail NTIS HC A03/MF A01 CSCL 20/4

Flow measurements were made behind a rotor using a 5-hole probe Results were obtained for nine (9) basic flow configurations produced by varying upstream conditions In these experiments the boundary layer thickness is the same order of magnitude as the rotor radius All tests were conducted in the 48-inch diameter water tunnel at a nominal velocity of 15 fps Author (GRA)

N78-15015# Lockheed-Georgia Co Marietta
FURTHER DEVELOPMENT OF A VISCOUS VORTEX/WING INTERACTION PROGRAM Interim Report, 1 Jul 1976 - 31 May 1977
Charles J Dixon and Roy M Scruggs (Sybucon Inc) Jun 1977 100 p refs
(Contract N00014-74-C-0151)
(AD-A046342, LG77ER0209 ONR-CR-215-233-3) Avail NTIS HC A05/MF A01 CSCL 20/4

A computational fluid mechanical model developed for analyzing the loads and flow mechanism due to vortex/wing interactions has been further improved and evaluated The model provides vorticity, velocity vectors and pressures for viscous flow on the upper surface of the wing with a leading edge vortex Viscous parametric investigations have been conducted showing the effects of such parameters as leading edge sweep leading edge feeding vorticity and viscosity Effects of grid size and various boundary conditions are presented Boundary conditions are determined from potential flow models by an iteration procedure Directions and an example of the interaction procedure are presented A simple 65 deg delta wing at 22 deg angle of attack is used for the analyses Iterations for this model are not complete but the results are instructive for analyzing other models and completing the 65 deg wing investigation The method is not limited to thin delta wings Arbitrary planforms can be evaluated Thick wings with rounded leading edges are under current investigation Experimental laser velocimeter data are presented for boundary conditions at one station on the 65 deg delta wing at 22 deg angle of attack Author (GRA)

N78-15017# Royal Aircraft Establishment Farnborough (England)
ITERATIVE CALCULATION OF SUBCRITICAL FLOW AROUND THICK CAMBERED WINGS DIRECT AND DESIGN PROBLEMS
C C L Sells 28 Mar 1977 26 p refs Presented at the Euromech Colloq 75 on the Calculation of Flow Fields by Panel Methods Rhode West Ger May 1976
(RAE-TM-Aero-1709 BR58403) Avail NTIS HC A03/MF A01

Iterative calculations of the classic problems of steady inviscid flow around a thick cambered wing providing improved accuracy in relation to the so-called RAE Standard Method, are described Author (ESA)

N78-15019# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF AN 18 PERCENT THICK AIRFOIL SECTION DESIGNED FOR THE ALL-FLYING TAILPLANE OF THE M-300 SAILPLANE
L M M Boermans and J J H Blom Nov 1976 44 p refs
(VTH-LR-226) Avail NTIS HC A03/MF A01

An investigation was conducted in the low-speed low-turbulence wind tunnel to determine the low-speed two-dimensional aerodynamic characteristics of the 18 % thick airfoil used in the all-moving horizontal tailplane of the Italian high performance standard class sailplane M-300 Aliante This tailplane was given a rectangular planform for the purpose of employing extruded profiles for its structure It has a chord of 0 27 m and an aspect ratio of 10 7 A part of this extruded structure was used as a test model The tests were conducted at three low Reynolds numbers (based on the airfoil chord) typical for the range at which the tailplane operates The angle-of-attack range was from -23 to +20 deg The extruded airfoil section deviates slightly from the nominal design which consists of an NACA 63 sub 3-018 thickness distribution combined with an S-type mean line To assess the consequences of this deviation on the characteristics potential and viscous flow calculations were carried out for both the actual and the nominal airfoil Results presented in tables and graphs, are discussed Author (ESA)

N78-15022# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering

THE USE OF THE TOTAL-HEAD RISE ACROSS THE PROPELLER OF THE DE HAVILLAND CANADA DHC-2 BEAVER AS A SIMILARITY PARAMETER TO SIMULATE POWER-ON FLIGHT IN THE WIND TUNNEL

J J Broek Jun 1976 37 p refs
(VTH-190) Avail NTIS HC A03/MF A01

A study is reported on the feasibility of simulating power-on flight of the De Havilland Canada DHC-2 Beaver aircraft with a 1/11th scale wind tunnel model using the non-dimensional rise in total head across the airplane and model propeller as a similarity parameter A parameter based on local measurements of this pressure rise is defined to replace the thrust coefficient as a similarity parameter Wind tunnel measurements were carried out in the 1 80 X 1 25 m low-speed wind tunnel with the model at zero angle-of-attack They were correlated with results of flight tests to evaluate the correspondence of thrust coefficient versus pressure rise parameter curves of the aircraft and the model Results indicate that the proposed replacement of the thrust coefficient by the pressure rise parameter is a promising solution to the problem of simulating propeller-thrust effect in the wind tunnel It is however necessary to set up a detailed investigation of their relation for the model propeller in yaw

Author (ESA)

N78-15025# Bendix Corp, Teterboro, N J Flight System Div

GLIDE PATH AUGMENTATION WITH INERTIAL FLIGHT PATH ANGLE Final Report, Jan 1972 - Dec 1974

Vincent Muehter Dec 1974 36 p
(Contract F33615-72-C-1753)
(AD-A046363 AFFDL-TR-77-72) Avail NTIS HC A03/MF A01 CSCL 01/2

A two segment approach configuration using inertially derived flight path angle to dampen the glide path and upper segment approach paths is developed in the text System performance in both head and tail winds is evaluated Stability analysis is also presented on root locus plots for the capture and track modes

Author (GRA)

N78-15026 Virginia Polytechnic Inst and State Univ Blacksburg

SYSTEMATIC INVESTIGATION OF MODELS OF HELICOPTER WITH A SLUNG LOAD Ph D Thesis

Bellur Lakshminarayana Nagabhushan 1977 208 p
Avail Univ Microfilms Order No 77-20258

The dynamics stability and control of a helicopter carrying an externally suspended load were studied Several mathematical models were developed to describe the dynamics of such a configuration in varying complexity The simplest model was obtained by assuming both the helicopter and load to be point masses The vehicle had a thrust force generated by a rigid disc rotor that had pitch and roll degrees of freedom A twelfth order model that included the rigid body motion of the fuselage was developed The dynamics of an articulated rotor were also included in an eighteenth order model Dissert Abstr

N78-15029# Army Aviation Engineering Flight Activity, Edwards AFB, Calif

C-12A LANDING GEAR CAPABILITY TESTS Final Report

Joseph C Watts and Vernon L Diekmann Mar 1977 46 p refs
(AD-A046554, USAAEFA-76-03) Avail NTIS HC A03/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted an evaluation of the C-12A aircraft During the test program four flights totaling 3 8 hours were flown Soft soil and simulated rough terrain operations were conducted The C-12A met the requirements of the prime item development specification for operating on soft soil If the aircraft is to be operated on rough/unprepared terrain one deficiency was found during this test program failure of the right main landing gear while braking over simulated rough terrain GRA

N78-15030# Air Force Flight Dynamics Lab, Wright-Patterson AFB, Ohio

SIMULATED LIGHTNING TEST ON THE NAVY AIRBORNE LIGHT OPTICAL FIBER TECHNOLOGY (ALOFT) A-7 AIRCRAFT Final Report, 1-31 Aug. 1976

Jerome T Dijak Jun 1977 99 p refs
(AD-A046370, AFFDL-TR-77-54) Avail NTIS HC A05/MF A01 CSCL 01/3

A simulated lightning test was conducted on the Navy A-7 Airborne Light Optical Fiber Technology (ALOFT) aircraft for the purpose of determining the advantage gained in the substitution of fiber optics data links within the Navigation and Weapons Delivery System over conventional wiring in reducing lightning-induced transients experienced by the Navigation and Weapons Delivery Computer (NWDC) A 1 6 x 50 microsecond double-exponentional pulse of 2000 amperes peak current was used for the lightning simulation Transients on three data circuits one power supply circuit and two electooptical circuits were monitored in seven system configurations The substitution of fiber optics for the signal wiring reduced the induced transients in the data circuits by 85 to 90 per cent over those observed with the hard-wiring in place Direct electromagnetic coupling of transient energy into the NWDC was found to be only 9 to 16 per cent as great as the combined effects of coupling due to the signal and power wiring The relative magnitudes of the signal-wiring and power-wiring induced transients were found to vary among the three data circuits Author (GRA)

N78-15031# Naval Postgraduate School, Monterey Calif

GENERALIZED HELICOPTER ROTOR PERFORMANCE PREDICTIONS M S. Thesis

James William Loiselle Sep 1977 139 p refs
(AD-A046368) Avail NTIS HC A07/MF A01 CSCL 01/3

The Generalized Rotor Performance (GRP) program is a computer program designed for calculating forward flight performance of a helicopter rotor system at a specific flight condition It can be used to evaluate either an articulated or a hingeless single rotor system in forward flight or in a wind-tunnel test The program was originally designed by the Sikorsky Aircraft Company and purchased by the United States Navy The goals of this thesis were (1) to reinvestigate the theory and logic used in the program (2) to add selected desirable features to the program (3) to produce a much needed Users' Manual, and (4) to run an analysis comparing the program s calculated results against manufacturer's data These goals were accomplished and the results of the analysis indicated that the program produces highly accurate results within the normal cruise range of a modern helicopter Author (GRA)

N78-15032# Hughes Helicopters, Culver City Calif

FLIGHT TEST OF A COMPOSITE MULTI-TUBULAR SPAR MAIN ROTOR BLADE ON THE AH-1G HELICOPTER VOLUME 2 COST ESTIMATES AND PROCESS SPECIFICATIONS Final Report, Jun 1974 - Jan 1977

Robert E Head Aug 1977 79 p refs
(Contract DAAJ02-74-C-0055)
(AD-A046279, HH-76-281-Vol-2 USAAMRDL-TR-77-19B)
Avail NTIS HC A05/MF A01 CSCL 01/3

The objectives of this program were to design a composite main rotor blade in the multi-tubular spar configuration to be directly interchangeable (in pairs) with the production metal (540) blades on the AH-1G helicopter, have increased fatigue life invulnerability to the 23mm ballistic threat, low radar cross section and low fabrication cost Manufacturing technology was developed and described in a Process Specification Laboratory, ground, and flight tests demonstrated that the wet filament wound co-cured blade met and in some cases surpassed, all objectives and could be adapted for Army service Author (GRA)

N78-15033# Army Aviation Engineering Flight Activity Edwards AFB Calif

ICING EVALUATION U-21A AIRPLANE WITH LOW REFLECTIVE PAINT Final Report

Charles L Thomas Robert L Stewart Tom P Benson and Ralph Woratschek May 1977 32 p refs
(AD-A046852 USAAEFA-77-05) Avail NTIS HC A03/MF A01 CSCL 01/3

An evaluation was conducted of the icing characteristics of a U-21A airplane painted with low reflective paint Test flights were made in trace, light, and moderate icing conditions During these tests four shortcomings were noted The shortcomings were ineffectiveness of the deice boots with rime ice accumulation, inability of the engine air inlet anti-ice system to prevent formation of ice in the engine air inlet, lack of an engine inlet lip boot anti-ice system preflight test and lack of anti-ice/deice capability for the wing area outboard of the pneumatic boots From the evaluation it was concluded that the low reflective paint does not significantly affect the ice accumulation characteristics of the U-21A airplane and also that, regardless of the type paint in moderate icing conditions at constant power, airspeed will be reduced by 20 to 30 knots GRA

N78-15034# School of Aerospace Medicine, Brooks AFB, Tex
OPTICAL EVALUATION OF F/FB-111 FIELD-SERVICE-TEST WINDSHIELDS Progress Report, 17 Apr 1975 - 18 Nov 1976
Wayne F Proviness Benjamin Kislin, and Thomas J Tredici Sep 1977 12 p
(AD-A046490, SAM-TR-77-19) Avail NTIS HC A02/MF A01 CSCL 13/6

Ten shipsets (pairs) of F/FB-111 bird-impact-resistant windshields plus four shipsets of spares were optically evaluated in the USAF School of Aerospace Medicine (USAFSAM) windshield laboratory before installation into aircraft This was in support of a field-test program directed by the Air Force Flight Dynamics Laboratory To elicit distortion characteristics, the USAFSAM effort included the determination of light-transmissivity properties and haze values, prism-deviation mapping and grid-board photography Seven of these windshields were optically evaluated also after the test, for pre-versus post-field-service direct comparisons Author (GRA)

N78-15035# Royal Aircraft Establishment Farnborough (England)
AN ASSESSMENT OF SOME FORMS OF FOLLOWER-TOOTH REDUCTION GEAR AND ITS APPLICATION TO HELICOPTER MAIN ROTOR GEARBOXES
T R Smith 21 Mar 1977 75 p refs
(RAE-TR-77040 BR58350) Avail NTIS HC A04/MF A01

A critical assessment of the cylindrical rotary form of the follower-tooth reduction gear, indicating deficiencies and suggesting improvements is presented Consideration was given to the mechanism s application to helicopter main gearboxes and a design study formulated It is not considered competitive with current types because (1) although the specific mass of a basic follower-tooth gear is about the same as that of conventional transmissions in similar configurations the latter have more potential for mass reduction and their efficiency is higher (2) The addition of tail rotor and ancillary drive take-offs would increase complexity and weight to a greater extent than in conventional systems (3) The geometric arrangement and the type and function of the speed reducing components are such that the mechanism would be more sensitive to environmental conditions (4) Although components are geometrically simple high manufacturing standards quality control and assembly difficulties would reflect adversely on costs (5) Refurbishment would probably entail replacement of most power-transmitting components, bearings and seals whereas conventional systems normally require only new bearings and seals Author (ESA)

N78-15036# Army Aviation Engineering Flight Activity Edwards AFB Calif
FLIGHT EVALUATION ROSEMOUNT LOW-RANGE ORTHOGONAL AIRSPEED SYSTEM WITH 853G SENSOR Final Report
William Y Abbott and Jerry R Guin Mar 1977 28 p refs
(AD-A046491 USAAEFA-75-17-3) Avail NTIS HC A03/MF A01 CSCL 01/4

The Rosemount low range orthogonal airspeed system with a Model 853G sensor installed above the main rotor was evaluated by the United States Army Aviation Engineering Flight Activity at Edwards Air Force Base California in August 1976 The system repeatedly measured airspeed in the direction of the relative wind However the system had excessive perturbations in the axis perpendicular to relative wind which must be corrected prior to the system becoming operational Author (GRA)

N78-15037# Army Aviation Engineering Flight Activity Edwards AFB, Calif
FLIGHT EVALUATION J-TEC VT-1003 VECTOR AIRSPEED SENSING SYSTEM Final Report, Apr 1976
William Y Abbott Robert L Stewart and Sherwood C Spring May 1977 28 p refs
(AD-A046553 USAAEFA-75-17-2) Avail NTIS HC A03/MF A01 CSCL 01/3

The J-TEC VT-1003 vector airspeed sensing system was evaluated on an AH-1G helicopter in April 1976 by the United States Army Aviation Engineering Flight Activity at Edwards Air Force Base California The sensor was mounted above the main rotor plane of rotation throughout the evaluation All tests were flown at approximately 8000 pounds gross weight mid center of gravity and a main rotor speed of 324 rpm The linear calibrations provided for in the system were unacceptable above 50 knots true airspeed (KTAS) and nonlinear post-processing was required Using the nonlinear calibrations longitudinal errors above a skid height of 50 feet in forward flight above 10 KTAS were less than 3 knots Errors were less than 6 knots between 10 KTAS forward and 30 KTAS rearward Author (GRA)

N78-15038# Naval Postgraduate School Monterey Calif
A STATE-OF-THE-ART ASSESSMENT OF AIR DATA SENSORS FOR NAVAL AIRCRAFT M S Thesis
Robert Dale Neil Sep 1977 176 p refs
(AD-A046500) Avail NTIS HC A09/MF A01 CSCL 01/3

A review of current air data measurement techniques in Naval aircraft was conducted Future requirements were identified for three classes of aircraft conventional fly-by-wire, and V/STOL A survey of state-of-the-art air data sensors was performed based on information obtained from current literature, correspondence, and personal interviews with major government contractors, government agencies and private companies The major areas covered include pressure airspeed fiber optics laser gyros, temperature and fuel quantity The basic operation of each system considered was presented and recommendations given based on its present stage of development and potential Author (GRA)

N78-15039# Human Engineering Labs, Aberdeen Proving Ground Md
THE EFFECTS OF ELIMINATING MINOR GRADUATIONS ON DIAL READING PERFORMANCE Final Report
Alan M Poston Sep 1977 20 p refs
(AD-A046709, HEL-TN-12-77) Avail NTIS HC A02/MF A01 CSCL 01/3

An investigation was made to determine dial reading performance using two dial marking schemes one as they appear in current aircraft and the other with the minor graduation marks eliminated Four instruments (dc voltmeter, fuel pressure indicator, exhaust gas temperature indicator and transmission oil temperature indicator) were used to examine each scheme Results indicated that performance was significantly better with the modified designs (minor graduations eliminated) A second result was that, regardless of the design used some instruments are significantly more difficult to read than others Author (GRA)

N78-15041*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
EXPERIMENTAL CLEAN COMBUSTOR PROGRAM TURBULENCE CHARACTERISTICS OF COMPRESSOR DISCHARGE FLOWS
P S Follansbee and R R Dils Oct 1977 43 p refs
(Contract NAS3-19447)
(NASA-CR-135277 PWA-5540) Avail NTIS HC A03/MF A01 CSCL 21E

The results of turbulence measurements at the entrance to the diffuser duct of a large gas turbine are presented Hot film and hot wire measurements were conducted over a compressor discharge temperature range of 450K to 608K It was found

that the turbulent intensity at the I D and midspan locations increases gradually from 6 + or - 1 percent at idle to 7 + or - 1 percent at approach, the turbulent intensity at the O D location increases from 7 5 + or - 0 5 percent at idle to 15 + or - 0 5 percent at approach The energy in the velocity waves is uniformly distributed over a 0 1 to 5 kHz bandwidth, and the cut-off frequency is not a strong function of the engine operation The axial length of the Fourier components within this bandwidth varies from 0 021 to 1 05m The turbulence near the diffuser O D is of sufficient amplitude and scale to affect the flow to the front end sections of the burner Author

N78-15042*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PRELIMINARY QCSEE PROGRAM TEST RESULTS
Carl C Ciepluch 1977 22 p refs Presented at 1977 Aerospace Meeting Los Angeles, 14-17 Nov 1977 sponsored by SAE
(NASA-TM-73732) Avail NTIS HC A02/MF A01 CSCL 21E

The QCSEE (Quiet Clean Short-Haul Experimental Engine) program has entered the engine test phase Overall design and advanced technology incorporated into the two engines in the program were described In addition preliminary engine test results are presented and compared to the technical requirements the engines were designed to meet Author

N78-15043*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COMPUTER PROGRAM FOR CALCULATION OF A GAS TEMPERATURE PROFILE BY INFRARED EMISSION ABSORPTION SPECTROSCOPY
Donald R Buchele Dec 1977 85 p refs
(NASA-TM-73848 E-9436) Avail NTIS HC A05/MF A01 CSCL 21E

A computer program to calculate the temperature profile of a flame or hot gas was presented in detail Emphasis was on profiles found in jet engine or rocket engine exhaust streams containing H2O or CO2 radiating gases The temperature profile was assumed axisymmetric with an assumed functional form controlled by two variable parameters The parameters were calculated using measurements of gas radiation at two wavelengths in the infrared The program also gave some information on the pressure profile A method of selection of wavelengths was given that is likely to lead to an accurate determination of the parameters The program is written in FORTRAN 4 language and runs in less than 60 seconds on a Univac 1100 computer Author

N78-15044*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
TEMPERATURE DISTRIBUTIONS AND THERMAL STRESSES IN A GRADED ZIRCONIA/METAL GAS PATH SEAL SYSTEM FOR AIRCRAFT GAS TURBINE ENGINES
Christopher M Taylor (Leeds Univ) and Robert C Bill (Army R and T Labs Cleveland) 1978 19 p refs Presented at the Conf on Air-Breathing Propulsion Systems Huntsville Ala 16-18 Jan 1978 sponsored by AIAA
(NASA-TM-73818) Avail NTIS HC A02/MF A01 CSCL 21E

A ceramic/metallic aircraft gas turbine outer gas path seal designed for improved engine performance was studied Transient temperature and stress profiles in a test seal geometry were determined by numerical analysis During a simulated engine deceleration cycle from sea-level takeoff to idle conditions the maximum seal temperature occurred below the seal surface therefore the top layer of the seal was probably subjected to tensile stresses exceeding the modulus of rupture In the stress analysis both two- and three-dimensional finite element computer programs were used Predicted trends of the simpler and more easily usable two-dimensional element programs were borne out by the three-dimensional finite element program results Author

N78-15048# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
SOME PROBLEMS OF EXPLOITATION OF JET TURBINE AIRCRAFT ENGINES OF LOT POLISH AIR LINES
Andrzej Slodownik 26 Apr 1977 21 p Transl into ENGLISH from Tech Lotnicza i Astronautycza (Poland) no 9 Sep 1974 p 29-58
(AD-A046221 FTD-ID(RS)I-0475-77) Avail NTIS HC A02/MF A01 CSCL 21/5

The article discusses the equipment of a turbine engine with control-measurement systems and the possibilities arising therefrom of evaluating the technical status of the NK-8-4 jet turbine engine with which the I1-62 airplane used by LOT Polish Air Lines is equipped The isotopic method of determining the technical status of turbine aircraft is also discussed Author (GRA)

N78-15050# Naval Postgraduate School Monterey, Calif
EFFECT OF CONFIGURATION VARIABLES ON PERFORMANCE OF SOLID FUEL RAMJETS M S Thesis
Clemens James Mady Jr Jun 1977 55 p refs
(AD-A046786) Avail NTIS HC A04/MF A01 CSCL 21/5

An experimental investigation into the effect of configuration variables on combustion performance in the solid fuel ramjet was conducted The effect of air ducting methods on combustion efficiency was found to be dependent not only on the flow rates momentum and geometry of the system but also on the composition of the solid fuel High pressures and low air mass fluxes through the fuel grain affect the regression rate by altering the heat transfer mechanism Some air duct configurations were found to create a favorable environment for combustion pressure oscillations Author (GRA)

N78-15052# Hughes Aircraft Co Culver City Calif
CAPACITORS FOR AIRCRAFT HIGH POWER Interim Report, May 1975 - Dec 1976
Robert D Parker Sep 1977 166 p
(Contract F33615-76-C-2021 AF Proj 3145)
(AD-A046340 AFAPL-TR-77-40) Avail NTIS HC A08/MF A01 CSCL 09/1

This report describes the initial phase of an on-going program conducted by Hughes Aircraft Company to develop lightweight reliable pulse-discharge capacitors for airborne application Two types of capacitors - low repetition rate and high repetition rate - were to be developed The high repetition rate component was to be 4 4 microfarads at 15 kV and was to achieve 200J/lb when operated at 300 pps in a 1 minute on 2 hour off duty The low repetition rate component was to be 3 4 microfarads at 40 kV, and was to achieve 500 J/lb when operated at 50 pps in a similar duty Both capacitors were to be designed for a 20 microsec current pulse representative of pulse-forming-network (PFN) operation The program divided logically into two phases In the first phase the designs and details of fabrication would be worked out, and single sections (capacitor elements) built and tested In the second phase full size capacitors composed of several sections would be built and tested This report describes the first phase Author (GRA)

N78-15053# Air Force Occupational and Environmental Health Lab Kelly AFB Tex Operating Location AA
ACOUSTIC PERFORMANCE OF THE A/M32A-52 EXHAUST MUFFLER (MODIFIED) DURING KC-135A AIRCRAFT GROUND RUNUP OPERATION
Nicholas A Farinacci Oct 1977 25 p refs
(AD-A046585 OEHL-OLAA-77-5) Avail NTIS HC A02/MF A01 CSCL 20/1

This report presents processed acoustic data acquired during ground runup operations on a KC-135A aircraft with and without a modified A/M32A-52 engine noise suppressor The data show a significant reduction in acoustic power levels at high power settings A short discussion for determining day-night equivalent levels is included Author (GRA)

N78-15054# Advisory Group for Aerospace Research and Development Paris (France)
ENGINES FOR SMALL PROPELLER-DRIVEN RPVs, REPORT OF SUB-GROUP A OF AGARD WORKING GROUP ON PROPULSION AND POWER SUPPLIES FOR UNMANNED VEHICLES, VOLUME 1

Nov 1977 102 p
(AGARD-AR-101-Vol-1 ISBN-92-835-1259-6) Avail NTIS HC A06/MF A01

The propulsion technology applicable to small propeller-driven RPVs used for military missions was surveyed An inventory of existing engines applicable to small RPV's, the power requirements of small RPVs and parametric calculations used to study the relationship between the RPV and the engine are presented

J M S

N78-15055*# Kansas Univ Lawrence
FLIGHT EVALUATION OF A SPOILER ROLL CONTROL SYSTEM ON A LIGHT TWIN-ENGINE AIRPLANE Final Report
David L Kohlman Jan 1978 51 p refs
(Grant NsG-1227)
(NASA-CR-2935 KU-FRL-203) Avail NTIS HC A04/MF A01 CSCL 01C

A flight test program was conducted to evaluate the characteristics of a spoiler roll control system on a light twin-engine airplane The spoilers provided excellent roll control with no deadband or reduced sensitivity for small deflections Roll power increased significantly with the flaps deployed Cable stretch limited spoiler authority at high dynamic pressure Data were presented on roll rates sideslip wheel deflections and wheel forces

Author

N78-15056*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AERODYNAMIC CHARACTERISTICS OF AN F-8 AIRCRAFT CONFIGURATION WITH A VARIABLE CAMBER WING AT MACH NUMBERS FROM 0 70 TO 1 15
Frederick W Boltz and Douglas F Pena Dec 1977 126 p
(NASA-TM-78432) Avail NTIS HC A07/MF A01 CSCL 01C

A 0 1-scale model of an F-8 aircraft was tested in the Ames 14-Foot Transonic Wind Tunnel at Mach numbers from 0 7 to 1 15 Angle of attack was varied from -2 deg to 22 deg at sideslip angles of 0 deg and -5 deg Reynolds number, dictated by the atmospheric stagnation pressure varied with Mach number from 3 4 to 4 0 million based on mean aerodynamic chord The model was configured with a wing designed to simulate the downward deflection of the leading and trailing edges of an advanced-technology-conformal-variable camber wing This wing was also equipped with conventional (simple hinge) flaps In addition, the model was tested with the basic F-8 wing to provide a reference for extrapolating to flight data In general, at all Mach numbers the use of conformal flap deflections at both the leading edge and trailing edge resulted in slightly higher maximum lift coefficients and lower drag coefficients than with the use of simple hinge flaps There were also found to be small improvements in the pitching-moment characteristics with the use of conformal flaps

Author

N78-15057# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
AN INTRODUCTION TO THE AERODYNAMICS OF FLIGHT DYNAMICS
H H B M Thomas 29 Mar 1977 56 p refs Presented at the course of lectures on Aerodyn Inputs for Probl in Aircraft Dyn , Rhode-St-Genese, Belgium 25-29 Apr 1977
(RAE-TM-Aero-1710, BR58309) Avail NTIS HC A04/MF A01

The solution of problems of flight dynamics requires the aerodynamic forces which are called into play to be expressed in a suitable form In this context a suitable form is one which adequately reflects the nature of the motion being considered and is, at the same time, convenient for the solution of the equations of motion Formulation in terms of aerodynamic derivatives, and generalizations thereof, are considered A brief discussion follows, in broad and simple physical terms, of how the various motion variables give rise to forces and moments which, within a linearized framework are expressible as force or moment derivatives specifically for an airplane Author (ESA)

N78-15058*# Vought Corp Advanced Technology Center Inc Dallas Tex
CALIBRATION OF TRANSONIC AND SUPERSONIC WIND TUNNELS Final Report
T D Reed T C Pope and J M Cooksey Nov 1977 287 p refs
(Contract NAS2-8606)
(NASA-CR-2920) Avail NTIS HC A13/MF A01 CSCL 14B

State-of-the art instrumentation and procedures for calibrating transonic (M greater than 0 6 and less than 1 4) and supersonic (M less than or equal to 3 5) wind tunnels were reviewed and evaluated Major emphasis was given to transonic tunnels Continuous blowdown and intermittent tunnels were considered The required measurements of pressure temperature flow angularity noise and humidity were discussed and the effects of measurement uncertainties were summarized A comprehensive review of instrumentation currently used to calibrate empty tunnel flow conditions was included The recent results of relevant research are noted and recommendations for achieving improved data accuracy are made where appropriate It is concluded for general testing purposes, that satisfactory calibration measurements can be achieved in both transonic and supersonic tunnels The goal of calibrating transonic tunnels to within 0 001 in centerline Mach number appears to be feasible with existing instrumentation, provided correct calibration procedures are carefully followed A comparable accuracy can be achieved off-centerline with carefully designed conventional probes except near Mach 1 In the range M greater than 0 95 and less than 1 05 the laser Doppler velocimeter appears to offer the most promise for improved calibration accuracy off-centerline

Author

N78-15060*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
OPERATIONAL EXPERIENCE IN THE LANGLEY EXPANSION TUBE WITH VARIOUS TEST GASES
Charles G Miller Dec 1977 35 p refs
(NASA-TM-78637) Avail NTIS HC A03/MF A01 CSCL 14B

The Langley Expansion Tube is an operational facility capable of producing good quality, highly repeatable quasi-steady flow for test times sufficient to establish flow about blunt axisymmetric and two-dimensional models Due to the capability of testing with arbitrary test gases a wide range of real-gas hypersonic-hypervelocity flow conditions may be generated However for a given test gas the range of operating conditions producing useful flow is shown to be rather limited hence, the facility yields a given flow condition for a given test gas and variation in flow conditions comes about by using different test gases Data are presented for operations using air and carbon dioxide as test gases The driver gas was unheated helium at a nominal pressure of 5000 psi (34 5 MN sq m)

Author

N78-15061# Singer Co , Binghamton, N Y Link Div
AVIATION WIDE-ANGLE VISUAL SYSTEM (AWAVS) TRAINER DESIGN REPORT SUBSYSTEM DESIGN REPORT Final Report
Robert A Fisher and Robert Lyons May 1977 394 p
(Contract N61339-75-C-0009)
(AD-A046699 AWAVS-7, NAVTRAEQUIPC-75-C-0009) Avail NTIS HC A17/MF A01 CSCL 05/9

This Visual System Design Report is provided in response to Data Item A003 of Contract No N61339-75-C-0009 for the Aviation Wide-Angle Visual System (AWAVS) The overall objective of the Design Report, together with the Configuration Facilities, Math Model and Design Analysis Reports is to present a total picture of the design and development engineering functions and the implementation of these functions to achieve the characteristics and performance for the visual portion of the AWAVS/VTFS system as required by AWAVS NAVTRAEQUIPCEN Specification 212-102 The primary purpose of the Visual Design Report is to provide, as clearly and concisely as possible, all required design information relative to AWAVS Visual hardware systems, elements and components Each of the major areas shown in the Master Block Diagram are treated separately in the various detail block diagrams Each of the interfaces, e g , electrical mechanical and optical, is defined in terms of its function, design features and implementation In this respect

the contents of DID S-0003 dated 6 October 1971, has been used as a guideline in generation of the material presented herein An analysis of the design and development of each AWAVS subsystem has also been included in this report however, only to the extent that such analysis differs from (or has evolved from) the one given in the Design Analysis Report NAVTRAEQUIP-CEN 75-C-0009-A001 GRA

N78-15239# Rockwell International Corp Los Angeles Calif Los Angeles Aircraft Div

LOWER COST BY SUBSTITUTING STEEL FOR TITANIUM AF1410 STEEL-DETAIL DESIGN AND DEVELOPMENT TESTS Interim Report, Jul 1976 - Jun 1977

W E Routh Jun 1977 330 p refs

(Contract F33615-75-C-3109)

(AD-A046705, RI/LAAD-NA-77-217 AFFDL-TR-77-73) Avail NTIS HC A15/MF A01 CSCL 01/3

Two selected components of the B-1 structure presently designed as Ti 6Al-4V were redesigned using AF1410 steel taking full advantage of the higher strength and lower volume aspects Both cost and weight savings are documented to show representative possibilities on similar parts of other aircraft structures A cost saving of 22 9 and 22 1 percent and weight saving of 7 6 and 15 1 percent are projected in the two examples designed Mechanical properties of AF1410 steel are validated through over 400 development tests run on production heats of this material Tests covered parent metal properties and weld properties obtained from both static and fatigue tests A special pre-machining heat-treatment was developed to permit lower cost machining prior to final heat-treatment for high strength properties Both heat-treat processes were selected from a series of heat-treat tests conducted GRA

N78-15284# Army Mobility Equipment Research and Development Center Fort Belvoir, Va

EVALUATION OF MILITARY SPECIFICATION AIRCRAFT COATINGS (AVSCOM NO 77-18) Final Report, Jun 1972 - Dec 1976

Melvin H Sandler and Fred L Lafferman Aug 1977 37 p refs

(AD-A046708 MERADCOM-2218) Avail NTIS HC A03/MF A01 CSCL 01/3

This report covers a comparison study on the properties of military specification aircraft finishes Coatings representing olive drab and white gloss and camouflage (lusterless) specification polyurethane acrylic and nitrocellulose-acrylic finishes were investigated Also included were a one-package moisture-cure urethane and an experimental urethane-acrylic coating Based on this study Specification MIL-C-83286 (USAF) Coating Urethane Aliphatic Isocyanate for Aerospace Application should be used for Army Aircraft where a gloss finish is required and specification MIL-L-81352 (AS) Lacquer Acrylic (for Naval Weapons Systems) where a lusterless finish is required Author (GRA)

N78-15287# Naval Air Development Center Warminster Pa Air Vehicle Technology Dept

DEVELOPMENT OF A HIGH TEMPERATURE SILICONE BASE FIRE-RESISTANT FLUID FOR APPLICATION IN FUTURE MILITARY AIRCRAFT HYDRAULIC SYSTEM DESIGNS

J Lee Hammond and Alfeo A Conte Jr 15 Jun 1977 56 p refs

(AD-A046824 NADC-77080-30) Avail NTIS HC A04/MF A01 CSCL 11/8

A candidate silicone-base fire-resistant hydraulic fluid designated Nadraul MS-6 has been developed for future military aircraft hydraulic system design A 500 hour hydraulic pump-loop circuit evaluation of the MS-6 fluid has been successfully completed Data on this phase of the investigation and the development effort on the MS-6 fluid and an alky-ester siloxane are reported A design guide is planned based on the physical and chemical properties of MS-6 so that future hydraulic systems can be designed around the properties of this new formulation and thus take advantage of its fire-resistant nature Author (GRA)

N78-15294# Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div

SUSPENSION FUELS ONE TYPE OF HOPEFUL HIGH ENERGY FUEL

Wang Chu Fa 24 Jan 1977 18 p Transl into ENGLISH from Hang Kung Chih Shih (Mainland China) no 6, 1976 p 26-27

(AD-A045908 FTD-ID(RS)I-1848-76) Avail NTIS HC A02/MF A01 CSCL 21/4

Contents What are Suspension Fuels How are Suspension Fuels made Suitable Additive Agents Brief Production Techniques, Special Characteristics of Several Types of Suspension Fuels Existent Problems GRA

N78-15311# Advisory Group for Aerospace Research and Development Paris (France)

FACTORS OF SAFETY HISTORICAL DEVELOPMENT, STATE OF THE ART AND FUTURE OUTLOOK

Nov 1977 69 p refs Three papers presented at the 43d 44th and 45th Meetings and the Technical Address given at the 44th Meeting of the Structures and Mater Panel of AGARD

(AGARD-R-661, ISBN-92-835-1255-3) Avail NTIS HC A04/MF A01

The factors of structural safety presently applied to the design of fixed-wing aircraft are considered in terms of progress in establishing aerodynamic derivatives, defining load conditions and predicting structural loads as well as enabling detailed analyses for stress and deformation to be made J M S

N78-15324*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

VOLUMETRIC PATTERN ANALYSIS OF AIRBORNE ANTENNAS Final Report

C L Yu (Ohio State Univ Columbus) W D Burnside (Ohio State Univ, Columbus) and M C Gilreath Dec 1977 21 p refs Original contains color illustrations

(Grant NGL-36-008-138)

(NASA-TM-78327 ESL-78-2902 FR-2902-27) Avail NTIS HC A02/MF A01 CSCL 20N

By blending together the roll and elevation plane high frequency solutions a very efficient technique was developed for the volumetric pattern analysis of antennas mounted on the fuselage of a generalized aircraft The fuselage is simulated by an infinitely long perfectly conducting, elliptic cylinder in cross-section and a composite elliptic cylinder in profile The wings nose section stabilizers and landing gear doors may be modeled by finite flat or bent plates Good agreement with accurate scale model measurements was obtained for a variety of airborne antenna problems Author

N78-15325*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va

AIRBORNE ANTENNA COVERAGE REQUIREMENTS FOR THE TCV B-737 AIRCRAFT

William A Southall Jr and William F White Jan 1978 36 p refs

(NASA-TM-78647) Avail NTIS HC A03/MF A01 CSCL 20N

The airborne antenna line of sight look angle requirement for operation with a Microwave Landing System (MLS) was studied The required azimuth and elevation line of sight look angles from an antenna located on an aircraft to three ground based antenna sites at the Wallops Flight Center (FPS-16 radar MLS azimuth and MLS elevation) as the aircraft follows specific approach paths selected as representative of MLS operations at the Denver Colorado terminal area are presented These required azimuth and elevation look angles may be interpreted as basic design requirements for antenna of the TCV B-737 airplane for MLS operations along these selected approach paths Author

N78-15368# Aerospace Corp El Segundo Calif Ivan A Getting Labs

CHARACTERISTICS OF 5- TO 35- TURN UNIFORM HELICAL ANTENNAS Final Report

H E King and J L Wong 1 Jun 1977 53 p refs
(Contract F04701-77-C-0078)
(AD-A046487, TR-0078(3724-01)-2 SAMSO-TR-77-200)
Avail NTIS HC A04/MF A01 CSCL 09/1

The measured VSWR, gain, pattern and axial ratio characteristics of a uniformly wound helical antenna are presented Experimental parametric studies were made of (1) fixed length helices with variable diameter and pitch angle (8 6 to 10 turns), and (2) variable length helices with constant diameter and pitch angle (5 to 35 turns) Simplified design relations are given for the antenna gain and half-power beamwidth (HPBW) as a function of axial length L/lambda and circumference C/lambda for helices consisting of approximately 10 turns Parametric curves are presented to show the gain and HPBW of a constant pitch helix as a function of L/lambda and C/lambda An empirical expression is derived for the antenna gain as a function of frequency and the helix design parameters In addition, the bandwidth characteristics are analyzed Author (GRA)

N78-15432 Virginia Polytechnic Inst and State Univ , Blacksburg
THE FLOW ABOUT A SLENDER PROPELLER-DRIVEN BODY IN A TEMPERATURE STRATIFIED FLUID Ph D Thesis
Thomas Franklin Swean, Jr 1977 117 p
Avail Univ Microfilms Order No 77-22090

An experimental study of the turbulent wake produced by a stern propellor-driven body moving in a temperature stratified fluid is presented The velocity and thermal boundary layers on the body upstream of the propellor are also examined Mean flow velocities static pressure flow angularity and mean temperature distributions are reported at five down-stream stations Z/O = 0 33, 1 0, 2 0, 3 0, and 4 0 Turbulence data, including temperature fluctuations are reported at Z/D = 0 33 and Z/D = 4 0 The measurements were taken using thermocouples and pitot tubes of various size, a yawhead probe, a cross-wire hot-wire, and a straight-wire hot-wire as appropriate For measuring the temperature fluctuations the straight hot-wire probe was operated in the low overheat mode to maximize temperature sensitivity Dissert Abstr

N78-15521# Northrop Corp , Hawthorne, Calif Aircraft Div
DEVELOPMENT AND EVALUATION OF METHODS OF PLANE STRESS FRACTURE ANALYSIS, PART 2 VOLUME 2 FRACTURE RESISTANCE AND MATERIAL PROPERTY CHARACTERIZATION Final Report, Jan 1973 - Dec 1974
D P Wilhem and J H Fitzgerald Aug 1977 211 p refs 2 Vol
(Contract F33615-72-C-1796 AF Proj 486U)
(AD-A046180, NOR-74-309-Pt-2-Vol-2, AFFDL-TR-73-42-Pt-2-Vol-2) Avail NTIS HC A10/MF A01 CSCL 01/3

In this volume those data required to characterize a materials fracture behavior and necessary to the residual strength prediction method proposed in Volume I are presented for the materials examined in this study These data were developed from an extensive series of crack growth resistance tests performed on the relatively new crack line wedge loaded (CLWL) specimen geometry The following materials were examined in both the LT and TL fracture plane orientations in two thicknesses (approximately 80 total specimens) 7075-T6, 7075-T73 2024-T3 Ti-6Al-4V, Ti-6Al-6V-2Sn Crack growth resistance data were also obtained for a 9 nickel steel sheet in both crack orientations Normal and extended range stress-strain data have been recorded for each material In addition to yield and ultimate strength, material moduli have been obtained by strain gage as well as conventional extensometer for use in the double compliance method for determining crack length and applied load GRA

N78-15525# Royal Aircraft Establishment Farnborough (England)
STRESS INTENSITY FACTORS FOR A CRACKED HOLE IN A ROW OF HOLES
D P Rooke and R W Coveney 25 May 1977 19 p refs
(RAE-TR-77073 BR58707) Avail NTIS HC A02/MF A01

The compounding technique of obtaining stress intensity factors is applied to cracks at the edge of one hole in a row of periodically spaced holes The cracks (one or two) lie along the line of holes and perpendicular to the uniform stress which is applied remotely from the holes This configuration models cracks at rivet holes in airframe structures reinforced with riveted stiffeners if there is little in-plane load-transfer through the rivets A particular feature of the solution is the high accuracy of the results at short crack lengths - a necessary requirement for the reliable estimation of the lifetimes of growing cracks Author (ESA)

N78-15635# National Physical Lab Teddington (England)
THE INSTALLATION OF A SUBMILLIMETRE MICHELSON INTERFEROMETER INTO CANBERRA AIRCRAFT WE173
M J Bangham R H Bradsell J E Harries N R W Swann N W B Stone, J R Birch J Hansen-Addy A P Cluley (RAE Farnborough Engl), and D G James (RAE Farnborough, Engl) Jun 1977 21 p refs
(NPL-QU-38) Avail NTIS HC A02/MF A01

A National Physical Laboratory Michelson interferometer spectrometer operating in the submillimeter wavelength region was installed in Canberra aircraft WE173 at the Royal Aircraft Establishment, Farnborough This device is intended for use in measurements of stratospheric water vapor, ozone and other minor constituents through an analysis of atmospheric thermal emission spectra Some details of the instrumentation and the installation are described and the results of three initial test flights are discussed Author (ESA)

N78-15712# Onyx Corp Bethesda Md
THE IMPACT OF MICROCOMPUTERS ON AVIATION A TECHNOLOGY FORECASTING AND ASSESSMENT STUDY VOLUME 1 UNCONSTRAINED FORECASTS OF MICROCOMPUTER TECHNOLOGY Final Report
Alfred Adler, F Thomas Ayers, Kan Chen Robert Lyjak and Kensall D Wise Sep 1977 315 p refs 2 Vol
(Contract DOT-FA76WAI-609)
(AD-A046217 OTSD-77-609-9-1) Avail NTIS HC A14/MF A01 CSCL 01/2

In recognition of the major impact which microcomputers may have on society in general and aviation in particular the Federal Aviation Administration Office of Aviation Policy Policy Development Division System Concepts Branch has funded this study consistent with the goals of its Technology Assessment and Forecasting Program The study has as its main objective the assessment of the impact of microcomputers on the National Aviation System (NAS) The time horizon of the impact assessment is 1976 to 2000 A D The impact will be assessed with respect to the important goals of the NAS specifically those referred to as the S3e goals (Safety Energy Environment Economics) Another objective of the study is to identify the policy implications accompanying the impacts Author (GRA)

N78-15713# Onyx Corp Bethesda Md
THE IMPACT OF MICROCOMPUTERS ON AVIATION A TECHNOLOGY FORECASTING AND ASSESSMENT STUDY VOLUME 2 CONSTRAINED FORECASTS AND ASSESSMENT OF MICROCOMPUTER TECHNOLOGY Final Report
F Thomas Ayers Kan Chen Kenan Jarboe Kensall D Wise and Ronald Yokely Sep 1977 197 p refs 2 Vol
(Contract DOT-FA76WAI-609)
(AD-A046218 OTSD-77-609-9-2) Avail NTIS HC A09/MF A01 CSCL 01/2

The study of the impact of microcomputers on aviation consists of two parts The first part technological forecasting of microcomputers with specific reference to aviation applications has been reported in Volume I This volume (Volume II) presents the results of technology assessment of microcomputers with special emphasis on the impacts of microcomputers with special emphasis on the impacts of microcomputers on the National Aviation System (NAS) and their policy implications Author (GRA)

N78-15852*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EBF NOISE SUPPRESSION AND AERODYNAMIC PENALTIES

D J Mckinzie Jr 1978 18 p refs Presented at the 16th Aerospace Sci Meeting Hunstville Ala 16-18 Jan 1978 Sponsored by AIAA

(NASA-TM-73823 E-9412) Avail NTIS CSCL 20A

Acoustic tests were conducted at model scale to determine the noise produced in the flyover and sideline planes at reduced separation distances between the nozzle exhaust plane and the flaps of an under-the-wing externally blown flap configuration in its approach attitude Tests were also made to determine the noise suppression effectiveness of two types of passive devices which were located on the jet impingement surfaces of the configuration In addition static aerodynamic performance data were obtained to evaluate the penalties produced by these suppression devices Author

N78-15859# National Aerospace Lab , Amsterdam (Netherlands) Flight Div

EXPLORATORY INVESTIGATION OF DECELERATING APPROACHES OF A TWIN-ENGINED JET TRANSPORT VOLUME 2 MOVING-BASE SIMULATION AND COMPARISON WITH RELATED EXPERIMENTS

C F G M Hofman 1 Oct 1976 85 p refs

(Contract NIVR-1747)

(NLR-TR-76150-U) Avail NTIS HC A05/MF A01

Aircraft noise perceived on the ground can be reduced by decelerating the aircraft during the landing approach As an additional benefit the lower thrust settings existing during a part of the approach and the shorter approach time result in reduced fuel consumption as compared to a conventional approach An experiment on decelerating approach procedures was carried out with a moving-base flight simulator During the decelerating approaches the constant deceleration (0 5 kt/s) initiated (with or without autothrottle) at a speed appreciably above the final approach speed was executed with an increasing flap deflection (constant rate) Results of performance measurements, pilot effort ratings and comments are given A comparison was made with a fixed-base simulation and an in-flight experiment During the decelerating approaches considered as acceptable, more effort was spent in obtaining a performance comparable to the performance obtained during a conventional approach

Author (ESA)

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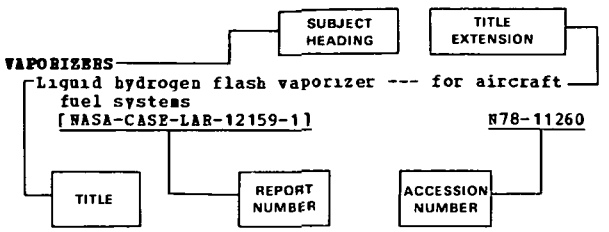

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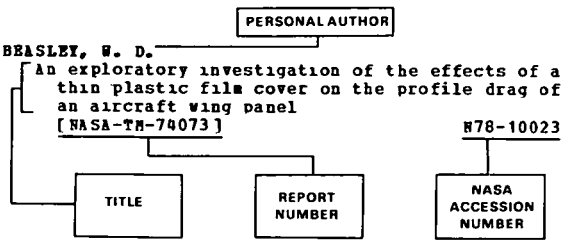

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1 Report No	2 Government Accession No	3 Recipient's Catalog No
NASA SP-7037 (95)		

4 Title and Subtitle	5 Report Date
AERONAUTICAL ENGINEERING A Continuing Bibliography (Supplement 95)	April 1978
	6 Performing Organization Code
7 Author(s)	8 Performing Organization Report No
	10 Work Unit No
9 Performing Organization Name and Address National Aeronautics and Space Administration Washington, D. C. 20546	11 Contract or Grant No
	13 Type of Report and Period Covered
12 Sponsoring Agency Name and Address	14 Sponsoring Agency Code

15 Supplementary Notes

16 Abstract

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17 Key Words (Suggested by Author(s))	18 Distribution Statement
Aerodynamics Aeronautical Engineering Aeronautics Bibliography	Unclassified - Unlimited

19 Security Classif (of this report)	20 Security Classif (of this page)	21 No of Pages	22 Price*
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