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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 56

APRIL 1975

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (56)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 56

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 1975 in:

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 439 reports, journal articles, and other documents originally announced in March 1975 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* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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

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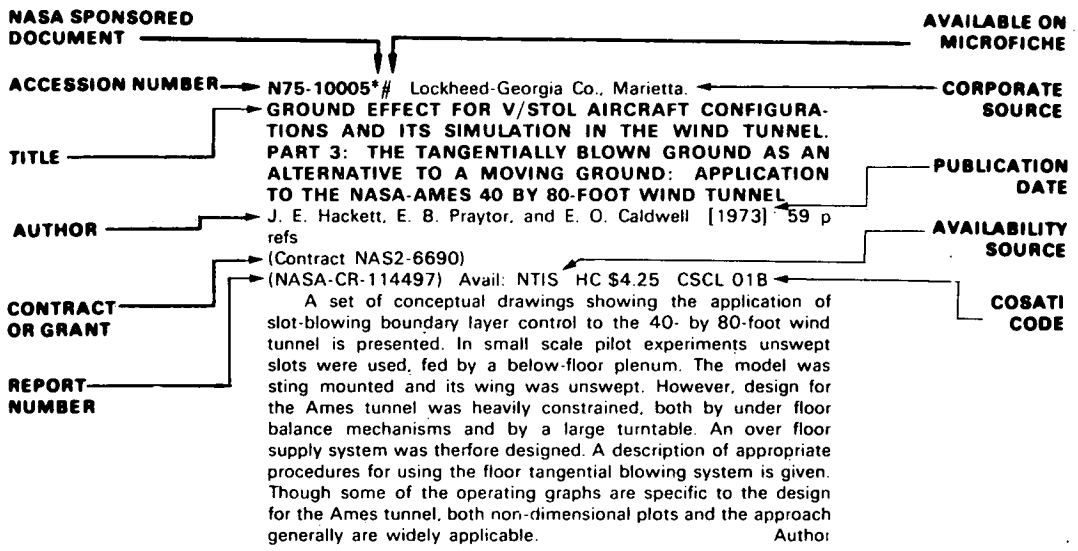

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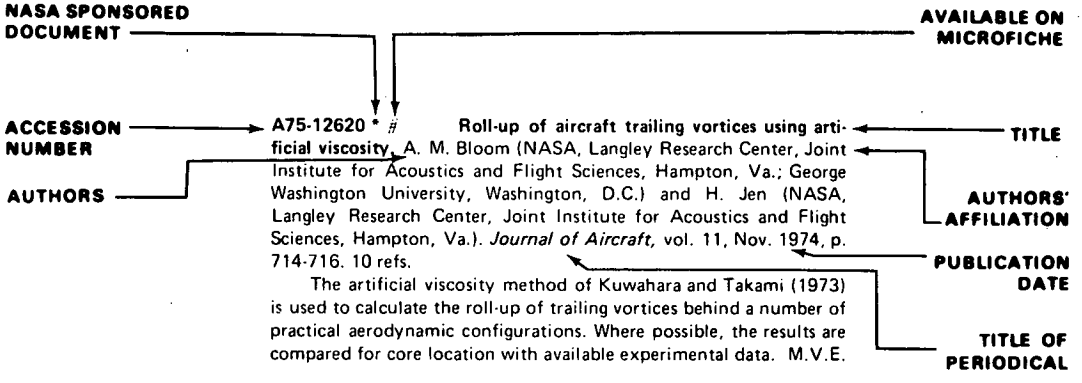

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 56) APRIL 1975

IAA ENTRIES

A75-16805 * # **Suppressor nozzle and airframe noise measurements during flyover of a modified F106B aircraft with underwing nacelles.** R. R. Burley (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Aero-1.* 14 p. 21 refs. Members, $1.00; nonmembers, $3.00.

The effect of flight velocity on the jet noise and thrust of a 104-tube suppressor nozzle was investigated using an F-106B delta wing aircraft modified to carry two underwing nacelles each containing a turbojet engine. The nozzle was mounted behind one of the nacelles. Flight velocity had a large adverse effect on thrust and a small adverse effect on suppression when correlated with relative jet velocity. The clean airframe noise of the aircraft was measured at Mach 0.4 and was compared with that predicted from an empirical expression. The 83-dB measured value was considerably below the predicted value. (Author)

A75-16806 # **Low frequency core engine noise.** S. B. Kazin and J. J. Emmerling (General Electric Co., Cincinnati, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Aero-2.* 8 p. 10 refs. Members, $1.00; nonmembers, $3.00. U.S. Department of Transportation Contract No. FA72WA-3023.

The impact of low frequency core engine noise on overall turbofan engine noise is illustrated and discussed. In addition, a relationship is established between combustor inlet and exit conditions and the resulting core engine noise. This relationship is established by examination of component combustor and engine test data. Also, a procedure is developed which allows the prediction of low frequency core noise in terms of acoustic power level, directionality, and spectral content. The characteristics of a low frequency combustor noise suppressor are examined, and results from testing such a suppressor are discussed. (Author)

A75-16807 # **Acoustic investigation of a hybrid propulsive lift system.** N. Sc...te (Lockheed-Georgia Co., Marietta, Ga.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Aero-3.* 12 p. 6 refs. Members, $1.00; nonmembers, $3.00.

Results are presented for a static small-scale model test program to investigate the acoustic characteristics of a hybrid propulsive lift system employing upper surface blowing in combination with blowing at the flap knee and trailing edge. Three USB nozzle configurations were tested in combination with two flap concepts at pressure ratios ranging from 1.2 to 1.5 in the take-off and landing modes. Trailing edge rake surveys were used to determine flow attachment. Compared with upper surface blowing (USB) nozzle alone, the addition of the wing causes a reduction in high frequency noise due to shielding and a significant increase in low frequency noise caused by the interaction of the flow with the wing/flap. Peak sideline noise is reduced slightly at the take-off flap setting but increases considerably at aft locations with a small flap knee radius and high turning angle. (Author)

A75-16808 * # **Effect of forward velocity on the noise characteristics of dual-flow jet nozzles.** D. H. Reed (Boeing Commercial Airplane Co., Renton, Wash.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Aero-4.* 9 p. Members, $1.00; nonmembers, $3.00. Contract No. NAS3-16815.

Acoustic results of jet noise tests conducted on scale-model nozzles at a wall isolation facility are presented and analyzed. The test fixture featured a triple-flow system for the purpose of simulating freestream flow around hot dual-flow jet nozzles. Test nozzles included 1/20th scale models of the exhaust system for the JT8D-9 engine, power plant for the Boeing 727 airplane (bypass ratio 1) and of the JT8D-109 refan engine (bypass ratio 2). It was found that overall jet noise is reduced by the forward velocity in proportion to the fifth and sixth power of the relative primary jet velocity. Spectral and directivity characteristics are presented. (Author)

A75-16820 # **The use of inertia compensators for heliostat base motion isolation.** G. C. Comfort (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, Colo.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Aut-13.* 7 p. 5 refs. Members, $1.00; nonmembers, $3.00.

The base motion isolation of an optical beam deflector with a two-axis gimbal support (heliostat) is discussed. The use of an auxiliary inertia coupled between the elevation gimbal and the heliostat mirror to produce a compensating torque upon the mirror is examined in detail. Two types of such inertia compensators, previously discussed and instrumented by others, referred to as a gear compensator and a belt compensator, are presented. The required size and inertia ratios of these compensators to provide output pointing direction isolation from base motion are determined. The effect of coulomb friction on the compensator action of a gear compensator is evaluated. Such friction-produced pointing error is shown to be reduced by the use of a combined inertia compensator utilizing both the belt and gear compensators simultaneously. The combined compensator investigation and the development of its dynamics equations, along with the investigation of coulomb friction effects are to the author's knowledge, original contributions. (Author)

A75-16827 # **The natural frequencies and critical speeds of a rotating, flexible shaft-disk system.** D. R. Chivens (Lexitron Corp., Chatsworth, Calif.) and H. D. Nelson (Arizona State University, Tempe, Ariz.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/DE-14.* 6 p. 7 refs. Members, $1.00; nonmembers, $3.00.

An analytical investigation into the influence of disk flexibility on the transverse bending natural frequencies and critical speeds of a rotating shaft-disk system is presented. The geometric model considered consists of a flexible continuous shaft carrying a flexible continuous circular plate. The partial differential equations governing the system motion and the associated exact solution form are developed. Numerical solutions are presented covering a wide range of non-dimensional parameters and general conclusions are drawn. (Author)

A75-16833 # **Vibration analysis of rotating turbine blades.** P. Trompette and M. Lalanne (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/DE-23.* 9 p. 11 refs. Members, $1.00; nonmembers, $3.00. Direction des Recherches et Moyens d'Essais Contract No. 70/688.

Kinetic and potential strain energies of a tri-dimensional system, including large strains and effect of rotation are presented. Complete calculations are performed using the finite-element method. Dynamic analysis of an actual turbine blade modeled by isoparametric elements including root's influence, temperature and rotation effects is then performed. It is shown that, the first three experimental and theoretical frequencies at rest are in good agreement, and that the temperature effect compensates rotation effect for the first frequency and is the dominant parameter for the higher frequencies at operating speed. Finally, the use of Rayleigh's quotient allows us to deduce easily the frequencies at various speed and temperature conditions from those calculated at operating speed and ambient temperature. (Author)

A75-16837 # **Use of low grade solid fuels in gas turbines.** D. A. Furlong and G. L. Wade (Combustion Power Co., Inc., Menlo Park, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Ener-5.* 10 p. Members, $1.00; nonmembers, $3.00. Research supported by the U.S. Environmental Protection Agency and U.S. Department of the Interior.

A direct combustion concept for using solid fuels, known as the CPU-400, is being developed at Combustion Power Company, under contract to the Environmental Protection Agency and the Office of Coal Research. The CPU-400 utilizes a fluidized bed combustor in a gas turbine cycle to convert the heating value of solid fuel into electricity. This paper describes the process development unit and results of experiments on the fluidized bed combustor and supporting equipment. Properties of the solid fuels used are presented and combustor performance is discussed. The effectiveness of the inertial separators used to remove particulates from the hot gases prior to turbine inlet is also discussed. Preliminary turbine performance is presented along with the results from a set of on-line exhaust gas sampling instruments. (Author)

A75-16846 * # **Experimental and analytical sonic nozzle discharge coefficients for Reynolds numbers up to 8,000,000.** A. J. Szaniszlo (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/FM-8.* 5 p. 36 refs. Members, $1.00; nonmembers, $3.00.

Sonic discharge coefficients are presented for two different geometry flow nozzles using nitrogen gas at high pressures where real-gas corrections are significant. Throat Reynolds number range extended up to 8,000,000. Experimentally obtained coefficients for a nozzle with a continuous and finite radius of curvature agreed with those obtained analytically to within 0.2 per cent. Experimental coefficients for a long-radius ASME nozzle agreed to within 0.25 per cent to an empirical equation representing the most probable subsonic discharge coefficient. (Author)

A75-16847 # **On the calculation of two-dimensional subsonic and shock-free transonic flow.** M. Ribaut and R. Vainio (Brown, Boveri et Cie. AG, Baden, Switzerland). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-1.* 7 p. 12 refs. Members, $1.00; nonmembers, $3.00.

Application of the potential theory to the full equations of two-dimensional compressible flow has yielded a method of calculation valid for isolated airfoils as well as for cascades situated on an arbitrary surface of revolution. Various computed subcritical and supercritical flows are presented and compared with exact solutions. Close relation between convergence interval and the existence of discontinuities in the solution was established, which makes it possible to recognize and develop transonic flow patterns having no or only weak shocks. (Author)

A75-16848 # **Recirculation effects in gas turbine combustors.** R. Kollrack and L. D. Aceto (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-3.* 4 p. Members, $1.00; nonmembers, $3.00.

An evaluation of the effects caused by recirculation of hot final combustion products into unburned or partially burned fuel/air mixtures indicates that the thermal effect predominates the combustion activity. Dilution and the introduction of active radicals produce lesser results. Internal recirculation, such as produced by swirl or bluff body stabilization, differs from external recirculation by the temperature levels of the recirculant and its composition. The net effect of recirculation is to simulate a longer residence time and/or an effective higher inlet temperature. As a general result, the end products are closer to equilibrium, specifically the CO levels are lower and the NO levels higher. (Author)

A75-16849 # **A comparison of the matrix and streamline curvature methods of axial flow turbomachinery analysis, from a user's point of view.** W. R. Davis (Carrier Corp., Syracuse, N.Y.) and D. A. J. Millar (Carleton University, Ottawa, Canada). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-4.* 10 p. 16 refs. Members, $1.00; nonmembers, $3.00. National Research Council of Canada Grant No. A-1676.

A75-16850 # **Effects of heat soakage in axial flow compressors.** R. Elder (Cranfield Institute of Technology, Cranfield, Beds., England). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-5.* 8 p. 8 refs. Members, $1.00; nonmembers, $3.00.

This paper considers the effects of heat soakage on the airflow within an axial flow compressor during a period of hot gas ingestion typically arising during VTOL, thrust reverse and armament firing operations. It also considers the blading surface temperature during a slam deceleration-acceleration cycle in an attempt to determine how quickly the blades cool after the deceleration and so avoid the premature stall which can arise during a 'slam' acceleration with the blading still hot. The approach is purely theoretical. (Author)

A75-16853 # **The influence of cooling, free-stream turbulence and surface-roughness on the aerodynamic behavior of cascades.** D. Bökenbrink (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-9.* 16 p. 31 refs. Members, $1.00; nonmembers, $3.00.

A method for computing the plane viscous compressible subsonic flow through cascades is presented and compared with measurements. The solution for the inviscous potential flow is based upon a singularity method taking the compressibility into account by a mean-streamline-analogy. The influence of friction is calculated from a set of equations, describing the behavior of the boundary layers. It is solved by the method of finite elements. The influence of upstream-turbulence, blade-surface-roughness and also of the dif-

ferent blade-cooling methods on the aerodynamic blade losses can be determined. The method can be applied to arbitrary blade profiles. Even for profiles with very thin or thick trailing edges good agreement with measurements is obtained. (Author)

A75-16858 # **Gas turbine combustor analysis.** D. A. Sullivan (General Electric Co., Gas Turbine Engineering Dept., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/GT-21.* 9 p. 10 refs. Members, $1.00; nonmembers, $3.00.

The pressure, temperature, and fuel-to-air ratio of a gas turbine combustor vary with ambient conditions, machine speed, and load. Only a few of these parameters are independent. An analysis has been developed which predicts the combustor operating parameters. The analysis includes low heating value fuel combustion, water injection, and three modes of steam injection. The analysis is used to predict the combustor operation for a simple-cycle gas turbine, but it is not restricted to this case. In addition, a simplified analysis is deduced and shown to be surprisingly accurate. Special solutions are presented which permit direct calculation of the firing temperatures, fuel heating value, or air extraction required to achieve a specified compressor pressure ratio. Finally, the analysis is compared with experimental results. (Author)

A75-16872 # **Wear characteristics of woven Teflon fabric bearings.** W. A. Glaeser and K. F. Dufrane (Battelle Columbus Laboratories, Columbus, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, New York, N.Y., Nov. 17-22, 1974, Paper 74-WA/Lub-2.* 4 p. Members, $1.00; nonmembers, $3.00. Navy-USAF-supported research.

The wear characteristics of a self lubricating material - woven Teflon fabric - have been determined for slow-motion oscillating plain bearings. Initial rapid wear and deformation were found to be significant, but the wear rate later diminished. Teflon-fabric bearings can be operated at temperatures to 500 F, provided the load is reduced below the capacity for the material under ambient-temperature conditions. Wear tends to increase with increasing sliding velocity. A tendency for adhesive bond failure was identified which can result in detachment of the fabric from its backing during service; detachment can cause a loss of the bearing. (Author)

A75-16895 **LARZAC - A small turbofan engine for military and general aviation aircraft.** L. A. Chuslo and H. D. Greenburg (Teledyne CAE, Arlington, Va.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740807.* 19 p. 9 refs. Members, $1.75; nonmembers, $2.75.

The Larzac turbofan engine, rated at 1318 deca Newtons (2965 pounds) thrust at sea level static, is now in final qualification as a powerplant for a new generation of military trainers, light strike fighters, and small business jets. The Larzac engine is being developed by two French companies through a joint controlling group. This paper discusses the Larzac engine design, development, flight test, preliminary qualification test, and manufacture. (Author)

A75-16896 **Research and development of the FJR710 turbofan engine.** M. Matsuki, T. Torisaki (National Aerospace Laboratory, Tokyo, Japan), K. Miyazawa, and M. Itoh (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740809.* 10 p. Members, $1.75; nonmembers, $2.75.

Research and development of high bypass ratio turbofan engines have been conducted in Japan since 1971. Three prototype engines have been built and tested and have met design specifications. The engineering background of the project's initiation is reviewed. The purpose and management of the system are discussed. The objectives and master schedule as well as engine specifications and design features of the engine are presented. The state of development of the engine, including performance data and problems encountered, are reviewed. (Author)

A75-16899 **Process control techniques in airplane manufacturing.** C. R. Cunningham (Boeing Commercial Airplane Co., Renton, Wash.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740812.* 6 p. 6 refs. Members, $1.75; nonmembers, $2.75.

This paper presents an explanation of the reasons why process control is used in airplane manufacture. A discussion of cadmium plating, structural bonding, and machining provides examples of current control of these processes. (Author)

A75-16900 * **Development and application of ride-quality criteria.** D. G. Stephens (NASA, Langley Research Center, Cleveland, Ohio). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740813.* 10 p. 10 refs. Members, $1.75; nonmembers, $2.75.

A program for the development of ride-quality vibration criteria applicable to the design and evaluation of air and surface transportation systems is described. Consideration is given to the magnitude of vehicle vibration experienced by the passenger, the frequency of vibration, the direction of vibration, and the influence of seat dynamics on passenger response. Comparative vibration measurements are presented for a variety of air and surface transportation systems. In addition, simulator data on seat dynamics and passenger response are presented. Results suggest the relative merits of various physical descriptors and measurement locations for characterizing the vibration in terms suitable for the design and/or evaluation of transportation systems. (Author)

A75-16902 **Improved vibration design and test procedure for aircraft.** C. J. Beck, Jr. (Boeing Aerospace Co., Seattle, Wash.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740815.* 6 p. Members, $1.75; nonmembers, $2.75.

Recent experience with vibration qualification of avionics for the B-1 airplane has revealed deficiencies in commonly used vibration design and test procedures. Specific examples of deficiencies are discussed. Recommendations for improving vibration design and test procedures are presented in the areas of environmental prediction, qualification testing, and use of vibration isolators. Suggestions are made relative to vibration design and testing in light of the 'try-before-buy' concept. (Author)

A75-16903 **U.S. Navy LAMPS operations report.** R. M. Boh, Jr. (U.S. Navy, Washington, D.C.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740817.* 5 p. Members, $1.75; nonmembers, $2.75.

The light airborne multipurpose system (LAMPS) is a destroyer/helicopter system designed to extend the antisubmarine warfare and surveillance capabilities of destroyer class ships beyond the horizon. The LAMPS program consists of two principal elements: the MK I system using modified H-2 helicopters aboard modified DASH ships, which has been operational since 1971; and the follow-on MK III system, with greatly increased capability, which is in full-scale development. The LAMPS concept has been proved and fully accepted by the fleet. All new surface combatants will have the capability of operating helicopters. (Author)

A75-16904 **Maritime VSTOL - The development of small ship helicopter operations in the Royal Navy.** D. B. Bathurst (Ministry of Defence/Navy/, London, England). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740820.* 16 p. 5 refs. Members, $1.75; nonmembers, $2.75.

A75-16905 * **Test techniques for obtaining off-nominal compressor data during engine tests.** T. J. Biesiadny (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740822.* 8 p. 6 refs. Members, $1.75; nonmembers, $2.75.

Several unique techniques and related devices are in use at the Lewis Research Center for off-design testing of fan and compressor sections in full-scale jet engines. The devices presented not only permit a wide range of experimental conditions but also minimize downtime for hardware changes. The techniques involve use of such devices as inlet pressure distortion jets, a hydrogen burner for inlet temperature distortions, fan back pressure jets to simulate a variable area nozzle, and either an inflow-outflow bleed system or a fuel spurt system to alter compressor discharge pressure. (Author)

A75-16906 **Utilization of a dual spool compressor test facility to aid development of turbofan engines.** A. W. Stubner and E. Canal, Jr. (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740823.* 12 p. Members, $1.75; nonmembers, $2.75.

The development of compression systems for advanced twin-spool turbofan engines became increasingly more difficult as stability, performance, weight, and cost reduction goals were increased. A requirement existed for a component test technique to develop the entire twin-spool compression system in a simulated engine environment, with sufficient operating flexibility to reproduce critical operating points that might be incurred during actual engine operation. The Pratt & Whitney Aircraft dual-spool compressor facility was designed and built to meet this requirement. The dual-spool facility has been employed in the development of several advanced models of the JT9D engine, in the JT10D demonstration engine development program, and in a U.S. Air Force sponsored program (F33615-70-C-1549, sponsored by AFAPL), which employed the TF30 compression system to investigate the nature of dual-spool interactions. This paper describes the facility as it was conceived and built at Pratt & Whitney Aircraft and also summarizes a few of the more important programs to which the facility has been applied. (Author)

A75-16907 **Supersonic inlet simulator - A tool for simulation of realistic engine entry flow conditions.** W. F. Kimzey (ARO, Inc., Arnold Air Force Station, Tenn.) and S. H. Ellis (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740824.* 14 p. 14 refs. Members, $1.75; nonmembers, $2.75. USAF-sponsored research.

Serious difficulties have been experienced in the development of some supersonic aircraft due to engine stability problems arising from previously unknown characteristics of the flow field at the engine-inlet interface plane. To ensure against further unknowns, an F-15 inlet simulator was designed, constructed, and installed in an altitude test cell for realistic engine testing with inlet flow distortions. Interface flow conditions are produced by accelerating air through a two-dimensional nozzle to duplicate the last oblique shock wave of the aircraft inlet. The terminal shock, spillage past the cowl lip, and inlet bleeds are reproduced. Forebody effects, angle of attack, and sideslip can be simulated. Scale model tests used to develop the simulator concept are reviewed. Experimental results from the full-scale inlet simulator are presented showing the ability to reproduce time-variant inlet flow fields, including the most severe inlet patterns, buzz, and hammershock. (Author)

A75-16908 * **On-line calibration of high-response pressure transducers during jet-engine testing.** E. C. Armentrout (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740825.* 8 p. Members, $1.75; nonmembers, $2.75.

Current jet engine testing is concerned with the effect of inlet pressure and temperature distortions on engine performance and involves the use of numerous miniature pressure transducers. Despite recent improvements in the manufacture of miniature pressure transducers, they still exhibit sensitivity change and zero shift with temperature and time. To obtain meaningful data, a calibration system is needed to determine these changes. A system has been developed which provides for computer selection of appropriate reference pressures selected from nine different sources to provide a two- or three-point calibration. Calibrations are made on command, before and sometimes after each data point. A unique 'no leak' matrix valve design is used in the reference-pressure system. Zero-shift corrections are measured and the values are automatically inserted into the data reduction program. (Author)

A75-16909 **F-12 inlet development.** D. H. Campbell (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740831.* 10 p. 5 refs. Members, $1.75; nonmembers, $2.75.

The aerodynamic design of the F-12 engine air inlet is discussed following development from its inception to the present configuration. A description of the various tests related to the inlet is presented, along with some of the tests results. The importance of engine, inlet, and ejector matching is discussed. Close coordination between the airframe and engine manufacturer allowed the selection of an airframe-mounted ejector with inherent performance advantages. The nozzle requirements affected the final selection of the inlet bleed system. Early testing of inlet distortion on the engine compressor rig helped provide adequate engine stall margins. Comparison of early one-eighth scale model data with recent NASA test and flight data is included. (Author)

A75-16910 **J58/YF-12 ejector nozzle performance.** P. W. Herrick (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif , Oct. 1-3, 1974, Paper 740832.* 11 p. 12 refs. Members, $1.75 nonmembers, $2.75.

The Lockheed YF-12 aircraft uses a blow-in door ejector nozzle, which consists of a variable area, primary nozzle mounted on the afterburner of a Pratt & Whitney Aircraft J58 engine and blow-in doors, a convergent-divergent spool piece, and variable exit area free-floating flaps integrated into a Lockheed YF-12 airframe. Performance data from cold-flow, wind tunnel models and hot-flow, static stand models were correlated and compared with actual flight test data. It was found that these data showed agreement when both internal thermodynamic and external aerodynamic effects were considered. (Author)

A75-16912 **Isothermal shape rolling of net sections.** A. G. Metcalfe, W. J. Carpenter, and F. K. Rose (International Harvester Co., San Diego, Calif.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740836.* 12 p. Members, $1.75; nonmembers, $2.75. Contract No. F33615-72-C-1217.

Isothermal metal working (ISR) using resistance heating of the metal being worked is a new process developed by the Solar Division of International Harvester. The process is unique and can be used effectively to roll structural as well as special shapes from various alloys including titanium, stainless steel, and superalloys. Sheet or plate stock can be rolled into Z-section stiffeners and channels with square external corners and internal fillets. Bar stock can be rolled into 'I' and 'T' sections in one-or two-roll passes. Airfoils for gas turbine blades and vanes can be formed with rolls profiled with the contour shapes desired. The general characteristics of the processes are described. These include: high metal recovery (better than 90%); fine surface finish (16 rms); freedom from surface contamination; major thickness reductions per pass (better than 80%); control of microstructure; and very low energy consumption in processing. These characteristics result in major cost reductions when compared with the existing methods of manufacture. (Author)

A75-16913 **F-14A status report - Operational capabilities, program accomplishments, and cost.** M. Pelehach (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740842.* 12 p. Members, $1.75; nonmembers, $2.75.

A75-16914 **Design, integration, and testing of the F-15.** H. H. Cole (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740843.* 19 p. Members, $1.75; nonmembers, $2.75.

The F-15 is a new generation air superiority fighter built by McDonnell Aircraft Co. for the U.S. Air Force. The aircraft is well along in its contractor development test and evaluation. Air Force development test and evaluation started in the spring of 1974, and operational aircraft will be delivered to the Air Force in the fall of 1974. The F-15 represents the first Air Force fighter weapon system with firm contract milestones developed under the U.S. Department of Defense concept of 'Fly Before Buy'. This new weapon system has called for new concepts in program management and new approaches to design, integration, and testing to meet its operational and contractural requirements. (Author)

A75-16915 **The transition from effective aircraft engine control to effective industrial engine control.** F. F. Hutton (General Motors Corp., Detroit Diesel Allison Div., Detroit, Mich.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740848.* 30 p. Members, $1.75; nonmembers, $2.75.

The Allison T56 turboprop aircraft engine has been modified and converted into an efficient industrial powerplant. As a part of this transition, the aircraft engine control system had to undergo certain changes to adapt it for regulation of industrial engines. The differences in engine applications, installations, duty cycle requirements, etc. were some of the considerations that had to be taken into account in the effort of making the industrial control system as effective as its aerospace counterpart. These problems and the approach to their solutions are discussed in this paper. (Author)

A75-16917 **An LN2 fuel tank inerting system for commercial transports.** K. R. Bragg (Parker-Hannifin Corp., Los Angeles, Calif.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740852.* 12 p. Members, $1.75; nonmembers, $2.75.

This paper presents what is considered to be the optimum fuel tank inerting system for commercial transport aircraft. It stresses the inherent simplicity made possible by use of liquid nitrogen for the source of inert gas. It also reviews some of the fundamentals involved in removing oxygen from fuel and presents a new concept for removing dissolved oxygen from fuel with no moving parts and no additional nitrogen. (Author)

A75-16918 **Hollow-fiber permeable membrane for airborne inert gas generation.** S. A. Manatt (AiResearch Manufacturing Company of California, Los Angeles, Calif.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740854.* 10 p. 12 refs. Members, $1.75; nonmembers, $2.75.

A hollow-fiber, permeable-membrane, air-separation module is being developed for applications to aircraft fuel tank inerting systems. The module reduces the oxygen content of air below the limit for flame propagation, allowing the use of the processed air as an inert gas. Unlike previous cyrogenic nitrogen inerting systems, onboard inert gas generation fuel tank inerting systems operate without the need for regular ground servicing or large airborne storage capacity, thereby offering substantially reduced weight. (Author)

A75-16919 **Thin film permeable membranes for inert gas generation.** W. Browall, J. W. Harrison, and R. Salemme (General Electric Co., New York, N.Y.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740855.* 7 p. Members, $1.75; nonmembers, $2.75.

A new ultrathin-backed semipermeable membrane has been developed which shows considerable promise as a gas separator for engine-bleed air to provide nitrogen-rich air for aircraft fuel tank inerting. The membrane is a silicone, polycarbonate copolymer of 1500 A effective thickness, deposited on a reinforced porous backing. The selective removal of oxygen provides oxygen concentrations of less than 9% in the inerting gas. Small-scale testing demonstrated that the backed membranes are suitable in the aircraft environment. A system using such membranes avoids the logistic and service requirements of tanked liquid nitrogen. (Author)

A75-16920 **Aircraft fuel tank inerting by catalytic fuel combustion.** J. Rousseau, G. H. McDonald (AiResearch Manufacturing Company of California, Los Angeles, Calif.), and G. W. Gandee (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740856.* 11 p. Members, $1.75; nonmembers, $2.75.

A flight-configured catalytic reactor suitable for aircraft fuel tank inerting by oxidation of jet fuel in flight has been successfully developed. Inert gas stream oxygen concentrations below 1% were achieved repeatedly when operating at near-stoichiometric fuel-air ratios. Reactor construction and thermal control features were validated through 60 h of testing over a wide range of operating conditions. The weight of a complete fuel tank inerting system capable of delivering 52 lb/min of inert gas is estimated at 305 lb, and its size is 19 x 24 x 55 in; this represents a significant savings when compared to current techniques of fuel tank inerting. (Author)

A75-16921 * **HiMAT - A new approach to the design of highly maneuverable aircraft.** D. R. Bellman (NASA, Flight Research Center, Edwards, Calif.) and D. A. Kier (NASA, Washington, D.C.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740859.* 8 p. Members, $1.75; nonmembers, $2.75.

Needed improvements in the maneuvering performance of combat aircraft appear to be possible through the simultaneous application of advances in various disciplines in such a way that they

complement one another and magnify the benefits derived. The highly maneuverable aircraft technology (HiMAT) program is being conducted to investigate such multidisciplinary concepts. The program has three phases: preliminary studies, conceptual design studies, and the final design and construction of a test airplane. Work is now in the second phase. The test airplane will be a scaled model flown by a remotely piloted research vehicle technique. This paper outlines the HiMAT program and indicates the types of concepts being considered. (Author)

A75-16922 * Implications of multiplane-multispeed balancing for future turbine engine design and cost. R. H. Badgley (Mechanical Technology, Inc., Latham, N.Y.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740865.* 13 p. 7 refs. Members, $1.75; nonmembers, $2.75. Contracts No. NAS3-14220; No. F33615-72-C-1801.

This paper describes several alternative approaches, provided by multiplane-multispeed balancing, to traditional gas turbine engine manufacture and assembly procedures. These alternatives, which range from addition of trim-balancing at the end of the traditional assembly process to modular design of the rotating system for assembly and balancing external to the engine, require attention by the engine designer as an integral part of the design process. Since multiplane-multispeed balancing may be incorporated at one or more of several points during manufacture-assembly, its deliberate use is expected to provide significant cost and performance (reduced vibration) benefits. Moreover, its availability provides the designer with a firm base from which he may advance, with reasonable assurance of success, into the flexible rotor dynamic regime. (Author)

A75-16924 A brief look at engine installations for future naval aircraft. R. M. Gaertner (U.S. Naval Air Systems Command, Washington, D.C.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740881.* 11 p. Members, $1.75; nonmembers, $2.75.

This paper discusses various engine installations in naval aircraft, looking especially at their costs of maintenance. Fuel systems, fuel control systems, and several engine accessories are discussed for present and future engines. It is concluded that simple, reliable equipment is necessary to keep aircraft in the air instead of in maintenance areas on the ground. (Author)

A75-16925 An engine project engineer's view of advanced secondary power systems. W. L. McIntire and S. M. Hudson (General Motors Corp., Detroit Diesel Allison Div., Detroit, Mich.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740884.* 11 p. Members, $1.75; nonmembers, $2.75.

Increasing secondary powerloads, advanced technology components, varied installations, and increased emphasis on cost and performance provide the requirements against which the engine project engineer must seek a balance during the conceptual, design, and development phases of an engine program. This paper reviews the requirements for advanced engine secondary power systems and some of the trends which are developing for future propulsion systems. (Author)

A75-16926 * Manual and automatic flight control during severe turbulence penetration. D. E. Johnston and R. H. Klein (Systems Technology, Inc., Hawthorne, Calif.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, San Diego, Calif., Oct. 1-3, 1974, Paper 740890.* 14 p. 11 refs. Members, $1.75; nonmembers, $2.75. Contract No. NASw-2118.

In this paper, updated pilot/display/aircraft analysis techniques are applied to the problem of turbulence upset. In the course of an investigation of standard operating procedures and current autopilot turbulence modes, it was found that an improved turbulence penetration system is needed. A simulation was conducted to evaluate the turbulence autopilot and flight director concepts. It was found that an energy management system comprising the integrated autopilot and thrust director provided the greatest decrease in pilot work load and improvement in performance. (Author)

A75-17047 Steady motion of a rotating symmetric aircraft. V. N. Soshnikov and N. V. Fedorova. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* Jan.-Feb. 1974, p. 169-175.) *Mechanics of Solids,* vol. 9, no. 1, 1974, pp. 149-154. 5 refs. Translation.

A class of possible steady motions of a controlled spinning rocket without fins is identified, and the characteristics of the motion are studied qualitatively. The stability of the motions is analyzed, taking under consideration only the force factors and the combination of harmonic signals of different frequency and amplitude which describe approximately the oscillatory nature of the actual control signal. V.P.

A75-17085 Profile of wing with rotating flap in shearing flow. T. S. Patel' (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 29, Mar.-Apr. 1974, p. 97-105.) *Moscow University Mechanics Bulletin,* vol. 29, no. 1-2, 1974, p. 19-25. Translation.

Solution of the problem of the unbounded linear shear flow around a circular cylinder and a thin wing profile with a rotating flap. On the basis of the results for a thin profile, the particular cases of a flat plate and a nonsymmetric profile are considered, calculating the aerodynamic lift and pitch moment coefficients. Results are presented in graphical form. P.T.H.

A75-17087 Designing hovercraft jet nozzles. L. F. Fonova (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 29, May-June 1974, p. 64-73.) *Moscow University Mechanics Bulletin,* vol. 29, no. 3-4, 1974, p. 10-17. Translation.

A75-17092 Aerodynamic characteristics of axisymmetric bodies in a flow under 'localization-law' conditions. A. I. Bunimovich (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 29, July-Aug. 1974, p. 97-102.) *Moscow University Mechanics Bulletin,* vol. 29, no. 3-4, 1974, p. 63-67. 5 refs. Translation.

A75-17098 Industrial application of fracture mechanics (Industrielle Anwendung der technischen Rissbruchmechanik). D. Radaj (Daimler-Benz AG, Stuttgart, West Germany). *Zeitschrift für Werkstofftechnik,* vol. 5, Dec. 1974, p. 440-447. 33 refs. In German.

The goals and possibilities for application of fracture mechanics in industry are discussed on the basis of typical methods and examples taken from industrial practice. In strength tests, it is a question of either safe life or fail safe construction. The concept of crack arrest is contrasted with that of crack initiation. Examples drawn refer to safety and pressure vessels of nuclear reactors, welded joints, and gas pipe lines. Material can be selected according to either fracture toughness or yield stress for static loading, or according to its behavior under varying load amplitude and corrosion conditions for fatigue. In cases of catastrophic failure, it is possible to calculate back, using fracture mechanics methods, to the cause of failure. Plane strain and stress fracture toughness measurements are also useful in quality control. P.T.H.

A75-17099 **Hybrid technique for the generation of transonic flows with high Reynolds numbers (Hybridtechnik zur Erzeugung transsonischer Anströmungen hoher Reynoldszahl).** T. Hottner (Stuttgart, Universität, Stuttgart, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 22, Dec. 1974, p. 403-416. 10 refs. In German.

A test arrangement is described which allows the simulation of high Reynolds numbers particularly in the domain of transonic speed with reasonable effort. According to this procedure the model is towed in the counterflow of a weak non-stationary expansion wave (hybrid technique). The towing speed of the model lies within the range of the electrical linear engine propulsion technique which is under development at present. The essential design and operational data of the proposed test arrangement are given in nondimensional form. Also the effect of boundary layer and the shaping of the walls of the towing channel for wave cancellation are discussed. (Author)

A75-17100 **Lift and drag measurements in the case of a rectangular airfoil with a splitter wedge in the wake, taking into account the Mach number range from 0.5 to 1.2 (Auftriebs- und Widerstandsmessungen an einem Rechteckflügel mit Trennkeil im Totwasser im Machzahlbereich von 0,5 bis 1,2).** M. Tanner (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Strömungsmechanik, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 22, Dec. 1974, p. 416-426. 14 refs. In German.

Lift and drag measurements were performed on a rectangular wing with blunt trailing edge with and without splitter wedge in the free-stream Mach number range from 0.5 to 1.2 at a Reynolds number of approximately 1,400,000. A comparison with previous experimental results shows that a greater reduction of the base drag can be obtained by using a splitter wedge than by means of a broken trailing edge. In the transonic Mach number range the wing with splitter wedge has a somewhat smaller drag, a somewhat higher lift curve slope and a greater maximum lift to drag ratio than the corresponding wing with a sharp trailing edge. (Author)

A75-17305 **Separated flow in the neighborhood of the trailing edge of a three-dimensional thin wing (Ecoulement décollé au voisinage du bord de fuite d'une aile mince tridimensionnelle).** J.-P. Guiraud (Paris VI, Université, Paris; ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Journal de Mécanique,* vol. 13, Sept. 1974, p. 409-432. 29 refs. In French.

Study of the effect of viscosity on the structure of a laminar incompressible flow in the neighborhood of the trailing edge of a thin wing. A triple-deck scheme, developed by Stewartson and Williams (1969), which makes it possible to treat the effects of singular coupling between boundary layer and external flow, is employed to construct a scheme of separated flow at the trailing edge of a three-dimensional thin wing in the case of high Reynolds numbers. This scheme is based on an idea stemming originally from Goldstein (1930) that, when the boundary layer undergoes a rapid variation in the longitudinal direction, this variation is an inviscid and even purely convective phenomenon in most of the thickness of the boundary layer. In this case the singular coupling is assumed to be dominated by the wedge effect, but the angle-of-attack effect can be taken into account as a perturbation. Within the framework of this scheme a detailed study is made of the behavior of the Blasius layer, the eddy zone, and the irrotational-flow zone. A.B.K.

A75-17315 **A nonlinear theory for a hovercraft moving over regular waves.** A. J. Reynolds (Brunel University, Uxbridge, Middx., England). *Journal of Mechanical Engineering Science,* vol. 16, Oct. 1974, p. 310-316. 7 refs.

The equations governing the heaving and pitching of a hovercraft supported on two interconnected plenum compartments are integrated numerically to find the response as the craft passes over sinusoidal waves whose crests are normal to the direction of motion. When the flexible skirt around the plenum chambers comes into contact with the wave profile, it is assumed to collapse against the unyielding surface of the water. The scheme of integration is explained, and predictions of accelerations experienced on the craft are compared with those from a linearized theory developed earlier. For the range of wave heights considered, the accelerations indicated by the nonlinear theory are normally higher than those of the linear theory; save near pitching resonance, the two predictions differ by less than fifty per cent. For small wave heights, the ultimate response retains significant elements linked to the natural frequencies of pitch and heave. (Author)

A75-17318 # **Some comparisons between commercial and military aircraft maintenance and logistics.** J. F. McDonald (Flying Tiger Line, Inc., Los Angeles, Calif.). *Tech Air,* vol. 31, Jan. 1975, p. 5-11. 9 refs.

The evolution of commercial airline maintenance and engineering systems is outlined. Three phases are described, from the pre-war and post-war periods, when fixed overhaul times for engines and airframes were the rule, to the introduction of the B-747, L-1011, and DC-10, which entailed new maintenance planning guidelines. 'On condition' engine control methods have increased the typical time between overhauls from about 1500 hours in 1960 to around 16,000 hours today. Periods between major maintenance operations have also increased for airframes, functional system components, and avionics systems. The FAA maintenance planning guidelines set forth in the MSG-2 document are discussed, and the concepts of scheduled overhaul, on condition (OC), and condition monitoring (CM) are explained. It is concluded that present military maintenance practices could be improved by drawing on the experiences of commercial aviation to increase the economic yield of equipment. A.T.S.

A75-17342 **Three-dimensional laminar boundary layers in crosswise pressure gradients.** J. H. Horlock (Cambridge University, Cambridge, England), A. K. Lewkowicz (Liverpool, University, Liverpool, England), and J. Wordsworth (INTERATOM, Bensberg, West Germany). *Journal of Fluid Mechanics,* vol. 66, Dec. 11, 1974, p. 641-655. 16 refs.

The present work describes two experiments designed to develop a three-dimensional laminar boundary layer in the flow over a flat plate in a curved duct without producing a significant streamwise pressure gradient, and yet obtaining an appreciable crosswise pressure gradient. Velocity and yaw-angle profiles were taken in the laminar boundary layer. When the free-stream velocity did not exceed 10 ft/sec, experimental results compared reasonably well with theory. At 30 ft/sec, simple laminar flow could not be obtained. It appears that in this case, the boundary layer observed was a three-dimensional variation of the transitional flow observed by Dhawan and Narasimha (1958) in a two-dimensional flow. P.T.H.

A75-17350 **B-1 - USAF priority number one.** C. M. Gilson. *Flight International,* vol. 106, Dec. 26, 1974, p. 911-919.

Studies concerning the Advanced Manned Strategic Aircraft were conducted in connection with investigations designed to define a low-altitude penetration bomber which was to succeed the USAF Strategic Air Command B-52s. The studies eventually led to the B-1. A drawing of the aircraft is presented. The engine for the B-1 is discussed along with questions regarding the control of the center-of-gravity location, aspects of system redundance, the avionics, and aspects of aircraft fracture mechanics. G.R.

A75-17351 **Conference on Reliability of Aircraft Equipment, Kunovice, Czechoslovakia, March 19-22, 1974, Proceedings (Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, March 19-22, 1974, Proceedings).** *Zpravodaj VZLU,* no. 2-3, 1974. No. 2, 42 p.; no. 3, 49 p. In Czech.

Topics discussed include the optimal organization of reliability control, computer simulation of the reliability of a jet trainer aircraft, a mathematical model of damage accumulation in aircraft engine components, a program for ensuring reliable operation of overhauled aircraft engines, a method of achieving a planned increase in aircraft equipment reliability, criteria for ensuring safety and regularity of air transport, the effect of low-cycle fatigue on the reliability of turbine disks, a method of graphic complex design which simplifies the problem of ensuring the reliability of aircraft engines, a proposed organizational structure for ensuring flight safety and maintenance of flight schedules, a program for reducing repairs required by aircraft hydraulic system components, reliability methods employed on a jet aircraft powered by four bypass engines, the role of a school for aeronautical specialists in improving aircraft equipment reliability, and the problem of aircraft reliability of the air transport systems of Comecon member states.

Individual items are announced in this issue. A.B.K.

A75-17352 # **Conference on Aircraft Equipment Reliability (Konference o Spolehlivosti Letecke Techniky).** V. Kahanek and O. Gregr. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 11-20. In Czech.

Review of the purposes and proceedings of a conference devoted to methods of ensuring efficient operation of aircraft and flight safety. Following a summary of the problems that must be solved in order to increase aircraft reliability, thus demonstrating a need for such a conference, the organization participating in the conference are indicated, and a number of abstracts of the main reports presented at the conference are presented. These reports concern the standardization of reliability nomenclature, the evaluation of existing methods of ensuring the fatigue life of airframes and the reliability of aircraft from the standpoint of efficient operation, the organization of reliability assurance in the aircraft industry, monitoring the reliability of aircraft equipment during operation, economic aspects of the reliability of transport aircraft, monitoring instrument reliability and determination of the optimal frequency and volume of instrument maintenance work, and the detection and evaluation of defects and malfunctions of aircraft equipment during operation.

A.B.K.

A75-17353 # **Problems of reliability in aircraft equipment (Problematika spolehlivosti v letecke technice).** J. Schindler. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 21-32. In Czech.

Development of approaches to the solution of aircraft reliability problems and recommendations regarding the optimal organization of reliability control. The objective need for a solution to reliability problems in aircraft, especially under the conditions of the Czechoslovakian aircraft industry, is stressed. The concept of reliability is singled out as a component of quality, and the importance of the relation between reliability and economy in the case of complex systems is stressed. It is shown that the optimality of a system can be expressed by a simple model of operational efficiency. The relation between the manufacturer, the operator, and government authorities with regard to reliability is considered. Techniques of failure diagnostics and prediction are discussed, showing how the origin of a malfunction depends on the load level and strength level, and on the time variation of this dependence. Possible approaches to ensuring the reliability of systems during their development, manufacture, and operation are suggested, giving particular attention to the problem of the so-called human factor and to the need for proper selection and classification of personnel to minimize difficulties at the man-machine interface. A.B.K.

A75-17354 # **A model of the reliability of a jet trainer aircraft (Model spolehlivosti cvicneho proudoveho letounu).** J. Turek. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 33-41. In Czech.

Description of a method of establishing an estimate of the reliability of a jet trainer aircraft on the basis of computer simulation of the operation of the aircraft. Following an analysis of the basic characteristics of aircraft reliability, a detailed account is given of the conception of a model for simulating aircraft reliability by employing the Monte Carlo method to generate a flow of aircraft actions, which is essentially a graphic model of the requirements for training aviators, and a flow of aircraft element breakdowns, which is essentially a graphic model of the aircraft malfunction mechanism.

A.B.K.

A75-17355 # **A method of predicting the lifetime of aircraft engine components (Metodika predpovedi zivotnosti dilu leteckych motoru).** P. Vacek and A. Mynarik. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 43-47. In Czech.

Consideration of the use of a simple mathematical model of the random process of damage buildup in aircraft engine components. It is recommended that an exponential model proposed by Tartakovskii be employed for estimating damage buildup of structural components during normal operation, with particular regard to ascertaining the level of efficiency loss of such components. The practical use of this method is demonstrated by calculations of the lifetimes of specific components. A.B.K.

A75-17356 # **Problems of reliability of overhauled aircraft engines (Problemy spolehlivosti opravovanych leteckych motoru).** A. Mynarik and P. Vacek. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 49-51. In Czech.

Consideration of the problem of improving the quality of repair work done on aircraft engines and monitoring the reliability of these engines during operation. The need for an information system which ensures a regular inflow of information concerning the quality of individual repair processes and the degree of damage during operation is stressed, as well as the need for a policy of rationally executed long-term testing to ensure the quality level and operational reliability of products. Factors to be taken into account in estimating the state of wear of aircraft components on the basis of time elapsed between repairs are discussed. A.B.K.

A75-17357 # **Planning a buildup of aircraft equipment reliability (Planovani nabehu spolehlivosti letecke techniky).** I. Forman. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 53-57. In Czech.

Consideration of the process of increasing the reliability of aircraft equipment to required or acceptable levels. This process, called the reliability buildup process, is subject to certain laws, so that it can be planned. An explanation is given of some of these laws, and the use of a graphic representation of a model for system reliability improvement - called a reliability buildup curve - is discussed, with particular regard to the quantification of this curve on the basis of a factor indicating the degree of realization of correction procedures. A.B.K.

A75-17358 # **Choice of a criterion for evaluating the reliability of aircraft equipment products (Vyber kriterii pro hodnoceni spolehlivosti vyrobku letecke techniky).** M. Svoboda. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 2, 1974, p. 59, 60. In Czech.

Description of three sets of criteria which make it possible to evaluate the reliability of aircraft equipment from several standpoints. The criteria discussed include criteria for evaluating the effect of reliability on the safety and regularity of air transport and on the maintainability of aircraft equipment, criteria for evaluating the technical reliability of products such as an aircraft system, and certain instructions for evaluating operating conditions. A.B.K.

A75-17359 # Contribution to the problem of turbine-disk reliability (Prispevek k otazce spolehlivosti turbinovych disku). J. Statecny. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 11-15. In Czech.

Consideration of the problem of low-cycle fatigue in turbine engine disks and its effect on the reliability of operation of the engine unit. The prerequisites for an analysis of the effect of low-cycle fatigue on the cracking of turbine disks are outlined, and a method of experimentally testing and monitoring the state of the disks during operation is indicated. A.B.K.

A75-17360 # The significance of methods of complex design for the reliability of aircraft engines (Vyznam metod komplexnich navrhu pro spolehlivost leteckych motoru). Z. Hujecek. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 17-20. In Czech.

Description of a method of graphic complex design which makes it possible, at the very outset of design work, to eliminate from further consideration those values of the design structural parameters which lead to unsuitability of the chosen main parameters of a turbine-powered unit. Using a turbine-powered propeller as an example, a method of determining those design parameters of the propeller and turbine which uniquely correspond to a possible thermodynamic solution is indicated, which ensures fulfillment of the performance requirements and gives the prerequisites for achieving high reliability of the designed structure. A.B.K.

A75-17361 # Improving reliability in civil air transport systems (Zvysovani spolehlivosti v systemu civilni letecke dopravy). M. Vyletal. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 21-26. In Czech.

Outline of a procedure for ensuring flight safety and maintenance of flight schedules of civil air transport carriers. According to the proposed procedure, the entire civil air transport system is divided into lower organizational units, within the framework of which the desired reliability can be monitored and controlled. The work of the main organizational unit (the state supervisory authority) in which data arise and are used is discussed, and a data processing sequence is described in which information obtained by testing is acquired, sorted, and evaluated, and appropriate corrective measures are taken to ensure operational and long-term efficiency. In this connection, particular importance is attached to information concerning the so-called human factor and its effect on reliability. Finally, certain changes in the structure of civil air transport systems are recommended. A.B.K.

A75-17362 # Experience gained from testing and operating aircraft hydraulic system units (Poznatky ze khousek a provozu pristroju hydraulicke soustavy letadel). J. Jecny and J. Salom. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 27-31. In Czech.

Description of a procedure employed to reduce the incidence of repairs required by aircraft hydraulic system components. The sources of information concerning malfunctions of hydraulic circuits are discussed, and a method of evaluating data obtained from the operation of hydraulic elements on L 410 aircraft is outlined which places special emphasis on determining quantitative and percentage ratios of hydraulic pneumatic and fuel devices found to be malfunctioning either on the basis of complaints or on the basis of lifetime tests. A.B.K.

A75-17363 # Reliability methods employed on IL-62 aircraft by CSA (Spolehlivostni metody uplatnovane na letadlech typu IL-62 u CSA). R. Hordossy. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 33-37. In Czech.

Description of a program of reliability assurance developed for the IL-62 aircraft and the NK-8-4 bypass engines installed on this aircraft. The time intervals that have been established for servicing, maintaining, and inspecting the IL-62 aircraft are reviewed, and a program for ensuring further operation of the IL-62 aircraft without a general overhauling for up to 6000 hr is outlined. The introduction of an enlarged inspection interval (increased from 220 to 330 hr) in the case of the IL-62 aircraft is discussed. Finally, a graphic method used in determining the operational reliability of the NK-8-4 engines is described. A.B.K.

A75-17364 # The place and role of the aeronautical technical school in ensuring optimal reliability of aircraft equipment (Misto a uloha letecke vysoke skoly pri zajistovani optimalni spolehlivosti letecke techniky). Z. Kopriva. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 39-41. In Czech.

Review of the role of the aeronautical technical school in achieving aircraft equipment reliability gains through reduction of human error. The basic difference in judging the problem of equipment reliability in socialist and bourgeois society is indicated, and the possibilities of the aeronautical technical school in training new cadres and in providing additional schooling to older workers are assessed from this standpoint. In addition, a path of cooperation between scientific and pedagogical workers of the school in a reliability program is indicated which accords with the national guideline concerning the close bond between the school and the life of socialist society. A.B.K.

A75-17365 # Certain problems of a reliability system in aeronautics (K nekterym problemum spolehlivostniho systemu v letectvi). V. Pavlicek. *(Konference o Spolehlivosti Letecke Techniky, Kunovice, Czechoslovakia, Mar. 19-22, 1974.) Zpravodaj VZLU,* no. 3, 1974, p. 43-46. In Czech.

Review of certain problems related to the realization of a complete system of reliability in aircraft equipment operation. Certain considerations, plans, and recommendations are introduced which should be taken into account in the formulation and subsequent method of solution of the problem of aircraft reliability both in Czechoslovakia and within the framework of the air transport systems of the member states of Comecon. A.B.K.

A75-17375 The place of the psychic factor among the causes of air accidents in general aviation (La place du facteur psychique dans les causes des accidents aériens en aviation générale). R. J. Digo and J. Lavernhe. *Revue de Médecine Aéronautique et Spatiale,* vol. 13, 3rd Quarter, 1974, p. 228-232. In French.

The role of psychosomatic and psychological failures of the pilot in general aviation air accidents is discussed. These psychological factors must be distinguished from those having to do with pilot's incompetence, physical sickness, or negligence. The problem is rendered more complex in that various latent neurotic states are not easily detectable and come to the surface unexpectedly. It is

recommended that all serious flight incidents which constitute a potential accident be given the same inquiry as in the case of accidents. P.T.H.

A75-17376 # **Air transport and the design engineer.** E. E. Marshall. *Aircraft Engineering,* vol. 46, Dec. 1974, p. 4-11, 19.

The growth of air transport in the past 20 years and its future prospects are surveyed. Journey time and cost are seen as the chief factors affecting passenger satisfaction and choice of air transport. Air transport has a clear advantage over other forms of transport (e.g., high speed rail) at distances over 300 miles. Current problems are considered. Solutions to environmental problems, such as noise, pollution, and congestion at airports, are suggested. The primary aim of designers is seen to be the minimization of operating costs and the achievement of low noise levels. Fuel costs now are about equal to first cost in their contribution to operating costs, so fuel consumption is an important design feature. Maintenance and reliability are also emphasized. Design improvements suggested include reduced weight of engines, furnishings, and avionics, advanced airfoil sections, optimized flight speeds, and greater use of titanium and composite materials. A.T.S.

A75-17377 # **The Skyship project.** *Aircraft Engineering,* vol. 46, Dec. 1974, p. 14-19.

A design study was made of an aerostatic aircraft, or Skyship, having symmetrical lenticular shape with a diameter of 700 ft, a maximum thickness of 208 ft, and total weight of 800 tons. The craft would carry large freight cargoes at a normal flight altitude of 5000 ft and cruising speed of 70-90 knots. Aerostatics and buoyancy control, drag and stability, structural elements, power requirements, operations, safety, commercial viability, and possible defense applications are discussed. A.T.S.

A75-17380 Identification of processes having direction-dependent responses, with gas-turbine engine applications. K. R. Godfrey (Warwick, University, Coventry, England) and D. J. Moore (Rolls-Royce /1971/, Ltd., Bristol Engine Div., Bristol, England). *Automatica,* vol. 10, Sept. 1974, p. 469-481. 23 refs.

Many processes have dynamic responses which are dependent on the direction in which the process variable is moving. The effects of such nonlinear behavior on the weighting function model of a process obtained by cross-correlation and on the difference equation model obtained by a generalized least-squares procedure are determined theoretically for a process with first-order dynamics perturbed with pseudo-random binary signals. The theory is confirmed by results from a hybrid computer simulation, and computer-simulated results for processes with second-order dynamics are also presented. The theory is used to explain discontinuities in weighting-function models of a gas-turbine engine in which the input-transducer had direction-dependent dynamic responses. Experimental work on a pilot-scale process is reported, and further examples from the literature are examined. (Author)

A75-17383 Application of the properties of Poincaré Fuchsian groups to the calculation of turbomachine blade vibrations (Application des propriétés des groupes fuchsiens de Poincaré au calcul des vibrations des ailettes de turbomachines). R. Legendre (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques,* vol. 279, no. 10, Sept. 2, 1974, p. 383-385. In French.

Development of a theoretical scheme for interpreting the vibrations of turbomachine blades in a compressible fluid flow. It is shown that a compressible fluid flow through a deformable turbomachine blade array may be schematized by a plane incompressible irrotational fluid flow through a blade array consisting of vibrating foils. The flow potential may then be represented as an Abelian integral associated with a Fuchsian group within the framework of the Poincaré uniformization method and may be calculated on the basis of the singularities of this integral. A.B.K.

A75-17405 Predictions of in-flight performances of a turbo-jet engine (Prévisions des performances en vol d'un turbo-réacteur). J. Szydlowski. *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol. 279, no. 14, Sept. 30, 1974, p. 335, 336. In French.

A method is described for defining in-flight performances of a single or double flow turbo-jet engine on the basis of ground test alone. Three dimensionless parameters obtained in ground tests are sufficient for an immediate determination of flight characteristics. P.T.H.

A75-17407 Experiments on the asymmetric turbulent wake of a foil in a decelerating flow (Expériences sur le sillage turbulent dissymétrique d'un profil dans un écoulement décéléré). J. Fayet and L. F. Tsen (Poitiers, Université, Poitiers, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol. 279, no. 13, Sept. 23, 1974, p. 309-312. 6 refs. In French.

Study of the development of the asymmetric turbulent wake of a foil by pitot and hot-wire anemometry. The mean-velocity and Reynolds-stress profiles are measured, starting from the trailing edge, where the sheared turbulence is of wall type, up to the far wake, where it is of free type. In addition to the asymmetry, the effect of an adverse pressure gradient is taken into account. A.B.K.

A75-17416 Effect of a blade placed on the upstream stagnation generatrix of a cylinder on heat transfer in a pulsed flow (Influence sur le transfert de chaleur en écoulement pulsé d'une ailette placée sur la génératrice d'arrêt amont d'un cylindre). F. N. Rémy and M. Martin (Ecole Nationale Supérieure de la Métallurgie et de l'industrie des Mines, Nancy, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol. 279, no. 16, Oct. 14, 1974, p. 411-414. 7 refs. In French.

Demonstration of the aerodynamic effect of a blade placed along the upstream stagnation generatrix of a cylinder on the heat transfer around the cylinder. An increase in heat transfer, due to the pulsations of the incident flow, is demonstrated in the vortex zones. The presence of the blade, on the one hand, increases the heat transfer on the upstream face of the cylinder in steady flow and, on the other hand, makes it possible to obtain, in pulsed flow, the same gains on the downstream face as in the case of a cylinder by itself, but at lower pulsation rates. A.B.K.

A75-17506 # **Aerothermodynamic factors governing the response rate of gas turbines.** B. D. MacIsaac (National Research Council, Div. of Mechanical Engineering, Ottawa, Canada) and H. I. H. Saravanamuttoo (National Research Council, Div. of Mechanical Engineering; Carleton University, Ottawa, Canada). *(NATO, AGARD, Meeting on Power Plant Control for Aero Gas Turbine Engines, 44th, Ankara, Turkey, Sept. 1974.) Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin,* no. 3, 1974, p. 23-29, 31-35. 9 refs.

This paper reviews the constraints on gas turbine response rates resulting from aerothermodynamic considerations and discusses the use of variable geometry to improve the response rate. Mathematical models, which have to be verified experimentally, permit a detailed

investigation of engine transient response. The transient behavior of a single spool unit is quite different from that of a twin spool unit and techniques of improving the response rate of both are discussed; significant gains can be realized and the use of simulation techniques permits these to be evaluated before carrying out actual engine tests. (Author)

A75-17541 Statistical characteristics of the turbulent wake behind a supersonic sphere. V. G. Ivanov, G. I. Mishin, and S. N. Palkin (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *(Zhurnal Tekhnicheskoi Fiziki,* vol. 44, Apr. 1974, p. 857-861.) *Soviet Physics - Technical Physics,* vol. 19, Oct. 1974, p. 543-545. 5 refs. Translation.

A75-17575 Alloys for spars of rotor blades of helicopters. E. I. Kutaitseva, V. S. Komissarova, I. V. Butusova, and N. V. Egorova. *(Metallovedenie i Termicheskaia Obrabotka Metallov,* no. 5, 1974, p. 15-18.) *Metal Science and Heat Treatment,* vol. 16, no. 5-6, Nov. 1974, p. 381-383. Translation.

A75-17582 Heat resistant wrought aluminum alloy D21. O. A. Romanova. *(Metallovedenie i Termicheskaia Obrabotka Metallov,* no. 6, 1974, p. 9-13.) *Metal Science and Heat Treatment,* vol. 16, no. 5-6, Nov. 1974, p. 468-471. Translation.

A75-17593 # Self-excitation of oscillations in supersonic stalled flows (Samovozbuzhdenie kolebanii pri sverkhzvukovykh otryvnykh techeniiakh). M. G. Morozov. *Inzhenerno-Fizicheskii Zhurnal,* vol. 27, Nov. 1974, p. 840-844. In Russian.

The mechanism of self-excitation of acoustic oscillations in a supersonic stalled flow was studied. The experiments were conducted in a closed-jet wind tunnel at Mach numbers from 1.6 to 3.5 and Reynolds numbers from 130,000 to 40,000,000. Two-dimensional models containing a rectangular depression were subjected to the flow. High-speed photography and flash photography were used to study the flow pattern, and it is analyzed as the resultant of interference among a number of simpler systems of acoustic waves. A.T.S.

A75-17631 Precipitation phenomena and their consequences for the properties of some families of industrial alloys; Conference on Metallurgy, 16th, Saclay, Essonne, France, June 25-27, 1973, Proceedings (Les phénomènes de précipitation et leurs conséquences sur les propriétés de quelques familles d'alliages industriels; Colloque de Métallurgie, 16th, Saclay, Essonne, France, June 25-27, 1973, Proceedings). Conference sponsored by the Commissariat à l'Energie Atomique and Institut National des Sciences et Techniques Nucléaires. Gif-sur-Yvette, Essonne, France, Centre d'Etudes Nucléaires de Saclay, 1974. 765 p. In French and English. $22.52.

Topics discussed include methods of improving the properties of aluminum and titanium alloys used in aircraft construction, the use of electron microscopy and microprobe analysis to study precipitation reactions in various alloy systems, the classification and utilization of methods of structural hardening of titanium alloys, a study of the creep behavior and embrittlement of a heat-resistant titanium alloy, the effect of small additions of boron on the structural hardening of titanium- or niobium-stabilized austenitic stainless steels, problems due to precipitation reactions in nickel-base superalloys, and a method of stabilizing the precipitation in a nickel-base superalloy at temperatures ranging from 700 to 750 C. A.B.K.

A75-17632 Key points of the development of aluminum and titanium alloys for aeronautical applications (Points clés du développement des alliages d'aluminium et de titane en vue des applications aéronautiques). G. Sertour, C. Bathias, A. Bourgeois, and J. M. Gregoire (Société Nationale Industrielle Aérospatiale, Laboratoire Central, Suresnes, Hauts-de-Seine, France). In: Precipitation phenomena and their consequences for the properties of some families of industrial alloys; Conference on Metallurgy, 16th, Saclay, Essonne, France, June 25-27, 1973, Proceedings. Gif-sur-Yvette, Essonne, France, Centre d'Etudes Nucléaires de Saclay, 1974, p. 223-254. 5 refs. In French.

Review of certain measures being taken to improve those utilization properties of aluminum and titanium alloys which are of most importance to the aircraft designer. In the case of aluminum alloys a systematic search for precipitation states corresponding, at a quasi-total intensity, to stress corrosion led to the use of alloys or heat-treatment states which are not optimal from the standpoint of the residual strength of cracked elements and the rate of propagation of fatigue cracks. Attempts are currently being made to seek intermediate heat-treatment states which make it possible to achieve a compromise between the stress corrosion resistance and the crack propagation resistance. In the case of titanium alloys, especially two-phase (alpha, beta) alloys, forging techniques are being studied which aim at a better normalization of the microstructure by seeking a dispersion of the phases such that an optimal compromise is found between various utilization properties. A.B.K.

A75-17634 Structural hardening of titanium alloys (Le durcissement structural des alliages de titane). L. Seraphin (Ugine-Aciers, Ugine, Savoie, France). In: Precipitation phenomena and their consequences for the properties of some families of industrial alloys; Conference on Metallurgy, 16th, Saclay, Essonne, France, June 25-27, 1973, Proceedings. Gif-sur-Yvette, Essonne, France, Centre d'Etudes Nucléaires de Saclay, 1974, p. 371-396. 19 refs. In French.

Detailed account of the mechanisms and purposes of structural hardening as applied to titanium alloys. Following a review of the principal methods currently used for the hardening of metal alloys and a practical classification of titanium alloys based on the nature of the dominant phase or phases of the structure in the utilization state, the principal metallurgical reactions occurring during the solution treatment, quenching, and aging of titanium alloys are discussed. Examples bearing on practical aspects and on the mechanical characteristics obtained are presented for various families of titanium alloys. The practical limitations regarding quenchability or embrittling-phase precipitation are also cited. A.B.K.

A75-17651 # Analysis of separation control by means of tangential blowing. E. S. Levinsky and R. H. Schappelle (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Journal of Aircraft,* vol. 12, Jan. 1975, p. 18-26. 16 refs.

A computational procedure is described for predicting the critical jet momentum coefficient for achieving full potential lift by means of tangential blowing on airfoils with unslotted flaps. The procedure incorporates a velocity profile with a velocity minimum, due to upstream boundary-layer and slot lip thickness effects, to describe the jet layer; and the initial jet velocity profile downstream of the slot exit contains an inviscid core region with a maximum velocity based on the total pressure inside the slot, rather than on empirical assumptions. The procedure utilizes the strip-integral

technique to reduce the partial differential equations describing the jet layer flow to ordinary differential equations, and assumptions are made regarding the turbulent shear stress values at the boundaries and midpoints of each strip in order to carry out the integration. (Author)

A75-17652 # **S-3A avionics - Software revolution forerunner.** L. F. Morgan (Lockheed-California Co., Burbank, Calif.). *Journal of Aircraft*, vol. 12, Jan. 1975, p. 51-57. 6 refs.

A review of the S-3A Project as the forerunner of software-integrated avionics systems leads the author to conclude that the guideposts of technical change are signalling a revolutionary change in the system development process itself. Advanced avionics systems are viewed as software rather than hardware based, requiring a development process which takes advantage of the greatly increased flexibilities offered for designing to a fixed cost and schedule. Examples are cited from the successful S-3A program of software-first influences which have a highly beneficial impact on total system design and method of implementation. (Author)

A75-17688 # **A study on the dynamic characteristics of a peripheral-jet air cushion.** M. Sasaki (National Aerospace Laboratory, Chofu, Japan). *JSME, Bulletin*, vol. 17, Nov. 1974, p. 1438-1446. 7 refs.

The frequency response of cushion pressure to a small sinusoidal oscillation of hover-height is investigated for an air cushion system composed of a fan, a duct, and a peripheral-jet-type cushion head both theoretically and experimentally. From comparison of the theory with the experimental results, it is concluded that the dynamic characteristics of the air cushion are well described within the limits of this experiment using the characteristic constants calculated with a quasi-steady flow model for an unbalanced jet. Furthermore, it is shown that the propagation of a low-frequency pressure pulsation in such a large-scale pipe line as an air cushion system is described in the same manner as in pneumatic transmission lines. (Author)

A75-17763 **Canada as an airfaring nation - A brief round-up of present major programmes.** *Airport Forum*, vol. 4, Dec. 1974, p. 35, 36, 39 (10 ff.). In English and German.

The particular importance of the aircraft for Canada is related to the vastness of its national territory and the unequal distribution of its population over this territory. Canada has the world's second largest general aviation fleet which includes about 12,000 aircraft. Attention is given to the airport construction site Montreal-Mirabel, problems connected with the overcrowding of the Toronto airport, the Ottawa International Airport, the hybrid terminal for Calgary, Halifax, and Vancouver's island airport. G.R.

A75-17774 **Numerical evaluation of further supersonic sections including ducted heat addition and nozzle flow.** E. G. Broadbent (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). *Ingenieur-Archiv*, vol. 43, no. 6, 1974, p. 395-412. 6 refs.

This paper follows earlier investigations of heat addition to the flow, both with and without ducting, past two-dimensional sections in a free stream at a Mach number of 7.5. The present results all refer to ducted heat addition, and two kinds of intake are investigated. One of these has just two shocks, both deflecting the flow downward, while the other has a third shock reflected upward from the cowl so as to reduce the incidence of the cowl and hence its drag. With the two-shock intake, the cowl is curved upward, again to reduce drag. Values of lift coefficient, net pressure-drag coefficient, and propulsive efficiency are calculated for various ranges of values of the parameters (including the strength of the intake shock), with values mostly in the ranges 0.04 to 0.08, -0.03 to -0.07, and 0.5 to 0.7, respectively. (Author)

A75-17775 **Calculation of a three-dimensional laminar boundary layer in the case of bodies of revolution at incidence with separation (Berechnung der dreidimensionalen laminaren Grenzschicht an schrägangeströmten Rotationskörpern mit Ablösung).** W. Geissler (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Ingenieur-Archiv*, vol. 43, no. 6, 1974, p. 413-425. 11 refs. In German.

A numerical method is presented to calculate the three dimensional laminar incompressible boundary layer over bodies of revolution at incidence. The inviscid flow velocities used for the boundary condition at the outer edge of the boundary layer are determined numerically by a singularity method. The boundary layer calculation is carried out in a streamline coordinate system; the coordinates are fixed to the streamlines and equipotential lines of the inviscid flow. The boundary layer equations are integrated by an implicit finite difference method. As a result of the numerical calculation process the velocity profiles in directions of streamlines and equipotential lines are known for each mesh point of the coordinate system. It is shown that this method can be used to determine the separation lines on the body surface. The results of the boundary layer calculation and the determination of flow separation are in very good agreement with numerical and analytical results of other investigators. (Author)

A75-17826 # **Presentation of the data required for takeoff and landing (Présentation des informations nécessaires pour le décollage et l'atterrissage).** J.-C. Wanner (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Take-off and Landing, Edinburgh, Scotland, Apr. 1-5, 1974.) ONERA, TP* no. 1350, 1974. 15 p. In French.

Description of a study leading to the development of a cockpit display the main part of which is designed for takeoff and landing phases. On the basis of a study of pilot behavior during the takeoff and landing phases a pilot model was constructed. This model was found to be useful in determining the necessary cues and, consequently, the parameters which have to be displayed in order to minimize the pilot work load and increase flight regularity and safety. A study with the aid of this model made it possible to develop a device which could serve as a future cockpit display (or collimator) in which the part designed for takeoff and landing phases is a head-up display presenting the ground track of the air velocity vector and the total climb angle. With these two parameters, the pilot can act directly on the air path, while knowing exactly the necessary engine rating and observing a correct safety margin for the angle of attack. A.B.K.

A75-17828 # **Interaction between the flow past an afterbody and a propulsion jet in inviscid flow theory (Couplage entre l'écoulement autour d'un arrière-corps et le jet propulsif en théorie de Fluide parfait).** R. Maria-Sube, J.-J. Chattot, and G. Gillon (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Airframe/Propulsion Interference, Rome, Italy, Sept. 3-6, 1974.) ONERA, TP* no. 1399, 1974. 13 p. 14 refs. In French.

The interference effects between external and internal flows are examined in the framework of the inviscid flow theory. These phenomena are connected mainly with flows around afterbodies. The first part of the paper is devoted to the study of subcritical axisymmetrical interacting flows. The computation of both internal and external flows is carried out using a finite element method. The results make it possible to determine the shape of the jet using a pseudo-hodographic method, with an iterative procedure. The second part concerns the interference effects of a supersonic internal flow with subsonic or transonic external flows. The supersonic internal jet is computed using the method of characteristics. The coupling conditions between the internal and the external flows are taken into account, using an iterative procedure in a way similar to that proposed by Young, but extended here to compressible external flows. A comparison with existing experimental results is presented. (Author)

A75-17829 # Problems of interaction between the air intake and the airframe (Problèmes d'interactions entre la prise d'air et l'avion). J. Leynaert (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Airframe/Propulsion Interference, Rome, Italy, Sept. 3-6, 1974.) ONERA, TP* no. 1400, 1974. 12 p. 25 refs. In French.

Some problems concerning intake-airframe interactions and the optimization of the air intake in its aerodynamic environment are presented. Emphasis is placed on the local study of internal and external flows at the intake entrance. Calculations and test methods are discussed for subsonic nacelles. Examples are given of the influence of nonuniform upstream flow on the operation of a supersonic intake, and ways to adapt the intake to such conditions, notably for flight with an angle of incidence or side slip, are analyzed. A.T.S.

A75-17830 # The ONERA supersonic straight cascade wind tunnel at Chalais-Meudon. G. Meauzé (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Supersonic Tunnel Association, Semi-Annual Meeting, 42nd, Buffalo, N.Y., Oct. 1, 2, 1974.) ONERA, TP* no. 1409, 1974. 8 p.

Development tests are reported for a straight-cascade wind tunnel arrangement in France intended to provide a truly periodic, two dimensional flow applicable to research on axial fluid flow engines. The installation incorporated a system of adjustment flaps at the cascade ends and a suction device to eliminate the effects due to boundary layer separation at the lateral walls. The tests were made at Mach 1.5. The test results indicate that the means used for flow adjustment and boundary-layer suction were successful in attaining flow periodicity and suppressing secondary effects. A.T.S.

A75-17831 # Flutter of wings equipped with engines in pod (Flottement d'ailes équipées de moteurs en nacelle). R. Destuynder (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Flutter of Wings with External Loads, Munich, West Germany, Oct. 6-12, 1974.) ONERA, TP* no. 1411, 1974. 13 p. 7 refs. In French.

Calculations and measurements of unsteady aerodynamic forces performed in subsonic flow on a model equipped with an engine in pod showed that the interference between engine and wing remains negligible. It was also shown that the aerodynamic forces induced on the engine itself by its own oscillation are important and give a significant contribution to the generalized forces. Account was taken of these two remarks, and the aerodynamic forces were calculated separately on the engine which was assimilated to a thin-walled cylinder with internal and external flow in the axial direction. An application to a flutter case shows the importance of the contribution of the forces on the engine. A good agreement was obtained between theory and experiment at Mach number 0.80. (Author)

A75-17832 # Explicit form of the optimal control law for a rigid aircraft flying in a turbulent atmosphere (Forme explicite de la loi optimale de pilotage d'un avion rigide volant en atmosphère turbulente). G. Coupry (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Symposium on Impact of Active Control Technology on Airplane Design, Paris, France, Oct. 13-18, 1974.) ONERA, TP* no. 1412, 1974. 11 p. 6 refs. In French.

Closed-loop ride control systems, which feed back, after appropriate filtering, certain aircraft responses (such as pitch speed) to the control surfaces, are widely used in designing high-speed, low-altitude military aircraft. The article explains how Wiener's theory makes it possible to derive the optimal control law explicitly as a function of reduced parameters which are directly dependent not on speed, but on the aircraft power-to-weight characteristics, dimensionless lift and moment coefficients, air density, and turbulence. The system proposed is an open-loop system which gives commands to the control surfaces depending only on the turbulence encountered, which is measured in real time on board the aircraft. Such a control system has been installed on a Mirage III for flight testing. A.T.S.

A75-17835 # Boundary layer study with hot film transducers in subsonic and transonic flows. C. Armand (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine and Modane, Savoie, France). *(Supersonic Tunnel Association, Semi-Annual Meeting, 42nd, Buffalo, N.Y., Oct. 1, 2, 1974.) ONERA, TP* no. 1416, 1974. 26 p. 5 refs.

Boundary layer measurements in subsonic and transonic flows were carried out in a wind tunnel, using hot-film transducers. By mounting several sensors on a wing, and recording the evolution of the signal during the changes in the aerodynamic parameters, it proved possible to determine continuously, in real time, the state of the boundary layer, the locations of transition and separation phenomena, and the direction of the flow at the wall. Good agreement with pressure measurements and visualization studies is noted. Newly developed means of signal interpretation are described. V.P.

A75-17876 AWACS - An airborne command and control post. C. E. White. *Microwave Journal*, vol. 18, Jan. 1975, p. 14, 16, 18.

A general description of AWACS, Airborne Warning and Control System, is given. The system consists of an externally-mounted thirty-foot-wide rotodome and an assembly of electronic detection, display, and communication equipment. The entire system operates as a moving command/control post, with more than 20 radio systems in the UHF to VHF ranges as well as a satellite-communication terminal on board. Radar, antenna, rotary coupler, identification/communication, and navigation/guidance are briefly described. P.T.H.

A75-17943 Aerospace sandwich materials. III (Matériaux sandwich aérospatiaux. III). S. Dzalba-Lyndis (Société Nationale Industrielle Aérospatiale, Paris, France). *Matériaux et Techniques*, vol. 62, Dec. 1974, p. 559-567. In French.

Review of the mode of production and the properties of certain types of plastic and metal honeycomb sandwich materials. Firstly, a description is given of a honeycomb sandwich material made of bonded polyamide paper, its production from nylon paper is described, the heat resistance and mechanical strength of the material are discussed, and the techniques used in shaping, sizing, and metal bonding of the material are noted. Secondly, a soldered metallic honeycomb sandwich material is described, and the chemical compositions of the alloys used in such material are cited. The mode of production of this material, starting from corrugated ribbons stacked up and soldered to each other and then connected to liner skins, is reviewed. Techniques used for bending and drawing this material are described, as well as techniques for boring and chemical milling. A.B.K.

A75-17998 **The French aeronautics and space equipment industry (L'industrie française des équipements aéronautiques et spatiaux).** P. Dupré (Société Française d'Equipements pour la Navigation Aérienne, Vélizy-Villacoublay, Yvelines, France). *Air et Cosmos,* vol. 12, Nov. 16, 1974, p. 22, 23. In French.

Future prospects of the French aerospace equipment industry are considered. The importance of maintaining competitive prices and sufficient research funding is emphasized. Various types of cooperation among industrial concerns are advisable in the future. Government aid to the industry in the form of legislation and research and development credits are recommended. A.T.S.

A75-17999 **Cooperation in the equipment industry (La coopération dans l'industrie des équipements).** J. Benichou (Messier-Hispano, S.A., Montrouge, Hauts-de-Seine, France). *Air et Cosmos,* vol. 12, Nov. 16, 1974, p. 28, 29. In French.

Two types of international cooperation on aerospace projects are distinguished. The first type consists of purely industrial cooperation at the level of fabrication. The second type is more inclusive, involving reciprocal contributions of two partners from the development stage onwards. The civilian Mercure and Airbus and the military Alphajet projects are examples of the second type. Factors essential to the success of cooperative projects include the harmonization of technological levels and methods, continuity, project control, adequate structures of cooperation, and clarity in the agreements between the partners. A.T.S.

A75-18000 **French equipment in general aviation (Les équipements français dans l'aviation générale).** C. Sobol. *Air et Cosmos,* vol. 12, Nov. 16, 1974, p. 38, 39. In French.

The French general aviation industry is the second largest in the world, next to that of the USA. The suppliers of instruments and other equipment used on various light planes manufactured in France are listed. The development of the 'Migrator' control panel will have importance for the light-aircraft and business-aircraft markets. A.T.S.

A75-18002 **Control and equipment of the M 53 motor (La régulation et les équipements du moteur M 53).** A. Ravagli (SNECMA, Paris, France). *Air et Cosmos,* vol. 12, Nov. 16, 1974, p. 49, 51, 52. In French.

The M 53 turbojet is a high-performance military engine designed to provide speeds exceeding Mach 2.5 with rapid acceleration for the Mirage F1. The M 53, in contrast to the ATAR series engines, uses an electronic computer to realize all control functions in order to optimize engine operation over the entire range of flight capabilities. The direct command emergency control system and the fuel pumps are described. Notable tests conducted on the M 53 system are indicated. A.T.S.

A75-18003 # **Investigation of the 'lateral' interaction between a supersonic underexpanded jet of an ideal gas with surfaces of various configuration (Issledovanie 'bokovogo' vzaimodeistviia sverkhzvukovoi nedorasshirennoi strui ideal'nogo gaza s poverkhnostiami razlichnoi formy).** M. Ia. Ivanov and V. P. Nazarov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 3-8. 12 refs. In Russian.

The impingement of a supersonic underexpanded jet of an inviscid nonheat-conducting gas expelled from an axisymmetric conical nozzle on flat, cylindrical, and spherical surfaces is studied numerically. The influence of the Mach number and the ratio of active to passive pressure on the flow pattern and on the impact force of the jet is analyzed. A comparison with approximate theories and with experimental data shows that the maximum pressure exerted on the surface is understated by roughly 20% when Newton's formula is used, and is overstated by 10 to 15% when using the formula for hypersonic flow past a thin wedge. V.P.

A75-18009 # **Transonic flow past bodies of revolution with ducts in the presence of an efflux from the duct (K okolozvukovomu obtekaniiu tel vrashcheniia s protokom pri nalichii istekaiushchei iz protoka strui).** A. N. Kraiko and R. K. Tagirov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 73-80. 8 refs. In Russian.

Similarity laws for the transonic flow past axisymmetric bodies with a duct, of the type of a jet-engine nacelle (or the aft part of the jet engine) are derived with allowance for the jet expelled from the nozzle. The correctness of the laws obtained is proven by the results of a numerical solution to the transonic problem, obtained by integrating the complete system of nonlinear flow equations. V.P.

A75-18010 # **Influence of nonequilibrium radiation on the flow of a low-density gas past blunted bodies (O vliianii neravnovesnogo izlucheniia na obtekanie zatuplennykh tel razrezhennym gazom).** G. N. Zalogin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 81-87. 18 refs. In Russian.

The hypersonic nonequilibrium flow of a low-density gas near the stagnation point in front of a blunted body is analyzed with allowance for the nonequilibrium radiation generated by electron excitation. The analysis is carried out for air and for carbon dioxide on the basis of a numerical solution of simplified Navier-Stokes equations, with allowance for shock structure. It is shown that at low densities (where the shock and boundary-layer thicknesses are of the same order) and in the presence of radiation, Cheng's (1963) two-layer model is no longer applicable. The governing process in the case under consideration is the diffusion of electron-excited molecules from the shock layer to the frontal portion of the shock front. V.P.

A75-18012 # **Density and temperature in front of a cylinder with a thermally insulated and cooled wall in a low-density supersonic flow (Plotnost' i temperatura pered tsilindrom s teploizolirovannoi i okhlazhdennoi stenkoi v razrezhennom sverkhzvukovom potoke).** N. D. Zuev and V. M. Kalugin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 94-98. 10 refs. In Russian.

A75-18013 # **Calculation of viscous shock layers on blunted cones (Raschet viazkogo udarnogo sloia na prituplennykh konusakh).** V. G. Voronkin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 99-105. 11 refs. In Russian.

A numerical method is proposed for solving the equations of a compressed viscous shock layer on smooth rounded axisymmetric cones situated at zero incidence in the flow of a perfect gas. The solution is based on breaking down the initial system of equations into second-order parabolic equations and first-order inviscid equations, and applying existing methods to the solution of these subsystems. The approach can be extended in a natural way to cover diffusion and nonequilibrium physicochemical processes. It is essentially an exact numerical method for solving the equations of a viscous shock layer. V.P.

A75-18017 # **Aerodynamic coefficients of nonconical bodies of star-shaped cross section (Aerodinamicheskie koeffitsienty nekonicheskikh tel so zvezdoobraznym poperechnym secheniem).** M. N. Kazakov, V. V. Kravets, and A. I. Shvets. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov.-Dec. 1974, p. 127-132. 16 refs. In Russian.

A75-18023 # **Experimental methods used in France for flutter prediction.** R. Dat. *(Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium, Göttingen, West Germany, Oct. 24, 25, 1974.) ONERA, TP* no. 1428, 1974. 22 p. 16 refs.

Test methods used in France for determining vibration natural frequencies or the transfer functions of aircraft on the ground or in flight are described. Chief among ground vibration testing methods

are the method of multiexcitations and the method of transfer functions. Among flight methods, most important are impulse excitation, harmonic excitation, and random excitation. The basic relations and analytic formulas for these techniques are given along with some examples of evaluations based on them. P.T.H.

A75-18078 National Electronics Conference, 30th, Chicago, Ill., October 16-18, 1974, Proceedings. Volume 29. Conference sponsored by the National Engineering Consortium. Edited by D. L. Cohn and G. S. Lauer. Oak Brook, Ill., National Engineering Consortium, Inc., 1974. 519 p. $10.00.

Papers are presented dealing with recent technological developments in telecommunications, microelectronics, power systems, optical communications, aeronautical communication, societal systems engineering, pattern recognition, integrated and fiber optics, speech coding and digital signal processing, and microwave transmission. Some of the topics covered include: Auger electron spectroscopy for analysis of integrated circuits, prospects and impact of fusion power, propagation models for optical communication through fog and clouds, signal processing techniques for decoding block codes, and sequential adaptive predictive coding of speech. P.T.H.

A75-18087 Toward unified digital aeronautical communications and navigation. J. H. Painter (Texas A & M University, College Station, Tex.) and D. G. Botha (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: National Electronics Conference, 30th, Chicago, Ill., October 16-18, 1974, Proceedings. Volume 29. Oak Brook, Ill., National Engineering Consortium, Inc., 1974, p. 236-240. 6 refs.

The present work outlines briefly the history of both civil and military aeronautical communications. Several current programs to develop digital communications and positioning systems are cursorily described. Digital signal processing technology makes it possible to realize a unified communication and positioning radio system. Aircraft should not be required to carry multiple equipments which perform the same functions of digital data communications and positioning. P.T.H.

A75-18088 The ARINC plan for implementing air/ground datalink. N. D. Steele, Jr. (Aeronautical Radio, Inc., Annapolis, Md.). In: National Electronics Conference, 30th, Chicago, Ill., October 16-18, 1974, Proceedings. Volume 29. Oak Brook, Ill., National Engineering Consortium, Inc., 1974, p. 249-251.

Efforts in the development and implementation of digital communications in the air-ground-air environment are described. The Advanced A/G System concept employs an air-ground-air data link that provides digital communications and affords bi-directional selective calling and signaling. A prototype of the system, known as Datalink, is being employed in some airlines. Current forecasts predict that approximately 95% of the air carrier fleet will be implemented by 1978. P.T.H.

A75-18089 Conformal microstrip phased array for aircraft test with ATS-6. G. G. Sanford (Ball Brothers Research Corp., Boulder, Colo.). In: National Electronics Conference, 30th, Chicago, Ill., October 16-18, 1974, Proceedings. Volume 29. Oak Brook, Ill., National Engineering Consortium, Inc., 1974, p. 252-257. 6 refs. U.S. Department of Transportation Contract No. TSC-763.

An electronically scanned, L-band microstrip phased array for aircraft is described. The array, which operates in receive mode only, is conformal to the surface of an aircraft, is 0.14 in. thick, is capable of 12-dB right-hand circular gain, has side lobes minimized in ocean multipath direction, and features 30-bit digital phase shifter resolution. It is producible in quantity at low cost and is inexpensive to operate and maintain. P.T.H.

A75-18169 # Accuracy of the Forward Scatter Visibility Meter. H. S. Muench (USAF, Cambridge Research Laboratories, Bedford, Mass.). In: Conference on Weather Forecasting and Analysis, 5th, St. Louis, Mo., March 4-7, 1974, Preprints. Boston, American Meteorological Society, 1974, p. 210-213.

Tests were made of the Forward Scatter Visibility Meter (model FSM 207) designed to operate in an automatic network for predicting aircraft visibility. The FSM was found to be accurate over more than two orders of magnitude of visibility. The calibration was more stable than that of transmissometers. The FSM has faster response and appears to describe actual conditions better than conventional visual observations. A.T.S.

A75-18186 STRACS - A solution for surface traffic control in the J. F. Kennedy Airport. J. L. Barker (LFE Corp., Norwalk, Conn.). In: Traffic control and transportation systems; Proceedings of the Second Symposium, Monte Carlo, Monaco, September 16-21, 1974. Amsterdam, North-Holland Publishing Co.; New York, American Elsevier Publishing Co., Inc., 1974, p. 589-600. Research supported by the Port Authority of New York and New Jersey.

The paper describes the development of a cost effective surface traffic control system (STRACS) for the J. F. Kennedy International Airport (JFKIA). Modular concepts permeate the system design in order to provide an evolutionary growth capability to achieve high standards of operation, at least by the time that all-weather take-offs and landings are operational realities. STRACS implies a complete system for the safe and efficient movement of aircraft, vehicles and emergency or rescue vehicles over the area encompassed between the terminal buildings and the points of takeoff and landing of aircrafts. The ground controllers can acquire status information throughout the JFKIA area at all times and be relieved of some of the burdensome tasks associated with routine assignment. The pilots can proceed at RVR's too low for visual tower contact in safety. The airport operator can provide all-weather service, both on a routine and emergency basis to aircrafts and to airport facilities. (Author)

A75-18187 Discrete event simulation model of terminal air traffic control system. J. C. Yu and S. A. Akhand (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Traffic control and transportation systems; Proceedings of the Second Symposium, Monte Carlo, Monaco, September 16-21, 1974. Amsterdam, North-Holland Publishing Co.; New York, American Elsevier Publishing Co., Inc., 1974, p. 601-612. 8 refs.

The objective of this study was to develop a simulation model to effectively assist in planning air traffic control operations in the terminal area. The analysis applied unique concepts employing a discrete events simulation philosophy through the proven simulation language known as GASP. An attempt was made to examine the model applicability in such analyses as runway evaluations, system component evaluations, landing sequencing policies, and sensitivity studies. The model was applied to simulate an existing air traffic control system. Realistic data were collected from the Atlanta, Ga., airport. For all performance variables tested, a positive relationship was found to exist between the values generated by the model and the expected values of these variables. Both internal and external verifications in the validation procedure have indicated that the model developed realistically represents the air traffic operations of a real world terminal area. (Author)

A75-18188 **Advanced concepts in air traffic control.** R. L. Maxwell (U.S. Department of Transportation, Office of Systems Engineering, Washington, D.C.). In: Traffic control and transportation systems; Proceedings of the Second Symposium, Monte Carlo, Monaco, September 16-21, 1974. . Amsterdam, North-Holland Publishing Co.; New York, American Elsevier Publishing Co., Inc., 1974, p. 613-625. 9 refs.

Summary of a system-engineering and functional analysis performed on air traffic control information processing and control functions within the framework of a study carried out to define concepts for possible application to air traffic control operations in the 1990s. This study, called the Advanced Air Traffic Management System (AATMS) study, encompasses the application of higher levels of automation to control and data processing systems and considers new approaches to the mechanization of surveillance, navigation, and communication functions. Following a review of the evolution of the air traffic control system employed in the U.S., the reasons for undertaking the AATMS study are outlined, and the scope of the study is indicated. The AATMS study includes an automation applications study to determine a level of automation (man-machine combination) which will perform air traffic management responsibilities safely, efficiently, and economically; a functional analysis to identify and describe generic air traffic management activities to a high level of detail; and the development of an objective and quantitative evaluation technique for relating man-machine performance capabilities to air traffic management tasks. A.B.K.

A75-18190 **Multisensor utilization for air traffic control in the terminal area.** S. H. Starr (Institute for Defense Analyses, Arlington, Va.). In: Traffic control and transportation systems; Proceedings of the Second Symposium, Monte Carlo, Monaco, September 16-21, 1974. Amsterdam, North-Holland Publishing Co.; New York, American Elsevier Publishing Co., Inc., 1974, p. 639-651. 7 refs.

Description of two proposed air traffic data utilization techniques which have the potential to realize the benefits implicit in multisensor utilization, yet satisfy all system constraints and avoid any potential adverse side effects. The essential difference between the two approaches lies in the techniques by which they compensate for the limited altitude information that is available and in their strategies for avoiding potential biases. In the combined data approach, the data from two sensors are synthesized on a report level and are subsequently processed in the system tracker. This procedure is rendered failsafe by augmenting the system tracker to detect aircraft which are in volumes of airspace that are inconsistent with a priori information. In the parallel-track approach, the data from two sensors are directly synthesized within the system tracker. The parallel-track procedure models both the aircraft motion and altitude-induced bias as constant-velocity processes perturbed by random-acceleration noise sources. While in the combined data process the data are selected so that the bias is only explicitly estimated in certain regions, the parallel-track procedure implicitly assumes that a quasi-constant velocity model for the bias is valid throughout the terminal area. A.B.K.

A75-18255 # **Numerical solution of the Navier Stokes equations for supersonic turbulent flow over a compression ramp.** J. S. Shang and W. L. Hankey, Jr. (USAF, Theoretical Aerodynamics Research Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-3.* 9 p. 20 refs.

A modified eddy viscosity model is incorporated into the compressible Navier-Stokes equations. The modification attempts to reproduce the response of turbulence to a severe pressure gradient in the flow field. This relaxation phenomenon is described by an exponential decay of the unperturbed eddy viscosity coefficient downstream of the perturbation in terms of a prescribed length scale. The system of equations is solved by MacCormack's time-splitting explicit numerical scheme for a series of compression corner configurations. Computations are performed for ramp angles varying from 15 to 25 degrees at a Mach number of 2.96 and a Reynolds number of 10 to the 7th power. Calculations utilizing the modified eddy viscosity for the interacting turbulent flow compare very well with experimental measurements, particularly in the prediction of the upstream pressure propagation and location of the separation and the reattachment points. Good agreement is also attained between the measured and the calculated density profiles in the viscous-inviscid interaction region. (Author)

A75-18256 * # **Shock-wave-induced turbulent boundary-layer separation at hypersonic speeds.** C. C. Horstman, M. I. Kussoy, T. J. Coakley, M. W. Rubesin, and J. G. Marvin (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-4.* 13 p. 16 refs.

An experiment is described that tests and guides computations of the interaction of a shock wave with a turbulent boundary layer. Numerical solutions of the time-averaged Navier-Stokes equations for the entire flow field employing algebraic eddy viscosity and turbulent Prandtl number models for shear stress and heat flux are presented and used to illustrate the dependence of the computations on the particulars of the turbulence models. To guide modifications in the models, the mean flow profiles and surface measurements of pressure, shear, and heat flux are analyzed critically. The results show that the models of eddy viscosity require substantial modifications in the interaction region. Improved solutions employing the experimentally modified models are presented. (Author)

A75-18257 # **Flare-induced separation lengths in supersonic, turbulent boundary layers.** A. Roshko (California Institute of Technology, Pasadena, Calif.) and G. J. Thomke (McDonnell Douglas Astronautics Co., El Segundo, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-6.* 13 p. 26 refs.

Wind-tunnel experiments were performed to investigate the effects of Mach number, Reynolds number, and corner angle on flare-induced separation of a supersonic, turbulent boundary layer. The model was a cylinder 12 in. in diameter and 51 in. long, with attached variable flares. The experiment covered flare angles of 9-40 deg, Mach numbers of 2-4.5, boundary-layer thickness Reynolds numbers of 100,000-1,000,000, and adiabatic wall conditions. It was found that the ratio of the upstream interaction length to the boundary-layer thickness at the beginning of the interaction decreases with increasing Mach number and Reynolds number, and increases with the flare angle. It is found that the Mach-number dependence of the interaction length and the incipient-separation angle disappears when they are plotted against the skin-friction coefficient. The incipient-separation data confirm a trend established previously at higher Reynolds numbers that the flare angle needed to induce separation increases with Reynolds number based on chord length. A.T.S.

A75-18258 # **Incipient separation of a supersonic turbulent boundary layer at moderate to high Reynolds numbers.** G. S. Settles, S. M. Bogdonoff, and I. E. Vas (Princeton University, Princeton, N.J.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-7.* 16 p. 30 refs. Contracts No. F33615-70-C-1244; No. F33615-73-C-4156.

Two-dimensional compression corner and axisymmetric flare geometries were used in this study of shock wave interaction with a compressible turbulent boundary layer. The study was carried out at a Mach number of 2.9 and over a Reynolds number range from 100,000 to 10,000,000. Detailed surface pressure, schlieren, and oil flow data were obtained for several corner angles. Two-dimensionality of the compression corner flow was verified by comparison with the flare data. A major finding of this study is that incipient is a gradual rather than an abrupt phenomenon. Incipient

separation corner angles were foud to be within a band of about 16 to 18 deg and essentially independent of Reynolds number over the range studied. (Author)

A75-18263 # **The unsteady supersonic cascade in subsonic axial flow.** J. M. Verdon (United Aircraft Research Laboratories, East Hartford, Conn.) and J. E. McCune (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-22.* 14 p. 19 refs. Research sponsored by the United Aircraft Corp.

This paper presents an analysis for determining the unsteady flow field produced by an oscillating cascade placed in a supersonic stream which has a subsonic velocity component normal to the cascade. The analysis is based on the assumptions of an inviscid, two-dimensional, linearized flow field. Solutions for the velocity potential and the blade pressure distributions which satisfy the blade-to-blade periodicity condition are developed explicitly in terms of disturbance functions distributed on blade and wake surfaces. The boundary conditions of flow tangency at blade surfaces and continuity of pressure across wake surfaces provide integral relations which can be solved numerically to evaluate the disturbance functions. Predicted blade pressure distributions are in good agreement with results determined from a previous finite cascade solution. (Author)

A75-18264 # **Relaxation solution of high subsonic cascade flows and extension of this method to transonic cascades.** F. L. Shope (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.) and B. Lakshminarayana (Pennsylvania State University, University Park, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-23.* 12 p. 10 refs.

A75-18265 * # **Chordwise propagation of dynamic stall cells on an oscillating airfoil.** F. O. Carta (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-25.* 10 p. 12 refs. Contract No. NAS1-11977.

The dynamic stall phenomenon was examined in detail by analyzing a set of unsteady pressure data obtained on an airfoil oscillating in pitch. These data were for sinusoidal oscillations which penetrated the stall region in varying degrees, and here the effort was concentrated on the chordwise propagation of pressure waves associated with the dynamic stall. It was found that this phenomenon could be quantified in terms of a pressure wave velocity which is consistently much less than free-stream velocity, and which varies directly with frequency. It was also found that even when the stall region has been deeply penetrated and a substantial dynamic stall occurs during the downstroke, stall recovery near minimum incidence will occur, followed by a potential flow behavior up to stall inception. (Author)

A75-18267 * # **Prediction of compressor stall for distorted and undistorted flow by use of a multistage compressor simulation on the digital computer.** C. J. Daniele and F. Teren (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-28.* 9 p. 9 refs.

A simulation technique is presented for the prediction of compressor stall for axial-flow compressors for clean and distorted inlet flow. The simulation is implemented on the digital computer and uses stage stacking and lumped-volume gas dynamics. The resulting nonlinear differential equations are linearized about a steady-state operating point, and a Routh-Hurwitz stability test is performed on the linear system matrix. Parallel compressor theory is utilized to extend the technique to the distorted inlet flow problem. The method is applied to the eight-stage J85-13 compressor. Analytical stall prediction for the undistorted stall line shows good agreement with experimental results. The predicted stall line for distorted inlet flow is in agreement with experimental results only for large distortion extents and/or low distortion levels. Results for low distortion extents and high distortion level do not agree with experimental results. (Author)

A75-18268 * # **Technology and methodology of separating two similar size aerospace vehicles within the atmosphere.** J. P. Decker and A. W. Wilhite (NASA, Langley Research Center, Space Systems Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-29.* 10 p. 30 refs.

During the past 10 years, the parallel separation, within the atmosphere, of two similar size aerospace vehicles has been investigated in technical areas such as static and dynamic stability, rocket exhaust plume interference, aerodynamic control, loads, and dynamic simulation. Advanced experimental and analysis techniques have been developed to analyze this problem. Results are presented which summarize some of this work. The effects of various parameters on the separation maneuver are illustrated using results from early and current space shuttle configurations. The technology and methodology that have been developed have helped verify the feasibility of separating similar size aerospace vehicles. (Author)

A75-18269 # **Extended energy management methods for flight performance optimization.** A. J. Calise (Dynamics Research Corp., Wilmington, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-30.* 8 p. 15 refs.

This paper develops a singular perturbation approach to extend existing energy management (EM) methods. A procedure is outlined for modeling altitude and flight path angle dynamics which are ignored in EM solutions. It is shown that feedback solutions can be obtained, even for EM problem formulations which currently result in a two-point boundary value problem. In particular, feedback controls for three-dimensional trajectory optimization problems have been derived using the extended energy management approach. The procedure outlined in this paper is general and applicable to solving a wide class of optimal control problems. It avoids the 'matching' problem that currently exists in applying singular perturbation theory to nonlinear problems. Asymptotically stable boundary layer solutions are a natural result of the approach. (Author)

A75-18270 * # **A non-Gaussian model of continuous atmospheric turbulence proposed for use in aircraft design.** P. M. Reeves (U.S. Navy, Naval Undersea Center, San Diego, Calif.), R. G. Joppa, and V. M. Ganzer (Washington, University, Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-31.* 10 p. 13 refs. Grant No. NGR-48-002-085.

This paper describes a statistical model proposed for use in forecasting vehicle responses to stationary continuous atmospheric turbulence. The model is suggested by the observed patchy character of turbulence, and differs from models now in use in that it does not assume the gust velocity to be a Gaussian process. For simplicity only the vertical gust component is considered here. The validity of the proposed model is established through comparison with published data. This comparison shows that the model is in better agreement with observed gust velocity probability distributions and exceedance frequencies than is the widely used Gaussian model, especially insofar as high velocity gusts are concerned. A method of applying the proposed model to the determination of vehicle responses is developed. It is shown that response probability distributions as well as exceedance frequencies can be derived from the eigenvalues and eigenfunction of certain unsymmetric kernels. (Author)

A75-18271 # **The use of a navigation platform for performance instrumentation on the YF-16 flight test program.** J. N. Olhausen (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-32.* 10 p.

An instrumentation package that makes use of an inertial navigation platform to obtain aerodynamic and performance flight test data has been developed. This package is being used quite successfully to obtain timely and accurate data during the YF-16 flight test program. This paper discusses the theoretical basis and practical aspects of using this instrumentation inertial reference set (IIRS) along with selected results obtained to date. Specific topics addressed include use of the IIRS to obtain flight path acceleration, alpha, beta; normal load factor, rate of climb, airspeed, take-off and landing velocities and distances, position error calibration through the Mach jump region, and wind information. This system has proved to be invaluable on the YF-16 program and has demonstrated many benefits over previously used performance instrumentation. (Author)

A75-18272 # **Anticipated spin susceptibility characteristics of the A-10 aircraft.** T. B. Willen (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-33.* 10 p. 7 refs.

This paper presents the results of a real-time six-degree-of-freedom analysis of the spin entry, spin, and recovery characteristics of the USAF A-10 close air-support aircraft. Analysis was based upon 640 wind tunnel test hours on 1/10 and 1/20 scale models of the prototype A-10 aircraft at high angle of attack. The results indicate that three spin modes exist for the A-10 aircraft but that only one of these spin modes - a low angle of attack spin mode - can be entered with misapplied control inputs from 1g trimmed flight conditions. The exception to this statement is the full speedbrake configuration where two spin modes were obtained. Recoveries from all spin modes are shown to be excellent except for the high angle of attack spin mode, where these results are inconclusive. (Author)

A75-18284 * # **Studies of scramjet/airframe integration techniques for hypersonic aircraft.** C. L. W. Edwards, W. J. Small, J. P. Weidner, and P. J. Johnston (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-58.* 15 p. 21 refs.

New design and analysis techniques for engine-airframe integration were applied in a recent hypersonic vehicle design study. A new technique was developed to design the vehicle's forebody so that uniform precompressed flow was produced at the inlet entrance. Results are verified with three-dimensional characteristic calculations. Results from a new three-dimensional method for calculating nozzle flows show that the entire lower afterbody of the vehicle can be used as a scramjet exhaust nozzle to achieve efficient, controlled, and stable flight over a wide range of flight conditions. (Author)

A75-18285 # **A survey of methods for exhaust-nozzle flow analysis.** E. F. Brown (Virginia Polytechnic Institute and State flame radiating noise to a free field. The change in the radiation impedance of the flame is determined when the enclosure is present as compared with the results when the enclosure is absent. It is concluded that if the enclosure contains sufficient acoustic damping to prevent combustion instability, the noise radiation characteristics of the enclosed flame may be predicted if the free field characteristics are known. Consequently, feedback interactions of wall-reflected pressure waves with the flame do not have to be considered when making noise calculations. (Author)

A75-18286 * # **The effect of Reynolds number on boattail drag.** D. E. Reubush (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-63.* 7 p. 16 refs.

An investigation has been conducted in the Langley pilot transonic cryogenic tunnel to determine the effects of varying Reynolds number on boattail drag at subsonic speeds. Six boattailed cone-cylinder nacelle models were tested with the jet exhaust simulated by a cylindrical sting. Reynolds number was varied from about 2.6 million to 132 million by changing model length and unit Reynolds number. Boattail pressure coefficient distributions show that increasing Reynolds number tends to make the pressure coefficients in the expansion region more negative and the pressure coefficients in the recompression region more positive. These two effects were compensating and as a result there was little or no effect of Reynolds number on the pressure drag of the isolated boattails. (Author)

A75-18287 # **An analytical model of axisymmetric afterbody flow separation.** W. M. Presz, Jr. (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) and E. T. Pitkin (Connecticut, University, Storrs, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-65.* 10 p. 20 refs.

A practical engineering approach to prediction of pressure distribution and boundary layer separation point location on afterbodies in subsonic flow is developed. Experimental data are reviewed and the inadequacy of currently available separation prediction methods is demonstrated. A control volume technique is developed as an alternative and shown to have merit. The separation bubble is then modeled and another control volume technique is developed to predict its outer boundary. Finally, these two developments are combined with a conventional inviscid flow field calculation and a boundary layer analysis to produce an iterative procedure to predict pressure distribution and separation point location on an afterbody given only body shape and free stream flow condition. (Author)

A75-18288 * # **Surface pressure and wake flow fluctuations in a supercritical airfoil flowfield.** F. W. Roos (McDonnell Douglas Research Laboratories, St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-66.* 10 p. 16 refs. Research supported by the McDonnell Douglas Research and Development Program and NASA.

Nonsteady features of a Whitcomb-type supercritical airfoil flowfield were studied in a series of transonic wind tunnel experiments. Data consisted of mean and fluctuating pressures on the airfoil and in the free stream, velocity fluctuations in the wake region, and airfoil vibrations. Fluctuation data were analyzed statistically for intensity, frequency content, and spatial coherence; variations in these parameters were correlated with changes in the mean airfoil flowfield. Surface pressure fluctuation intensity was influenced primarily by the location and motion of the upper-surface shock, the existence of separation, and (downstream of the shock) the development and upstream propagation of 'shocklets'. Power spectra of pressure fluctuations showed characteristics differences up- and downstream of the shock. Chordwise and spanwise coherences were considerably reduced in the presence of separation. Downwash fluctuations at the edge of the wake were noticeably affected only by the development of trailing-edge flow separation. (Author)

A75-18289 * # **Development and evaluation of a new method for predicting aircraft buffet response.** A. M. Cunningham, Jr., P. G. Waner, Jr., J. D. Watts, D. B. Benepe (General Dynamics Corp., Fort Worth, Tex.), and D. W. Riddle (NASA, Ames Research Center, Aeronautical Structures Branch, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences*

Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-69. 15 p. 11 refs. Contract No. NAS2-7091.

The buffet prediction method uses rigid wind tunnel model fluctuating pressure data to form a buffet forcing function. The response is then calculated with a mathematical dynamic model of the airplane developed for gust response analysis. By including the extremes of phasing and contribution of symmetric and antisymmetric airplane responses, the upper and lower bounds are established for buffet response. F-111A flight test data show good agreement with predicted bounds for a variety of flight conditions. (Author)

A75-18290 * # **Transonic buffet behavior of Northrop F-5A aircraft.** C. Hwang and W. S. Pi (Northrop Corp., Aircraft Div., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-70.* 11 p. 18 refs. Contract No. NAS2-6475.

Flight tests were performed on an extensively instrumented F-5A aircraft to investigate the dynamic buffet pressure distribution on the wing surfaces and the responses during a series of transonic maneuvers called the windup turns. The maneuvers to maximum lift were performed at three Mach number-altitude combinations with a constant 'q' of approximately 14,360 N/sq m (300 psf). The fluctuating buffet pressure data at 24 stations on the right wing of the F-5A were acquired by miniaturized semiconductor type pressure transducers mounted on the wing. A new transducer mounting and wiring technique was applied where the interference with the natural flow condition was minimized. The data acquired in this manner were found adequate to trace the shock origin, the movement of the shock front and the development of the separated flow (shock induced or leading edge induced) on the wing surface. (Author)

A75-18291 # **B-52 control configured vehicles maneuver load control system analysis and flight test results.** G. E. Hodges and J. R. McKenzie (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-72.* 12 p. 9 refs. Contract No. F33615-71-C-1926.

The Air Force Flight Dynamics Laboratory and the Wichita Division of the Boeing Company have jointly conducted an analysis and flight test program demonstrating benefits of applying advanced flight control technology to a large flexible airplane. Objectives of the CCV program were to improve ride, extend the flutter envelope, reduce wing bending moment during maneuvers and provide adequate flying qualities for a minimum static stability configuration. This paper is confined to reporting analysis and flight test results of the active control system that reduced wing bending moment during maneuvers. This system is called the maneuver load control (MLC) system. (Author)

A75-18292 # **Transonic turbulent viscous-inviscid interaction over airfoils.** T. C. Tai (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-78.* 11 p. 19 refs. Navy-sponsored research.

A theoretical model is formulated consisting of both inviscid external and viscous boundary-layer flows. The former is solved by the method of integral relations; the latter, by the integral method. Both attached and separated boundary layers are considered for either weak or strong interactions. In case of strong interaction, the surface pressure is calculated by the viscous system rather than prescribed by the inviscid solution. The systems of resulting ordinary differential equations for both flows are coupled by the flow angle at the edge of the boundary layer. The weak interaction is accounted for by simply correcting the airfoil surface with the boundary layer-displacement thickness. The theoretical results are in fair agreement with recent turbulent experimental data. (Author)

A75-18293 # **Finite element analysis of transonic flow by the method of weighted residuals.** S. T. K. Chan, M. R. Brashears, and V. Y. C. Young (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-79.* 10 p. 19 refs. Contract No. F33615-73-C-3144.

The finite element method in conjunction with the Galerkin and least squares approaches were investigated to calculate subsonic and transonic flows about thin airfoils, utilizing cubic triangular and quadrilateral elements. The Galerkin formulation was found to be extremely rapid and accurate for flow regimes up to barely critical. However, for supercritical airfoils the least squares approach was required and gave excellent results with approximately an order of magnitude reduction in computer time compared with relaxation techniques. Numerical results are presented which compared well with experimental data for NACA 64 A006 and 6% thick circular arc airfoils. The advantages of the method are discussed relative to finite difference techniques. (Author)

A75-18294 # **Calculation of transonic flow around axisymmetric inlets.** B. G. Arlinger (Saab-Scania AB, Linkoping, Sweden). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-80.* 11 p. 9 refs.

The transonic flow around an axisymmetric inlet is calculated for a prescribed mass flow ratio. The inlet consists of an initial part of arbitrary geometry which is continued to downstream infinity as a straight circular tube. With a sequence of conformal mappings and a final coordinate stretching the whole exterior and interior flow field is mapped to a rectangular domain in which the full inviscid transonic potential equation is solved using type-dependent line-relaxation. Comparisons of calculated pressure distributions are made with experimental results for various inlets and Mach numbers from 0.5 to 0.95 yielding very good agreement. (Author)

A75-18295 # **Transonic flow field past 2-D airfoils between porous wind tunnel walls with nonlinear characteristics.** J. J. Kacprzynski (National Research Council, Ottawa, Canada). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-81.* 18 p. 11 refs.

Two methods are presented for the calculation of transonic flow field past two-dimensional airfoils between porous wind tunnel walls with nonlinear characteristics. In the first method a small perturbation transonic equation is solved in the physical plane. In the second method the outside region of the airfoil including the wind tunnel walls is mapped to the inside of the circle and the full velocity potential equation is solved numerically. The methods are illustrated with numerical examples and by comparisons with experiment. (Author)

A75-18296 # **A relaxation solution for transonic flow over jet flapped airfoils.** N. D. Malmuth and W. D. Murphy (Rockwell International Science Center, Thousand Oaks, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-82.* 10 p. 16 refs.

Transonic small disturbance theory has been used as a framework for the development of a relaxation solution for the flow over supercritical jet flapped airfoils. The flexibility in grid refinement provided by the results obtained in this work for the far field and asymptotic jet development affords an accurate, rapidly convergent algorithm for this problem. The use of a three grid approach and spatially variable relaxation provides a decisive enhancement in

computational efficiency of the method. The structure of the far field solution corresponds to a 'vorticity packet' as the dominant term in the development. Results of the calculations for NACA 0012 and modified 64A406 airfoils indicate that the jet expands the region of supercritical flow and substantially enhances the lift. These conclusions are consistent with measurements of Yoshihara et al. (Author)

A75-18297 # Flow field study about a hemispherical cylinder in transonic and low supersonic Mach number range. T. Hsieh (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-83.* 12 p. 17 refs.

A theoretical and experimental study has been conducted of an inviscid flow field about a hemispherical cylinder at zero incidence in the transonic and low supersonic Mach number range (free-stream Mach numbers from 0.7 to 2.0). For Mach numbers greater than 1, the method used is a combination of the time-dependent solution for the hemispherical nose portion and the method of characteristics for the cylindrical body portion. Good agreement is found between theory and experiment for Mach numbers greater than or equal to 1.05. The relaxation method has been used for Mach numbers from 0.7 to 1.3. This method gives good results for the pressure distribution over the complete body for Mach numbers from 0.95 to 1.3; however, the predicted external flowfield is not satisfactory. Experimental results indicate a strong interaction of the shock and boundary layer for Mach numbers of about 0.8. (Author)

A75-18302 # Calculations of far-field and near-field jet noise. C.-Y. Chen (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-93.* 18 p. 60 refs.

A method is presented for estimating the noise produced by both cold and hot, shock-free round jets in terms of the details of the turbulent field. The acoustic characteristics of the jet are obtained by evaluating contributions from distributed sound sources represented as small volume elements of turbulence. Each volume element is regarded as an independent sound generator emitting acoustic energy at a characteristic frequency. Several models for far-field and near-field noise calculations based on various extensions of Lighthill's quadrupole theory are formulated and evaluated by comparing with experimental data. It is shown that quantitative estimates are obtainable for both the far and near fields. The strength distribution of sound sources in a jet obtained in the present calculation is in agreement with generally accepted theory. The initial turbulence level of a jet is shown to significantly affect far and near field noise levels and the high frequency portion of the noise spectra. (Author)

A75-18303 # Jet noise analysis utilizing the rate of decay of kinetic power. B. Pinkel. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-94.* 11 p. 13 refs.

A simple model of the noise generated from a gas jet discharging into the atmosphere is presented to facilitate calculation of the effects of nozzle flow and geometric parameters on jet noise. Equations are derived for the overall sound power and the sound generated per unit length of the jet. The application of these equations is illustrated by computations of the effects on noise of (1) jet temperature and (2) velocity of the nozzle relative to the ambient air. Good agreement between the computed values and published experimental results is noted. (Author)

A75-18304 * # Turbulent pressure field in a co-annular jet. R. J. Hammersley and B. G. Jones (Illinois, University, Urbana, Ill.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-95.* 7 p. 6 refs. Grant No. NGR-14-005-177.

Single point and two-point fluctuating static pressure measurements have been made in the initial mixing and transition regions in a co-annular circular jet. Space scales, correlation and time scales in the convected frame, and convection velocities have been determined for both broad band and narrow band frequency components. Analytical functionals describing the structural behavior of the turbulent pressure field have been developed from the data which are suitable for direct application in predicting the sound power level radiated from this turbulent field. Effects of both area and velocity ratios are incorporated in the model. (Author)

A75-18305 # Role of lip thickness in noise suppression by interacting coaxial supersonic jets. P. K. Bhutiani, D. S. Dosanjh (Syracuse University, Syracuse, N.Y.), and A. Abdelhamid (Carlton University, Ottawa, Canada). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-96.* 16 p. 21 refs. U.S. Department of Transportation Grant No. OS-20094.

Changes in the flow and shock structure and the resulting noise reductions from interacting coaxial supersonic jet flows are dependent upon a number of parameters including the lip thickness between the coaxial nozzles. Keeping other parameters fixed, the lip thickness is systematically varied for a coaxial convergent two-nozzle arrangement. The acoustic and optical data and the experimental results obtained with (1) the operating pressure ratios different for each jet and (2) the operating pressure ratios the same, for both jets are presented. The use of a coaxial nozzle arrangement having a finite but thin lip is shown to result in a significant modification of the flow and shock structure of the two interacting coaxial supersonic jets, yielding comparatively the best reduction in the radiated noise. A thick lip is shown to induce flow instabilities and generate additional noise, thus reducing the effectiveness of the coaxial multinozzle arrangement as a noise suppressor for supersonic jets. (Author)

A75-18306 * # Influence of mixer nozzle velocity decay characteristics on CTOL-OTW jet noise shielding. U. von Glahn and D. Groesbeck (NASA, Lewis Research Center, V/STOL and Noise Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-97.* 13 p. 12 refs.

Jet noise shielding benefits for CTOL engine-over-wing configurations were obtained with model-scale multitube and lobed mixer nozzles and various shielding surface geometries. Spectral data were obtained with jet velocities from 585 to 1110 ft/sec. Correlation equations for predicting jet noise shielding benefits with single conical nozzle installations were modified to correlate the mixer nozzle data. The modification included consideration of the number of nozzle elements and the peak axial velocity decay in the flow field adjacent to the shielding surface. The effect of forward velocity on jet noise attenuation by a shielding surface is discussed. (Author)

A75-18307 # Calculations of transonic flow over an oscillating airfoil. R. J. Magnus and H. Yoshihara (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-98.* 12 p. Contract No. N00014-73-C-0294.

Finite-difference solutions to the unsteady Euler equations are presented for the problem of inviscid planar transonic flow over an oscillating airfoil. The NACA 64A410 airfoil oscillating sinusoidally in pitch about the midchord at Mach number 0.72 was treated at reduced frequencies of 0.2, 1.0, and 5.0. The unsteady pressures, forces, pitching moment, and shock location through the oscillation cycle are presented. (Author)

A75-18308 * # Further developments in the prediction of oscillatory aerodynamics in mixed transonic flow. A. M. Cunning-

ham, Jr. (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-99.* 11 p. 15 refs. Contract No. NAS1-12399.

This paper presents improvements made to the oscillatory transonic aerodynamic kernel function method given in AIAA Paper No. 74-359. The improved method is fully developed for flows with continuously varying local Mach number and oscillating normal shocks. The boundary conditions developed for oscillating shocks require that a line doublet be added at the foot of the shock which represents the loads induced by shock movement. Numerical results show good agreement with experiment and significant deviation from linear aerodynamic theory. The method is also used to predict wind-tunnel wall interference effects. (Author)

A75-18309 * **Some recent developments in predicting unsteady loadings caused by control surface motions.** W. S. Rowe, J. D. Sebastian, and M. C. Redman (Boeing Commercial Airplane Co., Renton, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-101.* 9 p. 9 refs. Research supported by the Boeing Independent Research and Development Program; Contract No. NAS1-12020.

Solution instabilities are identified within the procedures used to predict unsteady loadings due to motions of swept hingeline control surfaces. A preferred solution process that demonstrates the need of calculating smooth residual downwash distributions is described. Numerical results displaying erratic solution behavior when use is made of various forms of pressure expressions currently employed in control surface analyses are presented. A new expression of the asymptotic pressure function is derived, which exactly satisfies the change in boundary conditions around the boundary of the control surface. Results of applying the new pressure function are presented and indicate that stable converged solutions may be achieved for predicting the unsteady loadings caused by motions of swept hingeline control surfaces. (Author)

A75-18310 * # **Stability analysis of nonlinear autonomous systems - General theory and application to flutter.** L. L. Smith and L. Morino (Boston University, Boston, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-102.* 11 p. 9 refs. Grant No. NGR-22-004-030.

The analysis makes use of a singular perturbation method, the multiple time scaling. Concepts of stable and unstable limit cycles are introduced. The solution is obtained in the form of an asymptotic expansion. Numerical results are presented for the nonlinear flutter of panels and airfoils in supersonic flow. The approach used is an extension of a method for analyzing nonlinear panel flutter reported by Morino (1969). G.R.

A75-18312 # **A pilot-in-the-loop, visual simulation of trailing vortex encounters at low speed.** M. W. M. Jenkins and J. E. Hackett (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-104.* 12 p. 6 refs.

A fixed base, visual flight simulator, using a transport cab, was used to explore pilot-in-the-loop encounters of a C-130 type transport flying in the wake of a C-5A. Some 80 flight conditions were flown through a range of vortex strengths, core radii, spatial orientations, direction of rotation, and encounter altitudes; all were at low speed on final approach. The roll control power of the encountering aircraft was varied from 75 to 125% of its nominal value. Twenty channels of data were recorded, and a movie of typical gyrations during encounter was obtained. Vortex-lattice modeling techniques were used to update the forces and moments on the penetrating aircraft. The study established the feasibility of performing realistic ground-based simulation evaluations of the vortex encounter hazard. It also established the feasibility of digitally updating the encounter aerodynamics in real time to permit pilot-in-the-loop visual tasks to be performed. (Author)

A75-18313 * # **A flight simulator control system using electric torque motors.** R. O. Musick and C. A. Wagner (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-105.* 8 p. 5 refs.

Control systems are required in flight simulators to provide representative stick and rudder pedal characteristics. A system has been developed that uses electric dc torque motors instead of the more common hydraulic actuators. The torque motor system overcomes certain disadvantages of hydraulic systems, such as high cost, high power consumption, noise, oil leaks, and safety problems. A description of the torque motor system is presented, including both electrical and mechanical design as well as performance characteristics. The system develops forces sufficiently high for most simulations, and is physically small and light enough to be used in most motion-base cockpits. (Author)

A75-18314 * # **Empirical comparison of a linear and a nonlinear washout for motion simulators.** R. V. Parrish (NASA, Langley Research Center, Hampton, Va.) and D. J. Martin, Jr. (Electronics Associates, Inc., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-106.* 10 p. 7 refs.

The subjective opinions gathered from seven pilots in the process of comparing a linear and a nonlinear washout for motion simulators reveal an important advance in motion cue presentation. The advance is not in the increased cue provided by the nonlinear filter over a linear filter for the same amount of motion base travel, but rather in the elimination of false rotational rate cues presented by linear filters. (Author)

A75-18321 # **The interaction between vortex-array representations of freestream turbulence and impermeable bodies.** H. L. Rogler (Case-Western-Reserve University, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-116.* 20 p. 25 refs. Grant No. AF-AFOSR-74-2577A.

The freestream turbulence is modeled with the aid of an array of counter-rotating vortices representing one wavenumber of a turbulent spectrum. Attention is given to the unsteady interaction of this vortex array with the body to obtain the instantaneous flowfield and any average properties of these solutions that may be desired. The flow over a semiinfinite plate is discussed along with rotational flows past finite-length bodies. G.R.

A75-18322 # **Experimental studies of the turbulent wake behind self-propelled slender bodies.** J. A. Schetz and A. K. Jakubowski (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-117.* 12 p. 17 refs. Navy-supported research.

Experimental program providing a systematic comparison of turbulent wakes behind slender bodies with identical forebody shape by varying through three cases: (1) drag, (2) jet-propelled, and (3) propeller-driven. The program is important because most available data concern only the drag-body situation. Impact and static pressures were measured with a pitot-static tube in a subsonic wind tunnel. Bodies (2) and (3) produced momentumless wakes whose development was quite different from the previously studied wake development of a blunt-body (disk) driven by a high-speed central jet to yield a zero-momentum wake. A number of trends concerning axial turbulence intensity, radial shear stress, downstream velocity defect and wake width were observed. S.J.M.

A75-18323 * # **The measurement of shear stress and total heat flux in a nonadiabatic turbulent hypersonic boundary layer.** V. Mikulla and C. C. Horstman (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-119.* 8 p. 9 refs.

Turbulent shear stress and direct turbulent total heat-flux measurements have been made across a nonadiabatic, zero pressure gradient, hypersonic boundary layer by using specially designed hot-wire probes free of strain-gauging and wire oscillation. Heat-flux measurements were in reasonably good agreement with values obtained by integrating the energy equation using measured profiles of velocity and temperature. The shear-stress values deduced from the measurements, by assuming zero correlation of velocity and pressure fluctuations, were lower than the values obtained by integrating the momentum equation. Statistical properties of the cross-correlations are similar to corresponding incompressible measurements at approximately the same momentum-thickness Reynolds number. (Author)

A75-18324 # **Laser velocimeter measurements in free and confined coaxial jets with recirculation.** F. K. Owen (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-120.* 11 p.

Laser velocimeter measurements have been made in the initial mixing regions of free and confined coaxial air jets. Measurements of the axial and radial mean velocity profiles and the RMS and probability density distributions of the velocity fluctuations show that, for the present test conditions, there are extensive regions of unsteady recirculating flow and these regions are substantially different for the two geometric configurations studied. The measured turbulent kinetic energy and shear stress distributions indicate that nonequilibrium effects are dominant in the initial mixing regions and that higher order turbulence models will probably be required to compute these flows. (Author)

A75-18325 * # **Effect of compressibility on the nonlinear prediction of the aerodynamic loads on lifting surfaces.** O. A. Kandil, D. T. Mook, and A. H. Nayfeh (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-121.* 8 p. 15 refs. Grant No. NGR-47-004-090.

The vortex-lattice technique for incompressible flow which accounts for separation at sharp edges is modified to account for compressibility. This is accomplished by extending the Prandtl-Glauert transformation to moderate angles of attack. Thus, the aerodynamic characteristics for the compressible case are obtained from the solution of an equivalent incompressible problem. Numerical results are presented for parallelogram and delta wings to assess the effects of compressibility. The results are in good agreement with available experimental data. (Author)

A75-18326 # **Investigation of a free-vortex aerodynamic window.** R. N. Guile (United Aircraft Research Laboratories, East Hartford, Conn.) and W. E. Hilding (Connecticut, University, Storrs, Conn.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-122.* 10 p. 13 refs.

An aerodynamic window employing a segment of a free vortex was used to seal a low pressure simulated laser cavity from its surroundings. Procedures are presented for determining the aerodynamic properties of the desired vortex segment. In addition, application of the method of characteristics to the design of supersonic nozzles for producing the vortex segment is discussed. Tests were performed to measure the aerodynamic performance of an aerodynamic window employing the free-votex segment. These tests demonstrate the effectiveness of the window in sealing a 3.8 cm aperture at an ambient-to-simulated laser cavity pressure ratio of 15. The tests were conducted using 0.264 kg/sec of air at a total temperature and pressure of 300 K and 10 atm, respectively. Validation of the nozzle design procedure is provided by schlieren photographs which show the flow at the nozzle exit to be wave free. Pitot pressure measurements at the nozzle exit are in close agreement with theory. (Author)

A75-18327 # **Multivortex model of asymmetric shedding on slender bodies at high angle of attack.** A. B. Wardlaw, Jr. (U.S. Navy, Naval Surface Weapons Center, Silver Spring, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-123.* 14 p. 27 refs. NAVAIR Task 320C.

The flow field behind a body at angle of attack is modeled using the impulsive flow analogy. The viscous crossflow plane is simulated by superimposing a large number of point vortices on the potential solution for flow about a cylinder. Development of an asymmetric flow field is triggered by initially perturbing the solution and compressibility effects are accounted for through the application of Gothert's rule. The predicted flow-field structure on bodies with pointed noses is in qualitative agreement with experimental observations. The calculated normal force compares to experimental results, with best agreement being obtained on bodies with pointed noses. The decrease in side force with increasing Mach number is correctly accounted for. Changes in normal and yaw forces accompanying the transition from laminar to turbulence are simulated by moving the separation point in a leeward direction. (Author)

A75-18328 # **Leading-edge-vortex augmentation in compressible flow.** R. G. Bradley, P. D. Whitten, and W. O. Wray (General Dynamics Corp., Aerospace Technology Dept., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-124.* 9 p. 6 refs.

Leading-edge-vortex enhancement by blowing has been explored experimentally. Conceptual half-span wind-tunnel tests were conducted on a wing-body-tail configuration with a cambered and twisted wing with leading-edge flaps. Blowing vortex-augmentation is shown to be effective in improving both lift and drag due to lift at high angle of attack for the Mach numbers tested, $M = 0.3$ and 0.75. Drag improvement results, in part, from an apparent vortex-suction effect on the cambered wing. (Author)

A75-18329 # **Potential flow about three-dimensional lifting configurations, with application to wings and rotors.** J. M. Summa (Texas, University, Austin, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-126.* 12 p. 24 refs. Contract No. F44620-72-C-0026.

A numerical method is developed and successfully applied which appears capable of converging to the exact calculation of three-dimensional, incompressible, lifting potential flows, including cases of unsteady motion. The finite element solution (quadrilateral elements and a 'step' doublet distribution) is obtained for configurations started impulsively from rest. Exact surface boundary conditions are enforced. The geometry and circulation distribution in the wake, including 'curling up' of the rear and side edges, are generated for each time step. Results are presented for the early stages of the flow-field and airload development for several isolated wing and two rotor configurations. For impulsive motion of rotors, the indicial thrust and circulation overshoot shortly after motion starts and then approach asymptotically from above their steady state values. (Author)

A75-18334 # **A graphics program for aircraft design - GPAD system.** W. J. Batdorf, J. F. Holliday, Sr., and J. L. Peed (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-136.* 17 p. 6 refs.

An interactive graphic system has been developed at the Lockheed-Georgia Company for sequencing any series of analysis programs. This in-house system is sometimes referred to as GPAD. The principal advantage of such a system is that program modules can easily be added to take advantage of interactive displays throughout the design process. This paper discusses the operating system, file management, and some of the GPAD programs. Computer graphic languages, the role of mini-computers, and future technology trends are also discussed. (Author)

A75-18335 * # Preliminary thermal-structural design and analysis of an airframe-integrated hydrogen-cooled scramjet. A. R. Wieting and R. W. Guy (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-137.* 12 p. 21 refs.

This paper presents the salient features of a preliminary thermal-structural design and analysis study of a hydrogen-fueled, regeneratively cooled, airframe-integrated scramjet. This three-dimensional fixed geometry scramjet concept which was developed at NASA Langley Research Center is designed to operate over a flight Mach number range from 4 to 10. The thermal-structural study was focused on a scramjet application to one concept for a hypersonic research vehicle and was based on technology developed under the NASA Hypersonic Research Engine Project. State-of-the-art analytical methods consisting of lumped system and finite difference steady-state thermal analyses and a finite element structural analysis were used. The results of the study indicated that this scramjet concept is viable from both a structural mass and cooling requirement standpoint. However, advances in material and fabrication technology for hydrogen-cooled structures appear necessary for acceptable engine life for commercial application. (Author)

A75-18341 * # Cryogenic nitrogen as a transonic wind-tunnel test gas. J. B. Adcock, R. A. Kilgore, and E. J. Ray (NASA, Langley Research Center, Fluid Dynamics Branch, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-143.* 9 p. 6 refs.

The test gas for the Langley Pilot Transonic Cryogenic Tunnel is nitrogen. Results from analytical and experimental studies that have verified cryogenic nitrogen as an acceptable test gas are reviewed. Real-gas isentropic and normal-shock flow solutions for nitrogen are compared to the ideal diatomic gas solutions. Experimental data demonstrate that for temperatures above the liquefaction boundaries there are no significant real-gas effects on two-dimensional airfoil pressure distributions. Results of studies to determine the minimum operating temperatures while avoiding appreciable effects due to liquefaction are included. (Author)

A75-18342 * # Development of minimum correction wind tunnels. S. Bernstein and R. G. Joppa (Washington, University, Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-144.* 8 p. 10 refs. Grant No. NGL-48-002-010.

Flow distortions due to wind tunnel wall interference may be accounted for if the model to tunnel ratio is small, but the theory becomes less reliable as the model becomes larger. This paper presents theoretical analysis and experimental evidence which supports a new concept of wind tunnel. The method employs active control of flow through the walls so that the model is in approximately free air conditions during the test. Practical considerations in the design of such a tunnel are presented. Results indicate that a minimum correction wind tunnel may be achieved with active walls of relatively low porosity. (Author)

A75-18343 * Description and test results of a water basin to determine ground effect in hover using small models. D. J. Renselaer (Rockwell International Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-145.* 8 p. NASA-supported research.

A water basin test facility was established capable of measuring forces and moments of small models of VTOL aircraft, simulating hover in and out of ground effect. Because the models and the operation of the facility are inexpensive, the water basin is particularly suitable for testing the relative characteristics of a great number of model configurations for preliminary design development. Results from a variety of models are given. Lift, pitching moments, and rolling moments are given with and without engine failure simulation in ground effect, and with and without pitched and banked conditions. (Author)

A75-18345 * # Numerical computation of two-dimensional viscous blunt body flows with an impinging shock. J. C. Tannehil, T. L. Holst (Iowa State University of Science and Technology, Ames, Iowa), and J. V. Rakich (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-154.* 12 p. 17 refs. Research supported by the Iowa State University of Science and Technology; Grant No. NGR-16-002-038.

Two-dimensional, viscous, blunt body flows with an impinging shock wave are computed using a time-dependent, finite-difference method to solve the complete set of Navier-Stokes equations. The bow shock wave is treated as a discontinuity, while all interior shock layer detail such as shear layers, shock waves, jets, and the wall boundary layer are automatically captured in the solution. Numerical results are presented for cases in which shock waves of different strengths are allowed to impinge on the flow field surrounding a circular cylinder resulting in different shock interference patterns. The two-dimensional results are compared qualitatively with existing three-dimensional experiments. (Author)

A75-18353 # Investigation of dump combustors with flameholders. F. D. Stull and R. R. Craig (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-165.* 10 p. 6 refs.

An experimental investigation has been conducted on the addition of flameholders to the inlet duct of a 5-in.-diam dump combustor in an attempt to reduce combustor length. Basic flameholder configurations, percentage blockage, leading edge bluntness, and trailing edge contours were varied to characterize the significant features of flameholders. A parametric study was then conducted around the two best flameholder configurations in which combustor length-to-diameter ratio (L/D), characteristic length, inlet temperature, and chamber pressure were varied. Combustion efficiency and combustor pressure losses were determined from each of these runs and compared to previous results for the basic dump combustor. Results are presented which show a marked difference in performance with small changes in trailing edge contour. Increases of up to 30 points in combustion efficiency were obtained when the best flameholder was added to the basic dump combustor with a L/D = 3. (Author)

A75-18355 # Deflection of a thick jet by a convex surface - A practical problem for powered lift. F. J. Davenport and D. N. Hunt (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-167.* 10 p. 9 refs.

Thick wall jets following a convex surface have been investigated to clarify processes limiting the performance of the upper surface blowing powered-lift concept. Planar-flow wind tunnel tests show that adhesion of the jet to the wall is sensitive to the speed of the surrounding flow and to the Mach number of the jet. Surface pressures and flow field survey data show that a local Mach number in excess of 1.5 can be attained without separation. A computation assuming inviscid, incompressible flow gives remarkably accurate pressure distributions up to the onset of local sonic flow, implying that the mixing process is not a dominant influence. (Author)

A75-18356 # **Thrust augmented wing sections in transition flight.** J. D. Wilson, S. Chandra, and J. L. Loth (West Virginia University, Morgantown, W. Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-169.* 8 p. 10 refs. Research supported by the Rockwell International Corp.; Contract No. N00014-68-A-0512.

A numerical method is presented for computing the external aerodynamic characteristics of a thrust-augmented wing section in transition flight in incompressible potential flow. The augmenter inflow velocities and exit jet momentum and line of action are taken from experimental data. With this information the airfoil-jet is treated as a thick semiinfinite body experiencing prescribed inflow velocities over portions of its surface. The incompressible potential flow analysis is performed by subdividing the body surface into line segments and assuming constant-strength vorticity and source-sink distributions on the elements. An exit jet of constant finite thickness is assumed, and its location is determined by iteration until the jet shape converges and satisfies the jet dynamic boundary condition. Jet entrainment effects are considered by assuming symmetric entrainment rates at both sides of the jet. (Author)

A75-18357 # **F-14A flight characteristics at high angles of attack.** W. Bihrle, Jr. and R. Meyer (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-170.* 12 p. 15 refs.

The F-14 has demonstrated that fighter aircraft can be designed to have no lift curve break or angle-of-attack limitation. The maneuver flight envelope, therefore, has been expanded beyond what had traditionally been considered possible. The value of this high alpha capability in the dogfight arena has been convincingly demonstrated in flight. The importance of slats and an ARI system for enhancing this capability has also been demonstrated. The development from concept through flight test of this high alpha capability is presented by candidly reviewing the design philosophy, the background that dictated it, and the results of experimental and analytical studies. It is shown that a breakthrough in the state-of-the-art was not required to obtain this capability, only a committment to exploit it. Had not this attitude prevailed in the face of some adverse predictions and, experimental and analytical uncertainties, the remarkable ACM capability might never have been demonstrated. (Author)

A75-18359 # **CONFLOW High Pressure Leg - A new response to simulation needs for testing advanced atmospheric penetration vehicles.** G. R. Cramer and J. M. Potts (Martin Marietta Aerospace, Orlando, Fla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-173.* 9 p. 8 refs.

A new facility is being constructed to meet the forecasted ground test needs for advanced atmospheric penetration vehicles. Analysis of the projected hypersonic velocity performance levels reveals a severe increase in critical material and component environments, and magnifies the thermally-coupled, particle erosion problems. Compared with these projections, current simulation capabilities are inadequate especially for evaluating full-scale nose tips, air vanes, and heat shields. This problem motivated the development of the CONFLOW High Pressure Leg facility based on a two-stage, high-pressure, high-mass-flow rate chemical burner with controlled particle injection and acceleration. Described are results of environment projections, simulation capability comparisons, and the new facility configuration features and status. (Author)

A75-18372 * # **Aerodynamic heating to corrugation stiffened structures in thick turbulent boundary layers.** H. J. Brandon, R. V. Masek (McDonnell Douglas Astronautics Co., St. Louis, Mo.), and J. C. Dunavant (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-190.* 11 p. 14 refs.

The results of an experimental program to evaluate heat transfer and pressure distributions on corrugation roughened flat plates in thick turbulent boundary layers are presented. The experimental program consisted of tests in the tunnel wall boundary layers of the Langley Unitary Plan Wind Tunnel (UPWT) and Continuous Flow Hypersonic Tunnel (CFHT) at freestream Mach numbers of 2.5, 3.5, 4.5, and 10.3. Tests in the UPWT were conducted at a freestream Reynolds number/m of 10,800,000 and in the CFHT, at Reynolds numbers/m of 1,300,000 to 5,800,000. The test configurations consisted of 50.8 x 50.8 cm panels with corrugated beads of two different peak amplitudes, 0.61 and 0.29 cm. The angle of the corrugated beads relative to the flow direction was varied between 0 (aligned) and 90 deg (normal). The measured peak and average heat transfer are analyzed and correlated in terms of the bulk boundary layer, internal boundary layer, and geometric parameters. (Author)

A75-18374 # **Magnus forces on spinning supersonic cones. I - The boundary layer.** H. A. Dwyer (California, University, Davis, Calif.) and B. R. Sanders (Sandia Laboratories, Livermore, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-193.* 11 p. 17 refs.

A detailed investigation of the laminar boundary layer flow over a spinning right circular cone at small angle of attack has shown that there are at least four significant forces contributing to the Magnus force on the cone. In order to calculate these forces, a novel numerical method has been developed which can calculate these small forces over a wide range of flow parameters. The flow conditions have a large influence on the relative magnitude of the Magnus force components and there can be significant cancelling of the various components. An investigation has also been carried out to show that boundary layer calculations are valid at small angles of attack and that 'boundary region' techniques are not needed until moderate angle of attack. (Author)

A75-18375 # **Boundary layer transition on a film-cooled slender cone.** J. Starkenberg and R. J. Cresci (New York, Polytechnic Institute, Farmingdale, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-194.* 11 p. 16 refs. Contract No. F44620-71-C-0008. AF Project 9781-01.

A combined theoretical and experimental investigation has been conducted in order to determine the effect on the location of the transition point of upstream mass transfer into the boundary layer on a 10 deg half-angle blunted cone. A numerical solution of the boundary layer equations with initial conditions reflecting mass injection was utilized to obtain predictions of the behavior of the downstream laminar boundary layer. Experimental measurements of heat transfer to the surface of the cone model were made at a Mach number of 8, stagnation temperature of 2000 R and free stream Reynolds numbers varying between 10,000 and 80,000 per inch. (Author)

A75-18381 * # **Aeroacoustic performance of scale model sonic inlets.** J. M. Abbott (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-202.* 14 p. 11 refs.

Various means can be used to vary engine inlet throat areas in order to reduce noise generated at takeoff and approach. Low-speed wind-tunnel tests were performed to evaluate the aeroacoustic performance of two takeoff geometries (cylindrical centerbody and bulb-shaped centerbody) and four approach geometries (bulb-shaped centerbody, annular ring, radial vanes, and step diffuser). The effects of inlet internal lip shape and diffuser length on sonic inlet performance were also investigated. It was found that the single-passage geometries, in particular a cylindrical centerbody takeoff geometry and a bulb-shaped centerbody approach geometry, provide the highest level of aeroacoustic performance. Increasing the inlet lip contraction ratio extends the maximum incidence angle for attached lip flow, while increasing the inlet diffuser length increases total pressure recovery for a given amount of noise suppression. A.T.S.

A75-18382 * # **An experimental study of the effect of treated length on fan inlet noise suppressors.** J. H. Dittmar and J. F. Groeneweg (NASA, Lewis Research Center, V/STOL and Noise Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-203.* 11 p. 9 refs.

An experimental study of the effect of length of acoustic treatment was performed on a full scale fan using two different inlets. Analysis of the data revealed that measured suppression varied linearly with the length of the ringed linear segments as anticipated. Further analysis indicated that the wall-only portion of the treatment was substantially more effective than anticipated suggesting that, if only moderate suppression is needed, wall only treatment may suffice. Contrary to expectation the two inlets behaved similarly. Introduction of a hard exhaust splitter into the configuration resulted in a noise increase at certain frequencies. (Author)

A75-18383 # **Acoustic characteristics of an upper-surface blowing concept of power-lift system.** N. N. Reddy and W. H. Brown (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-204.* 9 p. 14 refs.

The noise characteristics of a typical upper-surface-blowing (USB) configuration are studied experimentally using a small scale model. The directivity and the spectral distribution of the radiated noise measured in the free field environment and the mean flow profiles measured around the wing/flap indicate that the dominating noise generating mechanisms of USB are: free jet mixing, wall-jet mixing, secondary mixing (trailing edge wake), and boundary layer turbulence near the flap trailing edge. The wall-jet 'roll-up' at the edges also may contribute to the radiated noise. The relative significance of each source to community noise is discussed. (Author)

A75-18384 * # **Effect of at-the-source noise reduction on performance and weights of a tilt-rotor aircraft.** J. Gibs, W. Z. Stepniewski, and R. Spencer (Boeing Vertol Co., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-205.* 13 p. 8 refs. Contract No. NAS2-6784.

Reduction of far-field acoustic signature through modification of basic design parameters (tip speed, number of blades, disc loading and rotor blade area) was examined, using a tilt-rotor flight research aircraft as a baseline configuration. Of those design parameters, tip speed appeared as the most important. Next, preliminary design of two aircraft was performed, postulating the following reduction of noise level from that of the baseline machine, at 500 feet from the spot of OGE hover. In one aircraft, the PNL was lowered by 10 PNdB and in the other, OASPL decreased by 10 dB. The resulting weight and performance penalties were examined. Then, PNL and EPNL aspects of terminal operation were compared for the baseline and quieter aircraft. (Author)

A75-18385 * **Experimental evaluation of trailing edge and incidence fluctuation noise theories.** M. R. Fink. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-206.* 10 p. 13 refs. Contract No. NAS3-17863.

Tests were conducted to evaluate conflicting theories for trailing edge noise and for incidence fluctuation noise. A flat-plate airfoil with flush-mounted surface pressure transducers was tested in an anechoic wind tunnel at velocities from 31.5 to 177 m/sec and nominal 4 and 6% grid-generated turbulence levels. In one series of runs, the airfoil was faired into the tunnel nozzle and extended beyond the nozzle lip for studies of trailing edge noise without a leading edge and with flow on only one side. Such noise was found to vary with velocity to the fifth power and turbulence level squared as predicted by Ffowcs Williams and Hall (1970) and by Chase (1972). Power spectral density at high frequencies decayed approximately inversely with frequency to the 10/3 power as predicted by Chase. The data were poorly predicted by Hayden's correlation (1969, 1972). (Author)

A75-18387 # **Asymmetric vortex effects on missile configurations.** J. E. Fidler and M. C. Bateman (Martin Marietta Aerospace, Orlando, Fla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-209.* 12 p. 16 refs.

An engineering procedure for estimating the effects of asymmetric lee side vortices on slender missile configurations is described. A computerized model is used which incorporates both theoretical and empirical bases. Vortex locations and strengths are defined on mainly empirical grounds. Forces and moments are calculated from potential flow considerations. The procedure may be applied to bodies with or without tails. Among the effects calculable are: induced side forces, yawing moments, tail forces and rolling moments. Comparisons between predicted and experimental effects are shown. Procedure accuracy is generally suitable for preliminary design purposes. (Author)

A75-18388 # **Generalized unsteady embedded Newtonian flow.** L. E. Ericsson. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-210.* 15 p. 31 refs.

An analysis is presented which extends the previously developed unsteady embedded Newtonian theory down to finite supersonic Mach numbers. It is found that Mach number can have a very large influence on the stability characteristics of blunted slender cones, and that there exist cone angle-nose bluntness combinations for which these Mach number effects are minimized. The computed static and dynamic stability derivatives are in excellent agreement with available experimental data. This also hold true for the highly nonlinear effects of angle of attack. (Author)

A75-18394 # **A simplified numerical lifting surface theory applied to rotary wings in steady, incompressible flow.** P. R. Schatzle (Texas A & M University, College Station, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-218.* 7 p. 7 refs.

A75-18397 * # **Numerical solutions for inviscid supersonic corner flows.** V. S. V. Shankar (Iowa State University of Science and Technology, Ames, Iowa). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-221.* 8 p. 13 refs. NASA-sponsored research.

Analytical solutions for inviscid supersonic corner flows are virtually nonexistent due to the complexity of the interference geometry. In view of this, numerical solutions for compressive-compressive and expansive-compressive corner flows are obtained. The governing equations are written in strong conservation-law form and are solved iteratively in nonorthogonal conical coordinates by use of a second-order, shock-capturing, finite-difference technique. The computed wave structure and surface pressure distributions are compared with high Reynolds number (Re greater than 2,500,000 ft) experimental data. The results clearly show that the wave structure in the corner is dominated by the inviscid field. (Author)

A75-18417 * # **Prediction of vortex flow characteristics of wings at subsonic and supersonic speeds.** J. E. Lamar (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-249.* 9 p. 16 refs.

The leading-edge-suction analogy of Polhamus, which has been successful in the prediction of vortex lift characteristics on wings with pointed tips at subsonic and supersonic speeds, has recently been extended to account for the vortex flow characteristics for wings with side edges. Comparisons of experimental data and other currently used methods with the extended method are made for wings having side edges at subsonic and supersonic speeds. Recent data obtained for a low-aspect-ratio cropped-delta wing with various amounts of asymmetrical tip rake, simulating a roll control device, are also presented. (Author)

A75-18418 # **Propulsion perspective for the universities.** W. H. Heiser (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-250.* 4 p.

It is clear that the rapid advance of air-breathing propulsion technology will continue unabated into the next century, with important consequences for academia. In order to satisfy the desire for higher performance, we will require higher temperatures and pressures, new materials, and more complex aerodynamic design methods. The need for reduced weight and increased durability translates into a need for comprehensive structural technology. The chances for successful advance can obviously be greatly enhanced by strong support from the universities in the traditional forms of ideas, data, graduates, consultants and advisors. With this situation as background, this paper and discussion will focus on general future engine requirements, specific technology areas requiring attention, and some steps that are being taken by the government which will stimulate academic interest. (Author)

A75-18419 * # **Possibilities and goals for the future SST.** A. Ferri (New York University, Westbury, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-254.* 16 p. 22 refs. Grants No. NGL-33-016-119; No. NGR-33-016-131.

An approach directed to defining requirements that would make the development of the SST a worth-while program for the USA is presented. A detailed technical discussion of possible advances in propulsion, aerodynamics, structural construction and design and operational methods is presented. The impact on airplane performances of such improvements is evaluated. The ecological problems related to air pollution and sonic boom are discussed and possible solutions are described. It is concluded that the technical advances required for the development of an efficient economical competitive SST are within reach. (Author)

A75-18422 # **Pilot's and navigator's handbook (Spravochnik letchika i shturmana).** Edited by V. M. Lavskii. Moscow, Voenizdat, 1974. 505 p. In Russian.

The present work provides generalized and systematic reference data on nearly all aspects of aircraft technology and operation. The fundamental concepts, relations, and methods are outlined for such areas as aviation meteorology, aircraft design and construction, characteristics of chief types of aircraft power systems, aerodynamics and flight dynamics, aviation astronomy, aviation cartography, aircraft piloting, automatic flight control systems, maneuvering of aircraft and formation flying, bomb ballistics and bombardment procedures, use of wing rockets, and aerial photography. P.T.H.

A75-18433 # **Calculation of aircraft engine turbines: Gasdynamic calculation - Blade profiling (Raschet turbin aviatsionnykh dvigatelei: Gazodinamicheskii raschet - Profilirovanie lopatok).** S. Z. Kopelev and N. D. Tikhonov. Moscow, Izdatel'stvo Mashinostroenie, 1974. 268 p. 35 refs. In Russian.

A generalization of various methods of gas-turbine design is presented, including an evaluation of methods of gasdynamic calculation of turbine stages, methods of blade profiling, and methods of calculating cooled blades. The size and weight characteristics of a turbine and their dependence on the main parameters of the engine are considered, and the relation between the gasdynamic and strength parameters of a turbine is discussed with allowance for its structural features and fabrication technology, paying special attention to the choice of the layout and dimensions of the air-gas flow area and to the profiling of both nozzle and rotor blades. To facilitate understanding of the theory, a number of examples of specific calculations based on given numerical values of the initial parameters are presented which pertain to single-stage and multistage gas turbines of turbojet engines. A.B.K.

A75-18434 # **Effect of aerodynamic perturbations on the processes of aircraft dusting and spraying (Vliianie aerodinamicheskikh vozmushchenii na protsessy aviatsionnogo opylivaniia i opryskivaniia).** V. S. Derevianko. Moscow, Izdatel'stvo Transport, 1974. 72 p. 13 refs. In Russian.

The results of theoretical and experimental studies of the effect of aerodynamic perturbations on the quality of chemical dusting and spraying operations performed by aircraft are reviewed. Recommendations are made with a view to improving the existing atomizer equipment of the An-2 aircraft and to producing new equipment which more fully satisfies the requirements imposed on aircraft performing agricultural work. A method of studying the effect of various factors on the process of deposition of sprayed material on the treated surface is proposed, as well as a method of calculating its distribution for various initial spray conditions. Also discussed are the effect of flap deviation of the An-2 on the deposition and distribution of sprayed material, the effect of eddy flow around the propeller of the An-2 on the distribution of this material, and the effect of aerodynamic perturbations caused by the aircraft on the efficiency of a tunnel atomizer. A.B.K.

A75-18436 # **Aircraft gas-turbine engines: Design and calculation of components /4th revised and enlarged edition/ (Aviatsionnye gazoturbinnye dvigateli: Konstruktsiia i raschet detalei /4th revised and enlarged edition/).** G. S. Skubachevskii. Moscow, Izdatel'stvo Mashinostroenie, 1974. 520 p. 116 refs. In Russian.

Instructions are given concerning the design of various units of a gas-turbine engine. Following a review of the various types of gas-turbine engines and their applications, a study is made of the forces acting in gas-turbine engines, including the forces arising from the action of gases, the forces acting in the engine proper, and the forces acting on units connecting the engine to the aircraft. A detailed account is given of the design of the main components of axial-flow compressors, centrifugal compressors, and gas turbines. Methods of calculating the strength of turbine blades and disks are described, as well as methods of studying vibrations of blades and

disks. Methods of determining the critical rpm of rapidly rotating shafts are also presented. Difficulties arising in the design of combustion chambers are discussed, with special attention paid to the design of stabilizers of various types. Finally, a study is made of the design of exhaust devices, bearings, and rpm reducers. A.B.K.

A75-18440 # Application of aircraft industrial fluids (Primenenie aviatsionnykh tekhnicheskikh zhidkostei). A. F. Aksenov and A. A. Litvinov. Moscow, Izdatel'stvo Transport, 1974. 156 p. 51 refs. In Russian.

The present work describes quality criteria and operating conditions for fluids used in aircraft hydraulic systems and de-icing systems and for various kinds of cleansing fluids used in aircraft maintenance. The physico-chemical characteristics of these fluids are described in detail. Among fluids for hydrosystems, mineral, mixed, and synthetic fluids are discussed. Conditions for achieving de-icing with the aid of liquid de-icing agents are set forth. The characteristics of individual commercial products are compared and evaluated for all types of fluids examined. P.T.H.

A75-18448 The approach hazard. J. E. Hutchinson (International Federation of Air Line Pilots' Associations, London, England). *Shell Aviation News*, no. 426, 1974, p. 10-15.

The paper reports on some aspects of current pilot concern over approach guidance, design criteria, and performance certification during the approach and landing phase. Some characteristics of the jet aircraft that produce a more severe control of the approach path than is possible with a straight-winged piston or turboprop aircraft are evaluated. The problem occurring in long-bodied types due to the position of the ILS glide slope receiver antenna in relation to the wheels is discussed. A possible reappraisal of information presented to the pilot is considered. T.S.

A75-18490 * Nonlinearities in analyses of unsteady flow around oscillating wings. T. Bratanow, A. Ecer, H. Aksu, and T. Spehert (Wisconsin, University, Milwaukee, Wis.). In: Computational methods in nonlinear mechanics; Proceedings of the International Conference, Austin, Tex., September 23-25, 1974. Austin, Texas Institute for Computational Mechanics, 1974, p. 925-934. Grant No. NGR-50-007-001.

An analysis of nonlinearities involved in unsteady subsonic viscous flow around wings at high Reynolds numbers is presented. The finite element method was applied for the numerical integration of the vorticity transport equations. Physical and numerical aspects of the nonlinearities are discussed. Magnification of nonlinearities in the convection terms near wing surfaces due to changing geometry at leading and trailing edges of the wing chord is determined. As a bubble is generated near the leading edge, the timewise variation of vorticity and pressure distributions over the surface is shown. The different procedures for the integration of the vorticity transport equations in three dimensions along spanwise, chordwise, and normal directions are discussed. (Author)

A75-18530 Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Conference sponsored by the Institute of Noise Control Engineering. Edited by J. C. Snowdon (Pennsylvania State University, University Park, Pa.). Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974. 689 p. $25.

Studies devoted to the reduction, measurement, and effects of environmental noise are presented. This includes studies in city and community noise, aircraft noise, machinery noise, rail transportation noise, traffic noise, and construction noise. Some of the topics covered include: enforcement of noise standards, development of noise elements for communities' general plans, a digital automatic airport noise monitoring system, application of holography to noise source identification, status of the JT8D refan noise reduction program, new computer system for aircraft noise prediction, and methodology of developing and gaining acceptance of regulations for land development near a major airport. P.T.H.

A75-18531 Digital automatic airport noise monitoring system. W. K. Connor and B. K. Cooper (Tracor, Inc., Austin, Tex.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 77-80.

General description of an aircraft noise monitoring system which provides reports of single event noise exposure level (SENEL), hourly noise level (HNL), and community noise equivalent level (CNEL) in addition to data regarding specific aircraft operations and community noise due to nonaircraft sources. The system consists of eight remote stations and a central processing and display station. P.T.H.

A75-18533 Use of digital averaging techniques for the analysis of aircraft flyover noise. D. J. Stouder (McDonnell Douglas Corp., Long Beach, Calif.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 137-140. 5 refs.

A75-18534 * Status of the JT8D refan noise reduction program. J. D. Kester (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 145-150. NASA-sponsored research.

The present work describes measures being taken to suppress jet noise in the JT8D engine and reports on some preliminary acoustic tests to evaluate noise characteristics of the engine. To reduce noise generation without sacrificing other essential engine performance or durability characteristics, the two stage fan will be replaced by a larger-diameter single stage fan. Refanned engines have an increased bypass ratio that contributes to the reduction of jet exhaust noise. Advanced acoustical design features will be incorporated in the larger, single-stage fan, and acoustic treatment will be incorporated in both the engine and the nacelle. First tests have shown that engine component noise levels are about as predicted and the acoustic treatment sections tested to date are providing predicted levels of attenuation. Further work is required to demonstrate engine performance goals and compatibility with 727 and DC-9 installations. P.T.H.

A75-18535 Noise control of aircraft engines. R. Lee and R. E. Motsinger (General Electric Co., Aircraft Engine Group, West Lynn, Mass.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 151-156.

Test results on some feasible techniques for providing noise suppression levels required for the next generation CTOL and for the STOL engines are briefly described. Techniques for reducing fan inlet radiated noise include use of acoustic treatment on a conventional inlet, use of an accelerating inlet with high subsonic throat Mach number, and use of shielding effects. A multi-phase concept in fan exhaust has demonstrated its noise suppression effectiveness. Reduction of turbine noise by means of increased spacing between the stator and rotor has been demonstrated with and without treatment. P.T.H.

A75-18536 **Review of Boeing noise reduction activity.** V. L. Blumenthal, R. E. Russell, and J. M. Streckenbach (Boeing Commercial Airplane Co., Seattle, Wash.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 157-162.

The paper summarizes noise-reduction research and development programs of The Boeing Company from the early 1950s to the present time. Discussions concentrate on the background for each program, presenting the end results obtained or progress made. Acoustic treatments are described that could permit all current Boeing turbofan-powered commercial aircraft models to comply with applicable U.S. Government and international noise rules. Benefits attainable through noise abatement operating procedures are also included. The paper concludes with a summary of the current FAR 36 noise status of each Boeing model, relative to its original takeoff, approach and sideline noise levels. (Author)

A75-18537 **Research and development for quieter aircraft.** N. Shapiro (Lockheed-California Co., Burbank, Calif.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 163-168. 18 refs.

The L-1011 TriStar noise program is briefly described as an example of what research and development for quieter aircraft may entail. Extensive and expensive facilities, research and development programs, and design activities were required to realize the goal of a quiet jet transport. Careful design of the power plant and development of effective absorptive acoustical duct lining ensured the noise certification of the L-1011 at levels substantially below FAR Part 36 limits. Research and development are continuing with concentration on lining technology, nonengine airframe noise, augmented lift system noise, jet noise, and duct propagation and radiation. P.T.H.

A75-18538 **Noise control features of the DC-10.** A. H. Marsh (Douglas Aircraft Co., Long Beach, Calif.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 169-174.

The McDonnell Douglas DC-10 three-engine, wide-bodied jet transports offer new standards of low aircraft noise levels for airport neighbors and passengers. Acoustically absorptive duct linings were developed for installation in the engine inlet and exhaust ducts to reduce the turbomachinery noise generated by the advanced-technology, high-bypass-ratio turbofan engines and to ensure meeting the noise level requirements of Part 36 of the Federal Aviation Regulations for aircraft noise certification established in December 1969. This paper describes the development of the engine nacelle treatment for the DC-10 family of aircraft and presents the results in terms of flyover noise levels during takeoff and landing. (Author)

A75-18539 **Silencing the Hawker Siddeley HS 125 aircraft.** J. R. Brooks (Rolls-Royce /1971/, Ltd., Bristol, England) and R. J. Woodrow (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 175-178.

The present work describes a program for developing a suitable silencer for the HS 125 aircraft, a business jet powered by two turbojet engines. An 8-lobed nozzle proved to be the most effective way of silencing the engine and permits the aircraft to comply with the requirements of FAR Part 36. Total attenuation achieved is 15 EPNdB giving a total margin of around 8 EPNdB below requirements. P.T.H.

A75-18540 * **Jet transport noise - A comparison of predicted and measured noise for ILS and two-segment approaches.** K. C. White and K. R. Bourquin (NASA, Ames Research Center, Moffett Field, Calif.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 179-182. 5 refs.

Centerline noise measured during standard ILS and two-segment approaches in DC-8-61 aircraft were compared with noise predicted for these procedures using an existing noise prediction technique. Measured data is considered to be in good agreement with predicted data. Ninety EPNdB sideline locations were calculated from flight data obtained during two-segment approaches and were compared with predicted 90 EPNdB contours that were computed using three different models for excess ground attenuation and a contour with no correction for ground attenuation. The contour not corrected for ground attenuation was in better agreement with the measured data. P.T.H.

A75-18541 * **New computer system for aircraft noise prediction.** J. P. Raney and W. E. Zorumski (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, Va.). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 183-186. 10 refs.

The purpose of the Aircraft Noise Prediction Office (ANOPO) at Langley Research Center is to provide a focal point for NASA's aircraft noise prediction activities and an appropriate interface with other agencies and industry. An interim prediction system is now in operation, which includes a program for source modeling leading to noise prediction for a single event, two complementary multiple event prediction programs which predict NEF contours on the basis of interpolation of noise, thrust, and altitude data, and the FAA data base for the commercial fleet. An integrated multimode aircraft noise prediction program has been designed, and a mechanism for continuously providing current prediction technology to be incorporated in the program has been implemented. P.T.H.

A75-18542 **Experimental results on the mechanism of noise generation of blades in smooth flow at high Reynolds number.** J. S. B. Mather (Nottingham University, Nottingham, England) and R. A. Davis (Sound Research Laboratories, Colchester, Essex, England). In: Inter-noise 74; Proceedings of the International Conference on Noise Control Engineering, Washington, D.C., September 30-October 2, 1974. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1974, p. 209-212. 6 refs.

An experimental setup is described in which the noise generated by a single fixed blade in a free air jet could be measured for both smooth and turbulent blade inlet conditions. Experiments show that level of noise from a blade in smooth flow is considerably lower than current theories would predict and is probably better approximated by the calculation of noise radiated directly from the blade boundary layer. This type of noise is little dependent on Reynolds number. P.T.H.

A75-18558 **EM modeling of aircraft at low frequencies.** Y. T. Lin and J. H. Richmond (Ohio State University, Columbus, Ohio). *IEEE Transactions on Antennas and Propagation*, vol. AP-23, Jan. 1975, p. 53-56. Grant No. AF-AFOSR-69-1710A.

An efficient computational technique for obtaining scattering cross sections of electrically small aircraft is presented. The technique is based on the wire-grid reaction method. The aircraft shape is approximated by a grid of thin wires, leading to a mathematical representation of the aircraft in the form of an impedance matrix. The inverted matrix yields the scattering data. A variety of wire-grid models were tested. The results show that with power choice of

radius of the wire segments, good agreement with experimental data can be obtained for polarizations parallel to the fuselage axis. For polarizations perpendicular to the fuselage axis, only fair agreement was observed. This computational technique is used to simulate realistic scattering data, which serves as input to information processors for target identification. (Author)

A75-18563 **Microstrip antennas.** J. Q. Howell. *IEEE Transactions on Antennas and Propagation,* vol. AP-23, Jan. 1975, p. 90-93. 6 refs.

Microstrip antennas consist of a planar resonant radiating element parallel to, but separated, from a ground plane by a thin dielectric substrate. These antennas are very thin and consequently rugged and easy to mount. They may be fed from the back through the ground plane or from the edge by depositing microstrip lines on the dielectric substrate. Several varieties of microstrip antennas are discussed in this paper. Design procedures are given for both linearly and circularly polarized antennas. Measured patterns are presented for antennas from UHF through C band. (Author)

A75-18628 # **Influence of the parameters of a system of a certain class on the distribution of its roots (Vliianie parametrov sistemy odnogo klassa na raspredelenie ee kornei).** V. V. Bairak, N. G. Beletskaia, V. V. Kalishchuk, and A. V. Paterilov. In: Certain problems of automatic control of motion. Kiev, Izdatel'stvo Naukova Dumka, 1974, p. 160-164. In Russian.

The application of the root-locus method to the analysis and synthesis of aircraft autopilots is examined. A relationship between the roots of the characteristic equation of the system and the system parameters is established. The influence of the plant and control-system parameters on the distribution of the fundamental points of the root-locus curve is determined. V.P.

A75-18672 # **Use of pastes based on synthetic diamonds for aircraft repair (Primenenie past iz sinteticheskikh almazov pri remonte samoletov).** S. T. Bura (Akademiia Nauk Ukrainskoi SSR, Institut Sverkhtverdykh Materialov, Kiev, Ukrainian SSR) and V. D. Pinchuk (Aviaremontnyi Zavod, Kiev, Ukrainian SSR). *Sinteticheskie Almazy,* vol. 6, no. 2, 1974, p. 64, 65. In Russian.

Paste based on synthetic diamond and washed off with organic solvents was used in the finishing of parts and assemblies of an aircraft control system, and its working qualities were compared with those of conventional finishing materials. Use of diamond paste made it possible to finish hermetically joined surfaces of parts with high degree of purity and precision. Work productivity was increased 2-4 times. P.T.H.

A75-18695 **Present main trends in helicopters (Grandes tendances actuelles de l'hélicoptère).** G. Petit (Société Nationale Industrielle Aérospatiale, Division des Hélicoptères, Marignane, France). *L'Aéronautique et l'Astronautique,* no. 48, 1974, p. 13-27. In French.

Progress has been achieved in helicopter design in the following areas: improvement of performance, reduction of operating costs, and improvement in comfort. Performance improvements have included increased payloads (through decreased unloaded weights and improved rotors), increased speeds, and decreased fuel consumption. Operating costs are a greater factor in the expense of helicopters than initial cost. Operating costs can be reduced by increasing the fatigue life of various parts, improving systems which are subject to periodic maintenance or introducing on condition maintenance for them, simplifying complex rotor systems, and designing parts for ease of maintenance. Methods aimed at decreasing noise and vibration levels are outlined. A.T.S.

A75-18696 **Aircraft engines under development (Moteurs séronautiques en cours de développement).** A. Bodemer (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 48, 1974, p. 39-43. In French.

A survey is made of the known characteristics of various military and civilian jet engines now being developed. The military engines include the General Electric YJ 101 and F 101, the Turbo Union RB 199-34 R and RB 172-06 R, the Volvo RM 8-B, and the Pratt and Whitney F 100/F 401. The civilian engines are the Lycoming ALF 502, the Pratt and Whitney JT 10 D, JT 8 D-109, and JT 9 D-59, the Rolls Royce Spey Mk 606, the Garrett TFE 731-3, the Japanese FJR 710/720 (TF 1002), and the General Electric CF 6-50 J. A.T.S.

A75-18698 **Study of second-throat equipped ejectors with zero induced flow (Etude des éjecteurs à second col à flux induit nul).** C. Oiknine, C. Robert, and F. Sananes (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 48, 1974, p. 68-75. 19 refs. In French.

In ejectors with zero induced flow, the addition of a second throat may produce a choking effect which interferes with the start of the supersonic regime. Experimental results with such ejectors are examined in order to elucidate the influence of various parameters. These parameters include the shape of the nozzle, the expansion ratio of the unconfined jet, the distance between the nozzle exit plane and the entrance to the second throat, the junction angle with the second throat, the length of the second throat, and the presence of a subsonic diffuser. A method is proposed for computing the generating pressure and the limiting value of the contraction ratio. Secondary injection is found to be an effective and simple means to increase the performance of double-throated ejectors. A.T.S.

A75-18740 **Wave forms for a supersonic rotor.** M. V. Lowson and R. J. Jupe (Westland Helicopters, Ltd., Yeovil, England). *Journal of Sound and Vibration,* vol. 37, Dec. 22, 1974, p. 475-489. 8 refs. Research supported by the Science Research Council.

The geometry of the wave forms of a supersonic rotor is described, based on a ray theory. The waves formed by a nontranslating supersonic rotor are found to be limited by a hyperboloid, causing a cone of silence centered on the axis where only radiation from conventional noise sources may be observed. The wave region is limited by cusps which imply local focusing of the radiated energy. These fundamental features apply also to cases with hub motion but their geometry becomes complex. The approach is one in which nonlinear effects necessarily are ignored, but the results appear to have value in delineating potential regions of shock formation in the free field. Applications include the shock radiation from supersonic fans in jet engines and the advancing blade slap problem in helicopters. (Author)

A75-18809 **The potential of new display techniques in future ATC systems.** R. C. G. Jenyns. *Eurocontrol,* vol. 3, no. 4, 1974, p. 8-14. 16 refs.

New display techniques show potential of fulfilling future requirements in Air Traffic Control display systems, insofar as they will prove to be competitive alternatives to the cathode ray tube. The techniques include light emitting diode, liquid crystal and gas discharge. Implementation of them will only follow further programs of research and development and will require favorable results from cost benefit analyses and extensive human factors studies. S.J.M.

A75-18810 **The Netherlands ATC automation programme.** J. S. Smit (Rijksluchtvaartdienst, The Hague, Netherlands). *Eurocontrol,* vol. 3, no. 4, 1974, p. 21-27.

At the Air Traffic Control center near Amsterdam, an automated ATC system is being developed in successive stages designated as SATCO 1, SATCO 2, SARP 1 and SARP 2. SATCO 1 was an operational strip-printing system for processing flight data, put into use in 1961. SATCO 2, largely unsuccessful because of its rigidity, comprised an extended strip-printing system promulgated in 1964. It was greatly modified and made operational again in 1968, incorporating some radar. SARP was planned in three phases: reorganization of route structure using existing equipment, effective in early 1974; introduction of radar data processing (SARP 1, to be completed in late 1975), while maintaining SATCO flight data processing; and introduction of more radar data processing with replacement of SATCO (SARP 2, scheduled for early 1978). Phase 3, via a link between the Amsterdam Center and the EUROCONTROL Maastricht center, will enable control of the Netherlands upper airspace air traffic to be effected from Maastricht. S.J.M.

A75-18813 # **Speed characteristic of a booster with a two-stage control valve (Charakterystyka predkosciowa bustera ze zdwojonym suwakiem sterujacym).** E. Dobkowski. *Technika Lotnicza i Astronautyczna,* vol. 29, Dec. 1974, p. 16-18, 34. In Polish.

Description of a method of determining the speed characteristic of a hydraulic booster using a two-stage valve in the distributor. A method is proposed for determining the speed with which operation of the distributor using the main valve can be switched over to operation with the standby valve in case of failure of the main valve. It is shown how the proposed method can be applied to determining the speed characteristics of a booster with a properly operating distributor, a booster with an inclined main valve in the neutral position, and a booster with an inclined main valve in a position other than neutral. A.B.K.

A75-18814 # **Effect of fuel with a high sulfur content on the operation of turbojet engine fuel system components (Wplyw paliwa ze zwiekszona zawartoscia siarki na prace agregatow ukladow paliwowych turbinowych silnikow odrzutowych).** R. Bekiesinski and H. Rzewski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 29, Dec. 1974, p. 27-33. 9 refs. In Polish.

Consideration of the corrosive effects of sulfur compounds contained in the fuel used to power turbojet engines on the materials from which the fuel-system components are made. It is noted that the fuel-system components most susceptible to corrosion are those made of materials which contain copper alloys or which are coated by a protective layer of cadmium. A number of factors governing corrosion processes occurring under the action of sulfur compounds are cited - namely, the fuel temperature, the time in which the fuel acts on the fuel-system components, and turbulence of the fuel flow. A detailed study is made of the effects of the most corrosive compounds contained in jet fuels - namely, hydrogen sulfide, elementary sulfur, and mercaptan sulfur - on materials made of copper and bronze. The most severe deterioration is found to be caused by mercaptan sulfur. Finally, the effects of corrosion processes caused by sulfur on various components of the fuel-pump system, including the rotor, bearings, and filters, are indicated. A.B.K.

A75-18820 **Low-cost composite structures.** M. A. Nadler and E. H. Jaffee (Rockwell International Corp., Aircraft Div., Los Angeles, Calif.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, SME Paper EM74-733.* 18 p. 8 refs.

The emphasis in the advanced composites field has shifted from increased performance and associated payoffs to low-cost production, enabling direct cost competition with other materials of construction. Recent raw material cost reductions are primarily due to enthusiastic acceptance of composites in sporting goods and attendant high-volume production. Low-cost aspects of hybrid configurations and selective reinforcement of metal with filamentary composites are briefly discussed. Particular attention is paid to low-cost manufacturing methods, covering low-cost tooling, automated layup, relaxed layup tolerances, reusable silicone rubber bagging, RF curing, cocuring, wet processing, and time-lapse photography inspection. (Author)

A75-18821 # **Manufacturing of advanced composite structures.** R. L. Zwart (Douglas Aircraft Co., Long Beach, Calif.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, Paper.* 15 p.

The expanding use of Advanced Composites has resulted in rapid advances in manufacturing techniques. The initial use of flat laminates now encompasses fiber stiffened metal structures, complex moldings, laminated structure and tape/filament wound shapes. Since the cost of the composites has been lowered significantly within the last two years, and further decreases to less than $20.00/pound anticipated in the near future, much of the new work is being concentrated on the advantages of composites to the commercial aircraft field. Tool developments have been toward larger structures and co-curing in larger assemblies. This has necessitated tool designs that maintain configuration during cure and are rigid enough to counteract thermal movement. With the need for larger cure facilities, materials and tools are developing along the lines of self-heated and pressure contained tooling. (Author)

A75-18822 # **Reliability of airframe inspections at the depot maintenance level.** J. A. Moyzis, Jr. (Boeing Co., Wichita, Kan.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, Paper.* 20 p.

A requirement of 90 percent, at the 95 percent confidence level, for the reliability of present-day on-airplane depot maintenance level manual-scan eddy current airframe fastener hole inspections is unrealistic: large radial-length cracks are routinely missed. Significant variation in inspection performance level at different installations, as well as degradation of eddy current technique reliability at depot level compared with laboratory studies contribute to this lower efficiency. Specified modifications to contemporary procedure include a 1/64 inch ream of all fastener holes and two independent eddy current inspections. Reliability data are based on a comparison of on-airplane depot-level inspection data on teardown parts with laboratory inspection data on some of these parts after teardown. Data from continuing reliability studies utilizing automated-scan eddy current and ultrasonic techniques are now being correlated. S.J.M.

A75-18823 # **Holographic NDI of P-3 wing plank splices.** A. J. Koury (U.S. Naval Air Systems Command, Washington, D.C.), M. J. Devine, J. F. Erthal (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.), and P. G. Bhuta (TRW Systems Group, Redondo Beach, Calif.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, Paper.* 35 p. Contract No. N62269-72-C-0400.

Considerable savings in time and cost will result when current ultrasonic methods of wing plank splice stress corrosion cracking inspection are replaced by holographic techniques. The steps of stripping, resealing, and repainting will be eliminated. Continuous-wave and pulsed laser holographic interferometry of three P-3 wing panels detected all the crack areas revealed by a prior ultrasonic inspection, and in addition, interferograms located several other cracks not evinced by ultrasonic point-probe. Post-disassembly dye penetrant inspection verified these extra findings. Application of 4 different thicknesses of paint to one panel before lasing did not interfere with the holographic process. It may be useful to verify

integrity with 'structural signature,' i.e. periodic comparison of a component against itself via interferograms: a change in signature will result from fatigue or reduction in cross-section. Details of the laser equipment used are given. S.J.M.

A75-18824 # **Automated eddy current fastener hole scanner.** W. H. Thompson, E. J. Siracusa, and R. F. Clark (Lockheed-Georgia Co., Marietta, Ga.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, Paper.* 22 p.

Two prototype automated eddy current fastener hole scanners have been developed for the C-5A aircraft. By precisely positioning the probe and adding a written record the inspection reliability will be increased, thus decreasing inspector interpretation. A built-in calibration standard that checks inspection parameters after each fastener hole will enhance reliability. Both units are under evaluation to determine their applicability to inspection of various areas of the C-5A and to ascertain what modifications will be required for production. The scanners are sufficiently flexible to apply to other aircraft as well. Requirements, capabilities and circuit design details of the two units are discussed. S.J.M.

A75-18825 # **Evaluating the new aluminum aerospace forging alloys.** J. T. Staley (Alcoa Technical Center, Pittsburgh, Pa.). *ASM, SME, and ASNT, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., Mar. 11-15, 1974, Paper.* 28 p. 16 refs. Contract No. F33615-69-C-1644.

Die forgings in alloys 7050, 7049, special process 7175, and MA52 (variant of Boeing 21 and Reynolds RX720) were fabricated and evaluated for resistance to stress-corrosion cracking, quench sensitivity, and fracture toughness. Analyses of results of almost 1,000 tensile tests, 2,000 stress-corrosion tests, and 200 fracture toughness tests indicate that all of the newer alloys were less quench sensitive than alloy 7075, and when overaged to T7 tempers all developed better combinations of strength and resistance to stress-corrosion cracking and fracture toughness than 7075-T6 and 7079-T6 of equal strengths. Because 7050 developed the best combination of properties, it is a preferred selection for use as die forgings of relatively heavy section thickness for the aerospace industry. Special process 7175 is an equally good selection for die forgings of thin to moderate section thickness. (Author)

A75-18840 # **Influence of protective layers and coatings on the endurance limit of Kh17N2 steel (Vliianie zashchitnykh sloev i pokrytii na predel vynoslivosti stali Kh17N2).** B. A. Treskunov, V. M. Pleskach, P. A. Averchenko, and S. I. Riabtsev (Zaporizs'kii Mashinobudivnii Institut, Zaporozhe, Ukrainian SSR). *Problemy Prochnosti,* Nov. 1974, p. 116, 117. 7 refs. In Russian.

The influence of chromium plating and of cyanide hardening on the fatigue strength of compressor-blade steel (quench-hardened, tempered at 350 C, and cooled in air) was studied experimentally. It is found that low-temperature cyanide hardening is far superior to other means of increasing the service life of Kh17N2 compressor blades in high-temperature gas flows. V.P.

A75-18878 **On independent determination of the coordinates of vehicle position by means of a plane Cartesian coordinate system stereographically mapped onto a sphere, with allowance for the nonsphericity of the earth.** M. E. Temchenko. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* May-June 1974, p. 19-28.) *Mechanics of Solids,* vol. 9, no. 3, 1974, p. 15-22. 17 refs. Translation.

A75-18880 **Dynamics of body motion with allowance for nonstationarity of flow.** S. M. Belotserkovskii, Iu. A. Kochetkov, and V. K. Tomshin. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* May-June 1974, p. 35-43.) *Mechanics of Solids,* vol. 9, no. 3, 1974, p. 28-35. Translation.

A75-18882 **Error in a corrected gyrocompass in maneuvering.** N. V. Voroshilova, N. V. Gerasimov, E. Kh. Saringulian, and M. V. Chichinadze. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* May-June 1974, p. 56-61.) *Mechanics of Solids,* vol. 9, no. 3, 1974, p. 47-52. 7 refs. Translation.

A75-18898 **Air traffic control - Upgrading the third generation.** D. R. Israel (FAA, Washington, D.C.). *Technology Review,* vol. 77, Jan. 1975, p. 14-24.

The national air traffic control system's primary functions are control, navigation, surveillance, and communications. Planning and development of air traffic control must consider the needs of the operators and users of the system, the system's goals (improved performance, improved safety, and reduced costs), and factors such as economic and environmental constraints. An upgraded third-generation system for the 1980s and 1990s is judged to be superior to either a fourth-generation Advanced Air Traffic Management System (AATMS), which would involve a series of space satellites, or a distributed-management concept, which would transfer air traffic control to the cockpit. The nine key features of the upgraded third-generation system are: intermittent positive control to prevent mid-air collisions, a discrete address beacon system, area navigation, a microwave landing system, increased automation, airport surface traffic control, the wake vortex avoidance system, automated flight service stations, and aeronautical satellites for transocean flights. A.T.S.

A75-18927 # **Numerical calculation of linearized subsonic flows around wings (Calcul numérique d'écoulements subsoniques linéarisés autour d'ailes).** H. Viviand (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and W. Ghazzi. *La Recherche Aérospatiale,* Sept.-Oct. 1974, p. 247-260. 20 refs. In French.

A numerical method is presented for the calculation of steady subsonic linearized flows around wings, for the lifting problem on the one hand and for the thickness problem on the other hand. The collocation method which is proposed for the solution of the lifting problem belongs to the general class of finite element methods and presents some advantages over Multhopp methods from the point of view of simplicity and generality. Numerical examples are presented and compared with other theoretical results and with experimental results. (Author)

A75-18929 # **Explicit form of the optimal piloting law for a rigid aircraft flying in a turbulent atmosphere (Forme explicite de la loi optimale de pilotage d'un avion rigide volant en atmosphère turbulente).** G. Coupry (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* Sept.-Oct. 1974, p. 291-302. 7 refs. In French.

After having shown the differences in principle and in application range corresponding to flight control in turbulence by open loop and closed loop, the former method is developed. The piloting laws are presented in an explicit form as a function of flight velocity and of the aircraft dimensionless parameters, and the response attenuation is calculated. Lastly, an application of the method shows which gains may be obtained by using an open loop control for the flight in turbulence of a Mirage III aircraft. (Author)

A75-18960 **Design and development of the Hawker Siddeley 748 prop-jet feeder liner.** A. J. Troughton (Hawker Siddeley Aviation, Ltd., Woodford, Essex, England). *Aeronautical Journal*, vol. 78, Nov. 1974, p. 485-505.

A75-18961 **The future world demand for civil aircraft.** A. P. Ellison (Aviation Planning Services, Ltd., Montreal, Canada) and E. M. Stafford (Southampton, University, Southampton, England). *Aeronautical Journal*, vol. 78, Nov. 1974, p. 506-512.

Future demand for civil aircraft is discussed as well as the timing and magnitude of the ordering process. In an investment adjustment model two measures of aircraft stock are used. The deflated aircraft capacity measure of stock is found to give the most reasonable explanation. Structural equations of the overall model have been developed. The question of the effect of the removal of schedule fare controls to give either greater or less fluctuation in variables such as aircraft orders and passenger load factors is considered. Tables are presented which explain three possible structural changes that may produce comprehensive forecasts. These are delivery lags of 8 and 12 quarters and a change in the fare/load factor ratio of 30%. T.S.

A75-18963 **The tandem-wing concept applied to modern transports.** J. W. Bottomley (Aeroplane and Armament Experimental Establishment, Bascombe Down, Wilts., England). *Aeronautical Journal*, vol. 78, Nov. 1974, p. 523, 524.

Attention is given to the tandem-wing layout as used in design study. Some advantages and disadvantages of the design are briefly listed. Of special interest to the tandem-wing design, some areas of the performance envelope are considered, including drag estimation, take-off and landing performance, range and method of pitch control. Undercarriage layout and engine installation are discussed. T.S.

A75-18965 **NDT personnel team up with EB welders to upgrade production on supersonic Tomcat.** *Materials Evaluation*, vol. 33, Jan. 1975, p. 20A-23A.

A taut regimen of quality control for electron-beam (EB) welding has resulted in a 50% improvement on certain production phases of the supersonic F-14 Tomcat Air Superiority Fighter plane. The prime muscle of the plane, which enables abrupt speed shifts by allowing forward-rearward wing panel movement during flight, is the wing box. Its 70 EB welds are first surveyed for missed seams and internal voids by underwater ultrasonic examination. Questionable areas are analyzed in detail radiographically, using a helium-neon laser to position the X-ray tubehead. Finally, scrutiny of the wing box assembly surface is accomplished by dye penetrance. Repairable defects located by any of these nondestructive testing steps are machine-milled and rewelded by arc welding. S.J.M.

A75-18967 * **Transonic transport wings - Oblique or swept.** R. T. Jones (NASA, Ames Research Center, Moffett Field, Calif.) and J. W. Nisbet (Boeing Commercial Airplane Co., Seattle, Wash.). *Exxon Air World*, vol. 27, no. 1, 1974, p. 6-10. 6 refs.

Oblique-wing twin- and single-fuselage transonic transport models were wind tunnel tested and showed superior aerodynamic efficiency to that of fixed-swept-wing, variable-sweep-wing, and delta-wing configurations similarly tested. The oblique-wing airplane had the smallest gross weight and lowest fuel consumption; it could achieve lower noise levels than swept- and delta-wing aircraft by engine-nacelle treatment; and it was aeroelastically less stable than a sweptback wing but more stable than a swept-forward wing. Graphite-epoxy met stability requirements without additional stiffening, whereas aluminum needed some additional stiffness. Further studies are called for to develop the full potential of the oblique-wing concept. S.J.M.

A75-18971 **Future air traffic control systems - An important new study by controller/pilot group.** *The Controller*, vol. 13, Nov. 1974, p. 4-8.

The concept of a strategic ATC system is developed. Such a system is one where three-dimensional navigation and time all accord to a basic known plan. It is 'speechless' in that it is not dependent upon intervention from either controller or pilot. Such a system applies programmed scheduling both en route and at airports, in order to accord with system capacity. It serves primarily air transport and other cooperating agencies. The system must be programmed with the performance parameters of each aircraft type wishing to accept the ATC service. (Author)

A75-18972 **ARTS II automated air traffic control system.** G. J. de Boer. *The Controller*, vol. 13, Nov. 1974, p. 29-32.

ARTS II is an automated radar terminal system and represents the first significant application of a low-cost, high-reliability minicomputer for ATC technology, making automated ATC facilities throughout the world economically feasible, regardless of size. The operational features of ARTS II and system capacity and performance are described. Base of the system is secondary surveillance radar and transponder equipped aircraft. It can decode and analyze 256 transponder replying aircraft on each radar antenna scan and correlate up to 140 transponder codes to aircraft identities for each scan. The system is showing more than 6,000 hours mean time between failure in its 24-hour continuous operation at Wilkes-Barre/Scranton Airport. P.T.H.

A75-19028 **Development of a pulse compression distance measuring equipment system using surface acoustic wave devices.** D. W. Mellon and W. D. Daniels (Texas Instruments, Inc., Dallas, Tex.). *(Institute of Electrical and Electronics Engineers, International Microwave Symposium, Atlanta, Ga., June 12-14, 1974.) IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-22, Dec. 1974, pt. 2, p. 1308-1312. 7 refs.

Proposed C-band distance measuring equipment (DME) requires the use of triodes to generate high-power C-band transmitted pulses. The inherent short life of these triodes necessitates placing this equipment in physically accessible areas of the aircraft, often long distances from the antenna. Losses incurred in transmitting the C-band pulse to the antenna can increase the power requirements of the system. A pulse compression system has been designed to solve the cost of maintenance problems by using reliable low-power solid-state transmitters and also allowing the equipment to be installed close to the antenna. The use of a pulse compression system allows a reduction in peak transmit power by a factor equal to the time bandwidth (BW) product of the transmit pulse. Size, weight, and reliability are also improved by implementing surface wave devices (SWD's) in the pulse compression airborne interrogator. (Author)

A75-19051 **Traupel commemorative volume (Traupel-Festschrift).** Edited by P. Suter and G. Gyarmathy. Zurich, Juris-Verlag AG, 1974. 383 p. In German, English, and French. $18.

Topics discussed include examples of the use of the finite-element method in turbomachine design, evaluation of the loss components of axial-flow compressor blade cascades with various relative heights of the cascade and various blade tip clearances, a theoretical model for predicting fluctuations in multistage turbomachines on the basis of a concept of stochastic chopping of the blade wakes, use of the finite-element method in calculating inviscid compressible flows, the application of a figure of merit called entropy efficiency to the evaluation of information detectors, a method of estimating dynamic vibrational stresses in exhaust turbocharger turbine blades, a singularity method for calculating incompressible conical cascade flow, a method of calculating the stresses in radial-flow impellers with cover disks, problems in designing the exhaust duct of an axial-flow turbine, and a derivation of an axisymmetrical radial equilibrium equation for turbomachines. A.B.K.

A75-19053 **Evaluation of individual loss components on the basis of tests on a multistage axial-flow compressor (Evaluation des pertes élémentaires sur la base d'essais sur un compresseur axial multi-étage).** J.-P. Borel (Eidgenössische Technische Hochschule, Zurich, Switzerland). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974, p. 39, 41-66. 6 refs. In French.

Determination of the values of the individual loss components and the related coefficients for an axial-flow compressor blade cascade with a known performance. It is shown that the coefficients of these components can be calculated for a given blade cascade on the basis of overall measurements made on the compressor, during which the relative height of the cascade and the tip clearance are assigned different values. By extrapolating the parameters which are functions of the tip clearance to zero clearance, the losses due to the clearance can be determined and separated from the other losses to facilitate the subsequent calculations. The factor allowing determination of the tip-clearance losses does not depend on the blade aspect ratio but is strongly affected by the dimensionless mass flow rate. The losses arising on the channel walls and on the blade profiles are evaluated on the basis of standard relations, the difference between these losses constituting the residual losses. The proportionality factor figuring in the calculation of the residual-loss coefficient is found to lie in the range indicated by Traupel (1968). A.B.K.

A75-19054 **Flow fluctuations in multistage thermal turbomachines (Über die Strömungsfluktuationen in mehrstufigen termischen Turbomaschinen).** G. Gyarmathy (Brown, Boveri et Cie. AG, Baden, Switzerland) and P. Spengler (Eidgenössische Technische Hochschule, Zurich, Switzerland). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974, p. 95, 97-141. 7 refs. In German.

Development of a theoretical model for predicting the velocity, enthalpy, and temperature fluctuations in multistage turbomachines on the basis of a concept of stochastic chopping of the blade wakes by the following blade rows. For the proposed calculation, in which the fate of a large number of fluid particles is studied on the basis of the Monte Carlo method, the dissipation profiles for the blade wakes of the individual cascades must be known. Following a study of the nature of the fluctuations caused by the chopping effect and a review of the assumptions underlying the construction of the model, the proposed theory is applied to a number of examples involving turbines. The calculations show that the enthalpy at the outlet of multistage turbines fluctuates in a range the extent of which is comparable to the magnitude of the stage heat drop. For a steam turbine, for which turbulence measurements are available, it is found that the calculated intensities of the static-temperature and flow-velocity fluctuations are in fairly good agreement with the measured values. A.B.K.

A75-19057 **Dynamic loading of turbocharger turbine blades (Dynamische Beanspruchung der Turbolader-Turbinenschaufeln).** M. Naguib (Brown, Boveri et Cie. AG, Baden, Switzerland). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974, p. 231, 233-249. 10 refs. In German.

Description of a method by means of which dynamic vibrational stresses in exhaust turbocharger turbine blades and the lacing wires can be estimated. These stresses arise mainly as a result of excitation of the stator blades or from multiple sector admission. A method for calculating these stresses is proposed in which test results for a medium-sized turbocharger are used to determine the resonance rpm and the corresponding stress for a machine of different size. The prerequisites for this scaling calculation are described in detail and analyzed, paying particular attention to the calculation of the magnification factor in going from the test state to the operational state, and taking into account the possibilities of excitation by stator blade wakes and excitation due to multiple sector admission. Also discussed are stresses arising as a result of flow forces. A.B.K.

A75-19058 **Application of the singularity method to the calculation of conical flow through turbine cascades (Anwendung der Singulätitatenmethode auf die Berechnung der konischen Strömung durch Turbinengitter).** A. Roeder (Brown, Boveri et Cie. AG, Baden, Switzerland). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974, p. 251, 253-271. In German.

Description of a singularity method for calculating incompressible conical cascade flow. In the proposed method the vortex system in the blade cascade is represented by straight vortex lines in a flow on a conical surface. These vortex lines intersect the cone axis and vertically penetrate the cone surface along its lines of intersection with the blades (called profile contours). It is shown that this system of vortex lines may be regarded as a good approximation of a three-dimensional vortex system. Using the proposed method, a detailed calculation is made of the velocity distribution on a profile contour and of the flow exit angle in the case of both stationary and rotating blade cascades. The proposed method is then compared with a method described by Traupel, which is based on the use of the continuity equation, the theorem of conservation of angular momentum, and the assumption of isentropic state change. A.B.K.

A75-19060 **Aerodynamic streamlining of the exhaust ducts of axial-flow turbomachines (Strömungstechnische Gestaltung des Austrittsstutzens von axialmaschinen).** P. Suter (Ecole Polytechnique Fédérale, Lausanne, Switzerland) and R. Girsberger (Eidgenössische Technische Hochschule, Zurich, Switzerland). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974, p. 303, 305-350. 48 refs. In German.

Consideration of the problem of designing the exhaust duct of an axial-flow turbine so as to avoid the excitation of dangerous blade vibrations. The literature on the problem of ensuring that the working fluid coming from the blades is brought with a good degree of recovery and maximum possible flow uniformity to the exhaust duct, in order to avoid strong circumferential variation of the pressure at the site of the last rotor blade row, is critically reviewed, with the results being classified according to whether they pertain to ideal diffusors, annular diffusors, model tests on complete exhaust casings, or tests behind running machines. This literature review makes it possible to draw conclusions concerning the importance of the various parameters and concerning the outlook for special configurations to improve the flow in extremely confined exhausts. In connection with model testing, it is shown that the through-flow characteristics of the turbine should be simulated, especially if the likelihood of vibration excitation is to be evaluated. Finally, the relation between these vibrations and the nonuniformity of the pressure field downstream for the blading is examined. A.B.K.

A75-19061 **On the treatment of body forces in the radial equilibrium equation of turbomachinery.** A. J. Wennerstrom (USAF, Aerospace Research Laboratories, Wright-Patterson AFB, Ohio). In: Traupel commemorative volume. Zurich, Juris-Verlag AG, 1974. p. 351-367.

A derivation of the axisymmetric 'radial equilibrium equation' of turbomachinery is presented. The derivation employs spatially distributed body force fields to account for the effects of blade shape and of streamwise entropy gradients within the flow field. The derivation is aimed at a formulation convenient for use with streamline curvature computing procedures. Computing stations may be non-radial and the analysis is suitable for radial as well as axial turbomachinery. Finally, it is shown how airfoil gas bending forces may be obtained from the body force fields and how this result may be further used to determine blade surface velocities in some instances. (Author)

A75-19063 **Possible applications for an integrated communication, navigation, and identification system /ICNI/ in civil aviation (Anwendungsmöglichkeiten für ein integriertes Nachrichten-, Navigations- und Identifizierungssystem /ICNI/ in der zivilen Luft-**

fahrt). P. Form (Braunschweig, Technische Hochschule, Braunschweig, West Germany). *Ortung und Navigation,* no. 3, 1974, p. 65-74. 13 refs. In German.

A75-19109 # **An extinguisher emulsion (Löschemulsion).** G. Siegmund and H. Rohr (J. Schaberger und Co. GmbH, Gau-Algesheim, West Germany). In: Safety technology: Generation and action of explosive systems; Annual Meeting, Karlsruhe, West Germany, June 27-29, 1973, Reports. Berghausen bei Karlsruhe, Institut für Chemie der Treib- und Explosivstoffe, 1974, p. 475-496. In German.

Description of an extinguishing agent for fighting aircraft fires on airfields which can serve as an effective fire extinguisher when dropped from the air. It was found that an extinguishing agent suitable for this purpose is an emulsion of Halons in water which also contains dissolved foaming agents. The special feature of this extinguisher emulsion in contrast to systems known up to now is that it can be ejected as a compact jet and that it automatically starts foaming when heated by the flames. In fire-extinguishing tests carried out it was found that the new extinguishing agent is not limited just to airborne application but can also be applied in conventional ways. The combination of properties of liquid extinguishing agents with the advantages of foam extinguishers results in properties hitherto unknown in the use of fire-fighting vehicles, manual fire extinguishers, sprinkler systems, etc. The extinguisher emulsion can be produced either in a central production plant or can be prepared in situ when needed. A.B.K.

A75-19201 **Type of second wave and change in pressure on the initial section of a blunt cone generatrix.** A. N. Liubimov (Akademiia Nauk SSSR, Institut Prikladnoi Matematiki, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 216, May 21, 1974, p. 509-512.) *Soviet Physics - Doklady,* vol. 19, Nov. 1974, p. 255-257. 5 refs. Translation.

A75-19251 **Design of supercritical aerofoils.** R. C. Lock and J. L. Fulker (Royal Aircraft Establishment, Farnborough, Hants., England). *Aeronautical Quarterly,* vol. 25, Nov. 1974, p. 245-265. 18 refs.

Survey of experimental results on a series of aerofoils designed with the intention of operating at relatively high subsonic Mach numbers (around 0.8) with, on the upper surface, a large extent of supercritical flow, terminated by a weak shock wave. The paper describes the design of a basic aerofoil, together with some modifications to it which were successful in improving its performance at both high and low speeds. It is shown that the best of these aerofoils, with thickness/chord ratio 0.105, has a drag rise Mach number of 0.80 at a lift coefficient of 0.5, thus comparing favorably in this respect with other published examples; its maximum lift coefficient at low speeds, 1.2, is also satisfactory for an aerofoil of this thickness. Some comparisons are given between these experimental results and some theoretical calculations by the finite-difference method of Garabedian and Korn, including a partial allowance for viscous effects. It is concluded that further improvements in this theory are needed before it can be used with confidence for practical purposes. (Author)

A75-19255 **The boundary layer on a plane of symmetry.** M. R. Head and T. S. Prahlad (Cambridge University, Cambridge, England). *Aeronautical Quarterly,* vol. 25, Nov. 1974, p. 293-304. 6 refs. Ministry of Defence Contract No. AT/2029/051/SRA.

For the turbulent boundary layer it is shown that, if an initial velocity profile is given, along with the local pressure gradient and shear-stress distribution through the layer, then the shape of the velocity profile a short distance downstream is unaffected by flow convergence or divergence, provided this is constant through the layer. For flow approaching an obstacle, increased divergence close to the surface is shown to account for the marked changes in profile shape that have been observed. (Author)

A75-19256 **Similarities in pressure distribution in separated flow behind backward-facing steps.** M. A. B. Narayanan, Y. N. Khadgi, and P. R. Viswanath (Indian Institute of Science, Bangalore, India). *Aeronautical Quarterly,* vol. 25, Nov. 1974, p. 305-312. 6 refs.

Static pressures have been measured in the separated flow region behind backward-facing steps in a wind tunnel, suitable corrections being applied for the model blockage. The results indicate a reasonably well-defined similarity in the pressure distribution. (Author)

A75-19257 **Numerical solution of the hypersonic wake behind a wedge.** L. Walitt (Thermo-Mechanical Systems, Inc., Canoga Park, Calif.) and C. Y. Liu (California, University, Los Angeles, Calif.). *Aeronautical Quarterly,* vol. 25, Nov. 1974, p. 313-330. 19 refs. Grant No. DAAG05-70-C-0103.

A numerical method which solves the time-dependent Navier-Stokes equations for plane, two-dimensional, compressible flow problems is presented. The method was applied to obtain the steady-state flow field about a flat-based wedge at a free-stream Mach number of 6.05, a Reynolds number of 14,100, and a Prandtl number of 0.75. Two wedge surface temperature boundary conditions were investigated: adiabatic and isothermal walls. For the isothermal wedge, calculated pressures on the surface of the body, static pressure profiles, pitot pressures profiles, and velocity profiles in the near wake were in agreement with corresponding experimental data. A comparison of static temperature profiles in the near wake of the isothermal wedge produced significant differences between numerical and experimental results near the wake shock. It was found that these differences could be explained in terms of uncertainties in the accuracy of the experimental measurements and thermal boundary conditions on the wedge surface. For the adiabatic wedge, the ramp boundary layer profiles and pressure distribution were in agreement with theoretical predictions coming from hypersonic interaction theory. (Author)

A75-19323 # **Stability and controllability of flight vehicles. Part 2 - Longitudinal stability of aircraft (Stabilnost i upravljivost letelica. Part 2 - Uzduzna stabilnost aviona).** M. Nenadovic. Belgrade, Univerzitet u Beogradu, 1972. 728 p. 128 refs. In Serbo-Croatian.

A detailed study is made of the various systems comprising the longitudinal stability and controllability units of an aircraft. Topics discussed include aerodynamic forces and moments figuring in a study of the longitudinal stability of an aircraft, showing how the aircraft balance and static stability are affected by the structural flexibility of the aircraft, by the ground, by the angle of deflection of the wing flaps and ailerons, and by the aircraft speed. Also discussed are the longitudinal static stability of an aircraft with held and free altitude controls, the static stability of an aircraft during maneuver flight, systems of the longitudinal dynamic stability units of an aircraft, the longitudinal dynamic stability of an aircraft with held and free altitude controls, systems of differential units of various types figuring in a study of the longitudinal dynamic stability of an aircraft, and automatic longitudinal stability and controllability of an aircraft. A.B.K.

A75-19400 **Aircraft engine noise research.** London, Her Majesty's Stationery Office, 1974. 19 p. $0.51.

The sources of jet engine noise and design methods being studied to reduce it are discussed. High bypass ratio engines are capable of significant noise reduction in comparison to older low bypass designs. Supersonic transports such as the Concorde, which use zero bypass ratio turbojets for performance reasons, are inherently less capable of achieving the same noise level as contemporary subsonic aircraft of the same weight. Areas in which further research is needed, including the possible use of different engine types in future supersonic aircraft, are indicated. A.T.S.

A75-19401 **Investigation of the regularities of flow development in a system of viscous underexpanded supersonic jets.** V. S. Avduevskii, A. V. Ivanov, I. M. Karpman, V. D. Traskovskii, and M. Ia. Iudelovich. *(Akademiia Nauk SSSR, Doklady,* vol. 216, June 11, 1974, p. 1004-1007.) *Soviet Physics - Doklady,* vol. 19, Dec. 1974, p. 328-330. 5 refs. Translation.

A75-19479 **DICEF - A special Air Force facility for data acquisition and analysis and research in support of digital communications.** J. B. McEvoy and N. J. Sturdevant (USAF, Rome Air Development Center, Griffiss AFB, N.Y.). In: National Telecommunications Conference, San Diego, Calif., December 2-4, 1974, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 856-861. 10 refs.

A description is given of the Rome Air Development Center's Digital Communications Experimental Facility (DICEF), which is a laboratory dedicated to data acquisition and analysis, research, and development in digital communications. The communications processor can operate at any data rate up to 10 megabits per second. Real and simulated communications channels available include HF, wireline, and troposcatter. The support equipment, HF simulator, wireline simulator, and some typical studies performed at DICEF are described. A.T.S.

A75-19572 * **A study of noise guidelines for community acceptance of civil-helicopter operations.** C. L. Munch (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Journal,* vol. 20, Jan. 1975, p. 11-19. 23 refs. Contract No. NAS1-12495.

The Day-Night Noise Level, which takes tonal content, duration, and number of operations into account, and penalizes night-time noise, is found to be the best available index for rating community annoyance caused by aircraft. A Day-Night level of 60 for communities with ambient noise levels up to 58 dBA, and a level of 2 dBA higher than the ambient for communities where it is above 58 dBA, is proposed as acceptable. Evaluation of a large transport helicopter showed that the guidelines do not impose severe economic penalties on helicopter operations. A.T.S.

A75-19573 **Guidelines for reducing helicopter parasite drag.** C. N. Keys and R. Wiesner (Boeing Vertol Co., Philadelphia, Pa.). *American Helicopter Society, Journal,* vol. 20, Jan. 1975, p. 31-40. 6 refs.

This paper presents an analysis of the considerations involved in reducing the drag of new helicopter fuselage configurations within practical design constraints. Included are drag reduction guidelines for fuselage components such as the nose section, cabin, afterbody, hubs, engine nacelles, landing gear and protuberances. The guidelines are based primarily on wind tunnel test data and analytical studies conducted on numerous tandem and single rotor aircraft. (Author)

A75-19574 **Parachute escape from helicopters.** W. P. Schane (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). *(NATO, AGARD, Aerospace Medical Meeting, 30th, Soesterberg, Netherlands, Sept. 3-7, 1973.) American Helicopter Society, Journal,* vol. 20, Jan. 1975, p. 41-43.

Experimental evidence shows that a parachutist experiences no major difficulty in achieving vertical and horizontal separation from an autorotating helicopter. At high rates of descent, however, there is a 0.75 sec delay after exit before expected vertical separation begins. (Author)

STAR ENTRIES

N75-13791 *# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
HIGH ALTITUDE GUST ACCELERATION ENVIRONMENT AS EXPERIENCED BY A SUPERSONIC AIRPLANE
L. J. Ehernberger and Betty J. Love Washington Jan. 1975 26 p refs
(NASA-TN-D-7868; H-836) Avail: NTIS HC $3.75 CSCL 01A

High altitude turbulence experienced at supersonic speeds is described in terms of gust accelerations measured on the YF-12A airplane. The data were obtained during 90 flights at altitudes above 12.2 kilometers (40,000 feet). Subjective turbulence intensity ratings were obtained from air crew members. The air crew often rated given gust accelerations as being more intense during high altitude supersonic flight than during low altitude subsonic flight. The portion of flight distance in turbulence ranged from 6 percent to 8 percent at altitudes between 12.2 kilometers and 16.8 kilometers (40,000 feet and 55,000 feet) to less than 1 percent at altitudes above 18.3 kilometers (60,000 feet). The amount of turbulence varied with season, increasing by a factor of 3 or more from summer to winter. Given values of gust acceleration were less frequent, on the basis of distance traveled, for supersonic flight of the YF-12A airplane at altitudes above 12.2 kilometers (40,000 feet) than for subsonic flight of a jet passenger airplane at altitudes below 12.2 kilometers (40,000 feet). The median thickness of high altitude turbulence patches was less than 400 meters (1300 feet); the median length was less than 16 kilometers (10 miles). The distribution of the patch dimensions tended to be log normal. Author

N75-13792 *# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL INVESTIGATION OF A TWIN ENGINE STRAIGHT WING UPPER SURFACE BLOWN JET FLAP CONFIGURATION
Arthur E. Phelps, III Washington Jan. 1975 80 p refs Prepared in cooperation with Army Air Mobility Research and Development Lab., Hampton, Va.
(NASA-TN-D-7778; L-9758) Avail: NTIS HC $4.75 CSCL 01A

An investigation was conducted in a full scale wind tunnel to determine the performance and aerodynamic characteristics of a twin engine, straight wing, upper surface blown jet flap configuration. The model had two simulated high bypass ratio turbofan engines with rectangular nozzles exhausting onto the upper surface of the wing at the 35 percent chord station. The model was tested with an aspect ratio 8.2 wing and with the wingtips removed to give an aspect ratio of 6.0. Author

N75-13793 + Engineering Sciences Data Unit, London (England).
SUBSONIC LIFT-DEPENDENT DRAG DUE TO THE TRAILING VORTEX WAKE FOR WINGS WITHOUT CAMBER OR TWIST
Oct. 1974 10 p refs Supersedes ESDU-Aero-W.02.01.02 Sponsored by Roy. Aeron. Soc.
(ESDU-74035; ESDU-Aero-W.02.01.02) Copyright. Avail: NTIS HC $36.00

A numerical expression for the lift-dependent drag coefficient due to the wing trailing vortex wake at subsonic speeds is derived. The data apply to uncambered, untwisted wings with straight leading and trailing edges and streamwise tips. The theory from which the data were obtained is linearized and relates to inviscid flow. Additional mathematical relationships are developed for wings with different planforms. Graphs of the drag coefficient for various wing shapes and airspeed conditions are provided. Author

N75-13794 + Engineering Sciences Data Unit, London (England).
DRAG DUE TO A CIRCULAR CAVITY IN A PLATE WITH A TURBULENT BOUNDARY LAYER AT SUBSONIC, TRANSONIC AND SUPERSONIC SPEEDS
Nov. 1974 14 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-74036) Copyright. Avail: NTIS HC $74.50

Data on the drag due to a circular cavity in a plate immersed in a compressible turbulent boundary layer with zero heat transfer are provided. The data are applied to determining the drag penalty due to surface irregularities on aircraft components. The conditions under which the data are valid are: (1) circular cavities with sharp edges and flat bottoms, (2) depth to diameter ratios less than 1.5, (3) diameters up to about three times boundary-layer thickness, (4) turbulent boundary layers, (5) airflow with zero heat transfer, and Mach numbers less than 3.0. Author

N75-13795# Advisory Group for Aerospace Research and Development, Paris (France).
V/STOL AERODYNAMICS
Oct. 1974 355 p refs Partly in ENGLISH and partly in FRENCH Proc. of the Fluid Dyn. Panel Symp., Delft, Netherlands, 24-26 Apr. 1974
(AGARD-CP-143) Avail: NTIS HC $10.00

The proceedings of a conference on the design, development, and flight characteristics of V/STOL aircraft are presented. The subjects discussed include the following: (1) powered high lift systems, (2) mechanical high lift systems, (3) jet lift, (4) ground effect, and (5) aerodynamic prediction methods and simulation requirements. Examples of V/STOL aircraft configurations are illustrated. Specific performance parameters, actual and predicted, are analyzed in graph form. Numerical methods for determining aerodynamic characteristics from wind tunnel and flight tests are developed.

N75-13796* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL AERODYNAMICS: A REVIEW OF THE TECHNOLOGY
David H. Hickey *In* AGARD V/STOL Aerodyn. Oct. 1974 13 p refs
CSCL 01C

An analysis of the development and technological applications of V/STOL aircraft is presented. The use of V/STOL aircraft to overcome the limitations of conventional aircraft is discussed. The aspects of V/STOL aircraft which are considered are: (1) economic penalties of propulsive lift, (2) advantages of propulsive lift, (3) potential improvements in V/STOL aircraft, (4) the aerodynamics of V/STOL aircraft, and (5) proposals for additional research in V/STOL development. Author

N75-13797 De Havilland Aircraft Co., Ltd., Downsview (Ontario).
RESEARCH INTO POWERED HIGH LIFT SYSTEMS FOR AIRCRAFT WITH TURBOFAN PROPULSION
B. Eggleston *In* AGARD V/STOL Aerodyn. Oct. 1974 17 p refs

The characteristics and applications of powered high lift systems suitable for turbofan powered aircraft are reviewed. Aerodynamic research conducted on high lift systems for use with high bypass ratio turbofan engines are reported. The systems discussed include: (1) mechanical flaps, (2) internally blown flaps, (3) externally blown flaps, and (4) vectored thrust. Tests on two-dimensional and three-dimensional models were conducted and the aerodynamic characteristics are applied to design studies of a turbofan powered short takeoff and landing transport aircraft. The application of computerized three-dimensional potential flow method to lift prediction for a wing with internally blown flaps is described. Author

N75-13798 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PREDICTING THE MAXIMUM LIFT OF JET-FLAPPED WINGS
David J. Moorhouse *In* AGARD V/STOL Aerodyn. Oct. 1974 9 p refs

A method for predicting the maximum lift of jet flap configurations is presented. The three parts of the process are described. A theoretical expression for the increment in maximum lift due to blowing on jet-flapped airfoils was obtained that was based on the assumption of a leading-edge stall. For practical application a three-dimensional theory is required, with suitable corrections for finite aspect ratio and part span flaps. The expression shows agreement with measured results for pure jet flaps, internally blown flaps, externally blown flaps, and upper surface blown flaps. It was determined that the results are independent of the actual presence of a leading edge stall, independent of the sweep angle, and applicable to aspect ratios greater than approximately three. Author

N75-13799 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
WIND TUNNEL INVESTIGATION OF THREE POWERED LIFT STOL CONCEPTS
R. F. Osborn and G. S. Oates *In* AGARD V/STOL Aerodyn. Nov. 1974 12 p refs

A comprehensive, parametric wind tunnel investigation of three short takeoff and landing aircraft concepts was conducted. The three STOL configurations were: (1) the externally blown flap (EBF), (2) internally blown flaps (IBF), and (3) the mechanical flap/vectored thrust (MF/VT). Wind tunnel model characteristics are shown as well as the details of the high lift devices tested. The effect of engine location is discussed and is shown to be the dominant factor in EBF and MF/VT powered lift performance. Wing sweep and aspect ratio effects on lifting performance are analyzed. Performance in ground effect is covered using the test data collected. Incremental changes in the lift, drag, and pitching moment characteristics resulting from in-ground effect operation are explained. A comparison of the aerodynamic performance of the three powered lift systems is included.
Author

N75-13800 National Aeronautical Establishment, Ottawa (Ontario). Low Speed Aerodynamics Lab.
THE SPANWISE LIFT DISTRIBUTION AND TRAILING VORTEX WAKE DOWNWIND OF AN EXTERNALLY BLOWN JET FLAP
R. H. Wickens *In* AGARD V/STOL Aerodyn. Oct. 1974 23 p refs

The aerodynamic characteristics of externally blown flaps (EBF) are presented for configurations of the quasi-two dimensional and reflection-plane type. Force and surface pressure measurements have shown that significant lift increments can be realized by external blowing, and that the spanwise effect of this increase extends outward from the nacelle location. The effective stream tube dimension of the additional lift can be a significant fraction of the wing span. Downstream flow surveys have shown that the presence of mixed regions of propulsive and vortex flows is typical of the EBF, particularly for multi-engined finite wing configurations. The characteristics of wake measurements downwind of a half-model of a multi-engine aircraft of the EBF type are described.
Author

N75-13801 Royal Aircraft Establishment, Bedford (England).
THE FLOW AROUND A WING WITH AN EXTERNAL FLOW JET FLAP
P. R. Ashill and D. N. Foster *In* AGARD V/STOL Aerodyn. Oct. 1974 13 p refs

The main features of the flow around a wing with an externally blown jet flap are discussed. Measurements were made, under wind-on and wind-off conditions, on a half model of a wing-fuselage with an injector powered nacelle mounted under the wing. Analysis of the velocity distributions measured in the jet at the trailing edge of the flap suggests that the turning and spreading process is sensibly independent of forward speed. The sweepback effect on the spanwise distribution of momentum towards the wing tip is investigated. It was determined that the spanwise distributions of lift and pressure drag, derived from static pressure measurements made under wind-on conditions, exhibit a pronounced nonuniformity in the vicinity of the nacelle. It is stated that the jet flap effect on the total lift is small.
Author

N75-13802 Canadair, Ltd., Montreal (Quebec).
INVESTIGATION OF EXTERNALLY BLOWN FLAP AIRFOILS WITH LEADING EDGE DEVICES AND SLOTTED FLAPS
Fotis Mavriplis and David Gilmore *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs

An investigation was conducted to provide information on the aerodynamics of externally blown flap systems and to establish the correspondence of such systems, in which the flap is blown by a jet of circular cross section, with two dimensional jet flaps. Wind tunnel tests were conducted with a two dimensional high lift wing model and a tip turbine fan having a diameter-to-wing chord ratio of 0.365. A semi-empirical two dimensional method is also presented which is an extension of the theory for thin multi-element airfoils and a nonlinear jet geometry. The measured data provided useful empirical relationships for estimating the two dimensional C sub L max and C sub D.
Author

N75-13803 Societe Bertin et Cie, Plaisir (France).
PRESENTATION OF AERODYNAMIC AND ACOUSTIC RESULTS OF QUALIFICATION TESTS ON THE ALADIN 2 CONCEPT [PRESENTATION DES RESULTATS AERODYNAMIQUES ET ACOUSTIQUES DES ESSAIS DE QUALIFICATION OU CONCEPT ALADIN 2]
Maurice Collard, Claude Doyotte, and Max Sagner *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs In FRENCH

Wind tunnel tests were conducted of a scale model of the Aladin 2 aircraft. The propulsion system configuration is described and the air flow caused by jet ejection is analyzed. Three dimensional flow studies in the vicinity of the engine installation were made. Diagrams of the leading and trailing edge flaps are provided. Graphs are developed to show the aerodynamic performance under conditions of various airspeed and flap deflection.
Author

N75-13804 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDY OF BOUNDARY LAYER CONTROL BY BLOWING AT THE KNEE OF A FLAP
Bernard Monnerie and Guy Lovat *In* AGARD V/STOL Aerodyn. Oct. 1974 20 p refs In FRENCH; ENGLISH summary

An investigation of lift augmentation by boundary layer blowing was conducted. The test equipment consisted of a large scale mounting for the study of two dimensional boundary layers. The tests were conducted in a low speed wind tunnel three meters in diameter. The experimental results obtained by probing the jet-boundary layer mixing zone are presented. The results are compared with computations using a turbulence model based on the Nee-Kovasznay equation for the viscosity coefficient.
Author

N75-13805* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMICS OF JET FLAP AND ROTATING CYLINDER FLAP STOL CONCEPTS
Woodrow L. Cook, David H. Hickey, and Hervey C. Quigley *In* AGARD V/STOL Aerodyn. Oct. 1974 6 p refs

CSCL 01C

The aerodynamic effectiveness of various propulsive lift concepts to provide for the low speed performance and control required for short takeoff and landing aircraft is discussed. The importance of the interrelationship between the propulsion system and aerodynamic components of the aircraft is stressed. The relative effectiveness of different lift concepts was evaluated through static and wind tunnel tests of various aerodynamic models and propulsion components, simulations of aircraft, and in some cases, flight testing of research aircraft incorporating the concepts under study. Results of large scale tests of lift augmentation devices are presented. The results of flight tests of STOL research aircraft with augmented jet flaps and rotating cylinder flaps are presented to show the steeper approach flight paths at low forward speeds. Author

N75-13806 Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
PROGRESS REPORT ON MECHANICAL FLAPS
P. Perrier and M. Lavenant *In* AGARD V/STOL Aerodyn. Oct. 1974 15 p refs In FRENCH; ENGLISH summary

The development of wing lift augmentation for short takeoff aircraft is discussed. The problems associated with powered lift created interest in designing mechanical high lift devices capable of lift coefficient greater than 4. To obtain such a coefficient, computerized techniques were used. A wing with powerful mechanical high lift devices was designed with a combined use of theoretical aerodynamic methods and experience gained in developing the advanced mechanical systems. Comparisons between estimated and test results are provided. Author

N75-13807 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
A METHOD FOR PREDICTION OF LIFT FOR MULTI-ELEMENT AIRFOIL SYSTEMS WITH SEPARATION
K. Jacob and D. Steinbach *In* AGARD V/STOL Aerodyn. Oct. 1974 16 p refs

A numerical procedure is presented for analyzing the performance of high lift devices such as leading edge slats and slotted flaps. The method also makes it possible to predict pressure distributions and lift for many arbitrary airfoil combinations in incompressible flow. The method considers the boundary layer displacement effect and allows for rear separation with a dead air region. The maximum lift can be predicted on the basis of the geometry of the system and the Reynolds number of the flow. The method has been programmed in FORTRAN for the IBM 360-65 computer and has been applied to several airfoil combinations. Diagrams of the flow characteristics of the airfoils under varying conditions are provided. The mathematical models which support the theoretical aspects are developed. Author

N75-13808 Aeronautical Research Inst. of Sweden, Stockholm.
EXPERIMENTAL HIGH LIFT OPTIMIZATION OF MULTIPLE ELEMENT AIRFOILS
Bjoern L. G. Ljungstroem *In* AGARD V/STOL Aerodyn. Oct. 1974 16 p refs

The application of two dimensional testing and two dimensional wind tunnel techniques for experimental high lift investigations is discussed. The tests conducted on geometrical variations of double and triple slotted mechanical flaps are described. It is shown that an optimum slat position corresponds to a flow with relatively little interaction between the slat wake and the main wing and flap boundary layers. Similar results were also obtained for the trailing edge, where it is found that the different viscous layers should be kept essentially separated from each other. The interrelationship between the flow over the leading-edge slats and that over the trailing-edge flaps is analyzed. The calculation methods consist of a potential flow method and a method in which the boundary layer effects are considered.
Author

N75-13809 British Columbia Univ., Vancouver.
THE AERODYNAMICS OF TWO-DIMENSIONAL AIRFOILS WITH SPOILERS
G. V. Parkinson, G. P. Brown, and T. Jandali *In* AGARD V/STOL Aerodyn. Oct. 1974 10 p refs Sponsored by Defence Res. Board of Canada

The development of three incompressible potential flow methods for two dimensional airfoils with upper surface spoilers is discussed. A linearized free stream theory is used to predict the steady and transient lift on thin, single-element airfoils of arbitrary incidence, camber, and thickness, with spoilers of arbitrary position, height, and inclination. Theories for determining the pressure distribution on thick airfoils are reported. Wind tunnel measurements of steady and transient lift and pressure distribution have been made using two different airfoil profiles with several different spoiler sizes, positions, and inclinations. Author

N75-13810 Politecnico di Milano (Italy). Instituto di Ingegneria Aerospaziale.
THE EFFECT OF VORTEX GENERATORS ON THE DEVELOPMENT OF A BOUNDARY LAYER
Sergio DePonte and Arturo Baron *In* AGARD V/STOL Aerodyn. Oct. 1974 5 p refs

The development of computer techniques for predicting the aerodynamic characteristics of an airfoil in the presence of vortex generators is discussed. An experimental program to investigate the turbulent structure of the vortex was conducted. It was determined that the vorticity profiles are very similar to those characterizing the viscous case, although the vortex was turbulent. A model of vortex-boundary layer interaction was constructed. The model is the basis of many conclusions about the application of vortex generators as a means of boundary layer control.
Author

N75-13811 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
JET LIFT PROBLEMS OF V/STOL AIRCRAFT
J. Barche *In* AGARD V/STOL Aerodyn. Oct. 1974 18 p refs

The effect of jet lift interference on the design of jet-supported V/STOL aircraft is discussed. The basic flow problems which are assumed to be valid for all types of V/STOL aircraft are analyzed. The operational aspects of military V/STOL aircraft are examined. The specific problems of V/STOL operation involving transition flight, pitch control and stability, lateral/direction, control and stability, hovering flight, and recirculation of the jet exhaust are presented. Author

N75-13812 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
SIDESLIP IN VTOL-TRANSITION FLIGHT: A CRITICAL FLIGHT CONDITION AND ITS PREDICTION IN SIMPLE WIND TUNNEL TESTS
B. Ewald *In* AGARD V/STOL Aerodyn. Oct. 1974 13 p refs

Wind tunnel tests were conducted to analyze the performance of the VAK 191 B VTOL aircraft during transition flight. The procedures for conducting the wind tunnel tests are explained. It was determined that the ratio of jet momentum and free

stream momentum is the most important scaling parameter for the influence of the jet on the external flow field. The results of the wind tunnel tests are compared with flight test results to deteremine the extent of agreement. Based on the wind tunnel tests, development of the aircraft automatic altitude control system and a system for pilot training in the flight simulator was completed. Author

N75-13814 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Prototype Div.
DESIGN AND TEST OF EJECTOR THRUST AUGMENTATION CONFIGURATIONS
S. L. Brown and R. D. Murphy *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs

The application of hypermixing primary injection nozzle devices for operational vertical takeoff aircraft is discussed. Preliminary design studies have been directed toward subsonic and supersonic VTOL close air support fighters. In addition to demonstrating the feasibility of the ejector thrust augmentation (EVA), special problems in the areas of engine cycle characteristics, internal aerodynamics, and external dynamics were investigated. Two-dimensional wind tunnel tests were conducted to analyze the external aerodynamic problem areas. One test investigates the vertical flight mode and the other test investigates the transition flight mode. Author

N75-13815 Ruhr Univ., Bochum (West Germany).
GROUND EFFECT ON AIRFOILS WITH FLAPS OR JET FLAPS
K. Gersten, R. Loehr, and E. Beese *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs

The two-dimensional incompressible flow past airfoils with flaps or jet flaps near the ground is investigated. The inviscid flow is calculated by potential theory methods. It is shown that the nonlinear effects due to large angles of attack and flap angles become increasingly important as airfoils approach the ground. For airfoils with jet flaps, wind tunnel tests, including ground simulation, have been carried out. The theoretical results are compared with experiments and with linear theory. Author

N75-13816* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENT OF TILT ROTOR VTOL ROTOR WAKE-AIRFRAME GROUND AERODYNAMIC INTERFERENCE FOR APPLICATION TO REAL TIME FLIGHT SIMULATION
Troy M. Gaffey (Bell Helicopter Co., Ft. Worth, Tex.) and Martin D. Maisel *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs
CSCL 01C

The hover and low speed rotor wake-airframe-ground aerodynamic characteristics of the XV-15 tilt rotor research aircraft were determined in wind tunnel tests of a scale model. Results of the wind tunnel tests were applied to real flight time simulation. The principal findings of the wind tunnel tests are summarized. The effect of aerodynamic interference on the handling qualities of the aircraft is analyzed. It was determined that aerodynamic interference effects are significant in hover and at low speeds, with the influence being more pronounced in ground effect than out of it. At airspeeds above 60 knots, aerodynamic interference does not have a significant effect on handling characteristics. Author

N75-13817 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Control Div.
US AIR FORCE V/STOL AIRCRAFT AERODYNAMIC PREDICTION METHODS
Henry W. Woolard *In* AGARD V/STOL Aerodyn. Oct. 1974 14 p refs

Analytical methods for the prediction of the aerodynamic characteristics of V/STOL aircraft are reviewed. The aerodynamic characteristics of short takeoff aircraft are discussed with emphasis on high lift systems using internally-blown flaps, under-the-wing externally-blown flaps, and mechanical flaps combined with thrust vectoring. The power-induced aerodynamics of lift-jet, lift-fan, and vectored-thrust V/STOL aircraft operating in hover and transition flight regimes are examined. Emphasis is placed on describing selected methods that employ rational analytical modeling of the real aerodynamics in conjunction with empirical modifications as required. Author

N75-13818 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
PREDICTION OF AERODYNAMIC INTERFERENCE EFFECTS WITH JET-LIFT AND FAN-LIFT VTOL AIRCRAFT
Dieter Welte *In* AGARD V/STOL Aerodyn. Oct. 1974 9 p refs

A guide-line for a rough estimation of the jet induced lift losses of VTOL aircraft configurations with jet-lift and fan-lift engines hovering in and out of ground effect is presented. The nature and magnitude of the aerodynamic jet interference effects is found empirically by dimensional analysis of the flow field and by measurements. Jet induced lift losses and pitching moments with forward speeds are discussed on the basis of wind tunnel measurements. Author

N75-13819 British Aircraft Corp., London (England). Military Aircraft Div.
A REVIEW OF THE LIFTING CHARACTERISTICS OF SOME JET LIFT V/STOL CONFIGURATIONS
P. G. Knott and J. J. Hargreaves *In* AGARD V/STOL Aerodyn. Oct. 1974 12 p refs

Changes to the wing lift that occur as a result of the interaction between the lifting jet efflux and the free stream are discussed. Attempts to develop empirical models for predicting the aerodynamic characteristics are described. Data correlation attempts are discussed with respect to a curve fitting exercise using data from tests on a finite wing with jet size and position as variables, and a method which approximates the lift to thrust coefficient relationship linearly. It is stated that the location of the lift jets is one of the most fundamental parameters and test results are presented to show some of the lift trends. Results from tests conducted in ground effect in both hover and forward speed are discussed. Author

N75-13820* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REQUIREMENT FOR SIMULATION IN V/STOL RESEARCH AIRCRAFT PROGRAMS
Hervey C. Quigley and Curt A. Holzhauser *In* AGARD V/STOL Aerodyn. Oct. 1974 11 p refs

CSCL 01C

The application of flight simulation to aircraft design and development is discussed. The general stages of aircraft development are defined. The application of flight simulation to the following projects is reported: (1) the development and flight research of the Augmented Jet-Flap STOL research aircraft and (2) design studies of advanced VTOL research aircraft. It is stated that the simulation projects proved significant in helping establish criteria for the aircraft design and in facilitating the study of problems associated with new flight profiles, new methods of control, and special emergency conditions. Author

N75-13822*# Chrysler Corp., New Orleans, La. Space Div.
SUBSONIC AND TRANSONIC HINGE MOMENT AND WING BENDING/TORSION CHARACTERISTICS OF .015 SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE ROCKWELL INTERNATIONAL TRISONIC WIND TUNNEL (IA70), VOLUME 1
M. T. Hughes (Rockwell Intern., Los Angeles) and R. C. Mennell (Rockwell Intern., Los Angeles) Nov. 1974 732 p 3 Vol. (Contract NAS9-13247)
(NASA-CR-134431; DMS-DR-2175-Vol-1) Avail: NTIS HC $17.25

Experimental aerodynamic investigations were conducted on an 0.015-scale representation of the integrated space shuttle launch vehicle in the trisonic wind tunnel. The primary test objective was to obtain subsonic and transonic elevon and bodyflap

stations. The hinge moment, wing bending/torsion moments and wing pressure data were recorded over an angle-of-attack (alpha) range from -8 deg to +8 deg, and angle-of-sideslip (beta) range from -8 deg to, +8 deg and at Mach numbers of 0.90, 1.12, 1.24 and 1.50. Tests were also conducted to determine the effects of the orbiter rear attach cross beam and the forward attach wedge and strut diameter. The orbiter alone was tested at 0.90 and 1.24 Mach number only. Author

N75-13823*# Chrysler Corp., New Orleans, La. Space Div.
SUBSONIC AND TRANSONIC HINGE MOMENT AND WING BENDING/TORSION CHARACTERISTICS OF .015 SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE ROCKWELL INTERNATIONAL TRISONIC WIND TUNNEL (IA70), VOLUME 2
M. T. Hughes (Rockwell Intern., Los Angeles) and R. C. Mennell (Rockwell Intern., Los Angeles) Nov. 1974 809 p 3 Vol.
(Contract NAS9-13247)
(NASA-CR-134432; DMS-DR-2175-Vol-2) Avail: NTIS HC $19.25

N75-13824*# Chrysler Corp., New Orleans, La. Space Div.
SUBSONIC AND TRANSONIC HINGE MOMENT AND WING BENDING/TORSION CHARACTERISTICS OF .015 SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE ROCKWELL INTERNATIONAL TRISONIC WIND TUNNEL (IA70), VOLUME 3
M. T. Hughes (Rockwell Intern., Los Angeles) and R. C. Mennell (Rockwell Intern., Los Angeles) Nov. 1974 1095 p 3 Vol.
(Contract NAS9-13247)
(NASA-CR-134433; DMS-DR-2175-Vol-3) Avail: NTIS HC $25.25

N75-13825*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF A SIMPLE DISTORTION INDEX UTILIZING STEADY-STATE AND DYNAMIC DISTORTIONS IN A MACH 2.5 MIXED-COMPRESSION INLET AND TURBOFAN ENGINE
William G. Costakis Washington Jan. 1975 22 p refs
(NASA-TM-X-3169; E-8061) Avail: NTIS HC $3.25 CSCL 01A

A wind tunnel investigation was conducted to determine the amplitude and spatial distribution of steady-state and dynamic distortion produced in an inlet with 45 percent of the overall supersonic area contraction occurring internally. It was found that the inlet support strut location and/or the overboard bypass flow rate has a significant effect on the spatial distribution of distortion. Because of this effect the majority of the stall points exhibited four-per-revolution patterns of distortion. Data from this test were used to formulate a simple index that combines steady-state and dynamic distortions. Distortion results obtained with this index correlated well with exhaust nozzle area. It is shown that the exhaust nozzle area of a TF30-P-3, as modified for use in this test, can be controlled in a scheme to avoid engine stall. A considerable increase in engine distortion tolerance can be achieved by opening the 7th-stage bleed. The engine exhibited higher tolerance to distortion for multiple patterns of distortion per-revolution than for a one-per-revolution pattern of distortion. Author

N75-13826# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
AIRSHIPS
Jun. 1974 252 p Partly in GERMAN; partly in ENGLISH; ENGLISH summary Proc. of 2nd DGLR Colloq., Muehlheim, West Ger., 21-22 Mar. 1973
(DLR-Mitt-74-12) Avail: NTIS HC $8.50; ZLDI, Munich 52,30 DM

Economic factors of airship transportation were discussed to a large extent. A study related to the inventory of existing proposals for airship projects is reported, together with the evaluations of economic and technical feasibility. The application of an airship to the transportation of indivisible loads is discussed. A design for an airship carry 890 passengers and 200 tons of cargo is described. The use of nuclear propulsion for airships was examined. A novel concept of drag reduction for airships by wave incidence control is described.

N75-13827 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
PREREQUISITES FOR THE DEFINITION OF AN AIRSHIP PROJECT [VORAUSSETZUNGEN FUER DIE DEFINIERUNG EINES LUFTSCHIFFPROJEKTES]
W. VonKirschbaum *In its* Airships Jun. 1974 p 13-63 In GERMAN

A study was carried out related to the inventory of existing proposals for airship projects, evaluations of technical and economic feasibility, and requirements for airship traffic. An estimation provides useful indications for future work. It is pointed out that only an overall system will provide a basis for revival of large volume airship traffic. ESRO

N75-13828 Surrey Univ., London (England). Dept. of Mechanical Engineering.
THE AIRFLOAT TRANSPORT SYSTEM
E. Mowforth *In* DGLR Airships Jun. 1974 p 65-93

A transport system, based on the use of a large airship designed to carry 400 tons over a maximum still-air stage of 1000 km when cruising at 170 km/h at an altitude of 1000 m, is described. The system is intended primarily for the movement of large indivisible loads over moderate distances between unprepared sites, but other applications have also been considered using nodules. ESRO

N75-13829 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
DESCRIPTION OF AN AIRSHIP DESIGN: LIMITS FOR SPEED, SIZE, ADAPTABILITY [BESCHREIBUNG EINES LUFTSCHIFF-ENTWURFS. GRENZEN FUER GESCHWINDIGKEIT, GROESSE, EINSATZFAEHIGKEIT]
H. Toennes *In its* Airships Jun. 1974 p 95-105 In GERMAN

A design is described for an airship carrying 890 passengers and 200 tons of cargo for transatlantic crossings at a flight altitude of 1200 to 1400 m. The cruising speed is 160 km/h, and maximum speed 200 km/h. ESRO

N75-13830 Luftschifftechnik ALV, Graz (Austria).
THE NUCLEAR AIRSHIP ALV-C/1 [DAS ATOMLUFTSCHIFF ALV-C/1]
Erich VonVeress *In* DGLR Airships Jun. 1974 p 107-131 In GERMAN

The design of an airship propelled by helium closed cycle gas turbines in combination with a high temperature nuclear reactor is discussed. ESRO

N75-13831 Deutsche Studiengemeinschaft fuer Luftschiffahrt, Frankfurt am Main (West Germany).
FLIGHT IN UNDULATED FLOW: AIRSHIPS WITH NON-POLLUTING PROPULSION SYSTEMS [DER FLUG IN GEWELLTER STROEMUNG. LUFTSCHIFFE MIT UMWELTFREUNDLICHEM ANTRIEBSSYSTEM]
E. Krueger and W. Happel *In* DGLR Airships Jun. 1974 p 133-137 In GERMAN

The principle of drag reduction, based on the undulating motion of fish and simulated by alternate wave incidence, was applied to the design of an airship, which, in addition, is propelled by nonpolluting engines. The propulsion system consists of a cold jet engine drawing its energy from a steam turbine. The airship fuselage resembles the center part of an airfoil. A model test was carried out, and some results are presented. ESRO

N75-13832# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
STABILITY DERIVATIVES OF A 10 DEGREE CONE EXECUTING PLANAR AND NONPLANAR MOTION AT MACH 14 Interim Report, Jun. 1973 - Jun. 1974
Kevin E. Yelmgren, Frank M. Sawyer, and Otto Walchner Aug. 1974 46 p refs
(AF Proj. 7064)
(AD-786458; ARL-TR-74-0112) Avail: NTIS CSCL 16/2

A 10 degree half angle circular cone with 1.6% nose bluntness was mounted to the sting-strut support system of ARL's 20-inch Mach 14 wind tunnel by means of a two-degree of freedom flexure. The small amplitude (approximately 3 deg.) free oscillation technique allowed the investigation of planar motion in pitch, or planar motion in yaw, or nonplanar motion in pitch and yaw combined. In the case of planar motion, the logarithmic amplitude decayed linearly with time. In the case of nonplanar motion, however, the amplitude decay of both the pitch and yaw components was modulated. (Modified author abstract) GRA

N75-13833# Committee on Science and Astronautics (U. S. House).
AVIATION SAFETY
Washington GPO 1974 250 p refs Hearing before Subcomm. on Aeron. and Space Technol. of Comm. on Sci. and Astronaut., 93d Congr., 2d Sess., No. 47, 31 Jul. 1974
(GPO-41-958) Avail: Subcomm. on Aeron. and Space Technol.

A Congressional hearing was conducted to examine the aviation safety programs conducted by the U.S. Air Force, the U.S. Navy, the National Transportation Safety Board, the Federal Aviation Administration, and NASA. The investigation consisted primarily of testimony from representatives of the organizations and questions from the members of Congress. The various means which the organizations have taken to reduce accidents are discussed. The interchange of information between the organization to provide more effective use of the research efforts was recommended. Author

N75-13834# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TECHNICAL EVALUATION OF WEATHER CLUTTER FEASIBILITY MODEL Final Report, Jun. 1970 - Jun. 1974
Ronald S. Bassford Sep. 1974 70 p refs
(AD-787607; FAA-RD-74-137; FAA-NA-74-25) Avail: NTIS HC $4.25

An ASR-5 weather clutter feasibility model was developed and evaluated to determine its capability to provide air traffic controllers with a weather display (clutter free) of air traffic and a contour depiction of weather detected by radar. The technical tests included the determination of technical characteristics of each of four modifications (narrow transmitter pulse width, noncoherent moving target indicator, dual frequency diversity, and logarithmic/fast time constant), which comprised the weather rejection portion of the system, along with their capabilities to provide clutter rejection and target detection in weather. The four modifications were tested in unison to determine the system's overall capability. The weather channel portion of the equipment was tested to determine its capability to provide weather clutter formatting in the form of isoamplitude contours. The results demonstrated that the weather clutter feasibility model does not effectively perform the designed functions of weather clutter rejection and weather clutter contouring. Author

N75-13835# Technische Universitaet, Brunswick (West Germany). Sonderforschungsbereich 58 Flugfuehrung.
ALL-WEATHER SHORT RANGE FLIGHT OF CIVIL TRANSPORT AIRCRAFT Annual Report, 1974 [ALLWETTERFLUG ZIVILER TRANSPORTFLUGZEUGE IM NAHBEREICH, FORSCHUNGSBERICHT 1974]
1974 268 p refs In GERMAN
Avail: NTIS HC $8.50

An annual civil aviation research report, 1974 edition, is presented. Research groups reporting are aircraft path and attitude control, navigation and safety systems, and instrumentation and anthropotechnology. ESRO

N75-13836# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST OF GLIDE SLOPE GUIDANCE WITH AND WITHOUT SIMPLIFIED ABBREVIATED VISUAL APPROACH SLOPE INDICATOR Interim Report, Jul. - Dec. 1973
Guy S. Brown and Richard L. Sulzer Oct. 1974 31 p refs
(AD-787304; FAA-RD-74-139; FAA-NA-74-22) Avail: NTIS HC $3.75

In a flight test at a small airport, rectangular aiming-point markings with and without the additional use of a low-cost version of the red/white simplified abbreviated visual approach slope indicator (SAVASI) served as daytime approach guidance aids. Results showed that approaches made with the SAVASI were less variable in measured approach slope, and approaches made in the last half-mile before landing were nearer the 4 deg SAVASI glidepath angle. On average, approaches made either with or without the SAVASI were steeper than 4 deg, and tracking of itinerant aircraft not informed of the testing confirmed that the usual approach for small aircraft at this runway was in the 5 deg, to 6 deg range. This indicates that future installations of SAVASI or related guidance aids should be made after measuring the normal practice at a given airport. Test pilot opinion was that the SAVASI was easy to use and provided good guidance in the vertical plane and that the rectangular aiming-point markings were beneficial. Author

N75-13837# Federal Aviation Administration, Washington, D.C. Office of Systems Engineering Management.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: AREA NAVIGATION
D. Michael Brandewie and Ricardo Cassell Sep. 1974 44 p refs
(AD-787452; FAA-ED-04-02) Avail: NTIS HC $3.25

This program development plan provides the research and development necessary to support the evaluation of the concepts and provide answers to critical issues affecting the implementation of area navigation as described in the report of the Joint FAA/Industry Area Navigation Task Force, Application of Area Navigation in the National Airspace System. The program objectives, background, interfaces, technical approach, resource requirements and schedules are detailed in the plan. The program is responsive to the R&D requested efforts outlined in the Task Force Report. The work efforts are divided into five interdependent product activities: RNAV Payoff Analysis, RNAV Terminal Design, RNAV En Route Design, RNAV Avionics and Supporting Studies. Author

N75-13838*# Ohio Univ., Athens. Dept. of Electrical Engineering.
FLIGHT EVALUATION: OHIO UNIVERSITY OMEGA RECEIVER BASE
Kent A. Chamberlin, Robert W. Lilley, and Richard J. Salter Nov. 1974 33 p refs
(Grant NGR-36-009-017)
(NASA-CR-141058; TM-13) Avail: NTIS HC $3.75 CSCL 17G

A flight evaluation is presented of the Ohio University Omega Receiver Base, developed under the NASA Tri-University Program in Air Transportation, to provide a vehicle for the transfer of flight-test data to NASA and to other participants in the Tri-University program. Chart recordings of flight data are given, along with chronological listings of significant events which occurred during the flight. Digital data was prepared in data-processing card form for distribution. Data include phase measurements from all eight Omega time-slots for the duration of the flight, plus event marks which serve to correlate the phase data with flight-path documentation. Author

N75-13841# Naval Electronic Systems Test and Evaluation Detachment, Patuxent River, Md.
CERTIFICATION TEST PROCEDURES FOR AIRCRAFT APPROACH CONTROL AN/SPN-41
1 Feb. 1974 33 p
(AD-786207; NESTED-022-106) Avail: NTIS CSCL 17/7

Aircraft Approach Control AN/SPN-41, composed of shipboard and airborne equipments, can be used as an independent landing aid or as a Mode I monitor on AN/SPN-42 equipped carriers. In order to satisfactorily accomplish this monitoring, each piece of equipment must operate within allowable tolerances. The tests are designed to provide the criteria for initial and periodic checks of the system to ensure operation within acceptable limits. There are three categories of certification tests. Category I tests are the basic equipment tests. Category II tests are pierside flights to check the system alignment and correlation of the AN/SPN-41 with the AN/SPN-42, the AN/SPN-35, and the FLOLS (Fresnel Lens Optical Landing System). Category III tests are the at-sea flight tests using aircraft equipped to record data. GRA

N75-13842# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 1: SUMMARY Final Report, Oct. 1972 - Oct. 1973
H. T. Freedman, C. S. Hoffman, B. N. Gaon, T. Felisky, and W. R. Fried Feb. 1974 117 p 10 Vol.
(Contract DOT-TSC-508)
(PB-234264/0; DOT-TSC-OST-73-29-1-Vol-1) Avail: NTIS HC $5.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The results of studies and analyses directed toward the definition of a Satellite-Based Advanced Air Traffic Management System (SAATMS) are presented. This system is an advanced, integrated air traffic control system which is based on the use of a satellite constellation for surveillance, navigation, and communications. The system is disigned to service the anticipated air traffic density (commercial, military, and general aviation) predicted for the period from 1995 and beyond. The major items discussed in this report include the definition of user classes, the management concept, the system services and functions, the system description, system costs, the system performance, transition into full system operation, and the RDT and E plan. The report is presented in ten volumes. This volume summarizes the study findings. GRA

N75-13843# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 2: SYSTEM FUNCTIONAL DESCRIPTION AND SYSTEM CLASSIFICATION Final Report, Oct. 1972 - Oct. 1973
R. G. Loeliger, J. H. Mitzel, C. S. Hoffman, H. T. Freedman, and K. C. Kochi Feb. 1974 151 p 10 Vol.
(Contract DOT-TSC-508)
(PB-234265/7; DOT-TSC-OST-73-29-2-Vol-2) Avail: NTIS HC $6.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

A functional description and specification for the Satellite-Based Advanced Air Traffic Management System is presented. The system description is presented in terms of the surveillance, navigation, and communications functions along with the additional supportive subfunctions needed to implement the basic functions. The volume includes a description of the basic system and backup philosophy, the system architecture and information flow between the elements required to achieve a cohesive system organization, and the satellite constellation and tracking subsystem. A preliminary system specification in the format of MIL-STD-490A is also presented. GRA

N75-13844# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 3: SUBSYSTEM FUNCTIONAL DESCRIPTION Final Report, Oct. 1972 - Oct. 1973
R. G. Loeliger, F. S. Nakamoto, R. A. Gronlund, H. T. Freedman, and J. W. Petway Feb. 1974 214 p 10 Vol.
(Contract DOT-TSC-508)
(PB-234266/5; DOT-TSC-OST-73-29-3-Vol-3) Avail: NTIS HC $7.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

A description of the subsystems that comprise the Satellite-Based Advanced Air Traffic Management System is presented. Described in detail are the surveillance, navigation, communications, data processing, and airport subsystems. The electronics required to implement each subsystem is also presented. The subsystem descriptions include a detailed description of the subsystem mechanization, the rationale for its selection, and the expected performance of each subsystem. The electronics are presented in block diagram form. Particular emphasis is placed on the integrated avionic hardware associated with each subsystem mechanization. Included in the mechanization description of each subsystem are the basic analyses, algorithms, and equations that were used to implement the subsystem. GRA

N75-13845# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 4: OPERATIONAL DESCRIPTION AND QUALITATIVE ASSESSMENT Final Report, Oct. 1972 - Oct. 1973
C. S. Hoffman, H. T. Freedman, C. V. Hamilton, and W. R. Fried Feb. 1974 115 p refs 10 Vol.
(Contract DOT-TSC-508)
(PB-234267/3; DOT-TSC-OST-73-29-4-Vol-4) Avail: NTIS HC $5.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

A description of how the Satellite-Based Advanced Air Traffic Management System (SAATMS) operates and a qualitative assessment of the system are presented. The operational description includes the services, functions, and tasks performed by the system, a description of user classes, the airspace structure, and rules and procedures. The concept for managing air traffic is then presented. It is characterized by pilot responsibility for conforming to a flight path while the ground concentrates on assuring flight safety, maximizing capacity, and minimizing delay. A discussion of the SAATMS automation philosphy and a description of how an aircarrier and a GA aircraft fly through the system complete the operational description. GRA

N75-13846# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 5: SYSTEM PERFORMANCE Final Report, Oct. 1972 - Oct. 1973
J. C. Elsey, J. B. King, I. M. Weiss, K. M. Armstrong, and C. Chen Feb. 1974 146 p refs 10 Vol.
(Contract DOT-TSC-508)
(PB-234268/1; DOT-TSC-OST-73-29-5-Vol-5) Avail: NTIS HC $5.75; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The volume presents the results of the performance evaluation of the Satellite-Based Advanced Air Traffic Management System (SAATMS). The evaluation established the capacity, safety, and delay performance of the system for the Los Angeles Basin terminal area operation. The results of the performance evaluation were compared to the established performance specification. SAATMS provides capacity exceeding the highest traffic demand projected for 1995 while meeting the delay specification and maintaining the safety level provided by the present system. An evaluation of enroute safety is presented, along with a comparison of the enroute safety provided by the present system and a Ground-Based Advanced Air Traffic Management System (GAATMS). Author (GRA)

N75-13847# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 6: DEVELOPMENT AND TRANSITION PLANS Final Report, Oct. 1972 - Oct. 1973
H. T. Freedman, W. R. Fried, C. S. Hoffman, J. B. King, and C. V. Hamilton Feb. 1974 114 p refs 10 Vol.
(Contract DOT-TSC-508)
(PB-234269/9; DOT-TSC-OST-73-29-6-Vol-6) Avail: NTIS

HC $5.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The volume presents the plans for implementing the Satellite-Based Advanced Air Traffic Management System (SAATMS) described in Volumes II, III, and IV. Two plans are presented: an RDT and E plan and a transition plan. The RDT and E plan is presented as a series of task descriptions which delineate the activities that must be performed to generate requirements and to develop the hardware and software that comprise the various components of the system. The plan also describes those management tasks necessary to document and control the orderly development of the system. Development schedules and associated costs are also presented.

Author (GRA)

N75-13848# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 7: SYSTEM COST Final Report, Oct. 1972 - Oct. 1973
T. Felisky and H. T. Freedman Feb. 1974 159 p refs 10 Vol.
(Contract DOT-TSC-508)
(PB-234270/7; DOT-TSC-OST-73-29-7-Vol-7) Avail: NTIS HC $6.25; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The volume presents estimates of the federal government and user costs for the Satellite-Based Advanced Air Traffic Management System and the supporting rationale. The system configuration is that presented in volumes II and III. The cost estimates are also based upon the development and transition plans in Volume VI. The costing methodology and procedures used are presented. Cost summaries and detailed cost breakdowns by Research summaries and detailed cbst breakdowns by Research and Development, Facilities and Equipment, and Operations and Maintenance costs for the ground sites and satellites are provided for the federal government costs. Summaries and breakdowns by user class and by purchase, installation, and maintenance costs are provided for the user avionics cost. Various cost analyses are also provided, including the estimated annual expenditures for various transition schedules and comparisons with ground-based ATC systems. Author (GRA)

N75-13849# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 9: SYSTEM AND SUBSYSTEM PERFORMANCE MODELS Final Report, Oct. 1972 - Oct. 1973
C. Chen, R. G. Loeliger, F. S. Nakamoto, J. C. Elsey, and J. B. King Feb. 1974 138 p refs 10 Vol.
(Contract DOT-TSC-508)
(PB-234272/3; DOT-TSC-OST-73-29-9-Vol-9) Avail: NTIS HC $5.75; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The volume presents the models used to analyze basic features of the system, establish feasibility of techniques, and evaluate system performance. The models use analytical expressions and computer simulations to represent the relationship between system structure and state variables, system inputs, and system output measures. GRA

N75-13850# Autonetics, Anaheim, Calif.
CONCEPT FOR A SATELLITE-BASED ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 10: SUB-SYSTEM PERFORMANCE REQUIREMENTS Final Report, Oct. 1972 - Oct. 1973
J. B. King, C. I. Chen, and R. P. Utsumi Feb. 1974 94 p 10 Vol.
(Contract DOT-TSC-508)
(PB-234273/1; DOT-TSC-OST-73-29-10-Vol-10) Avail: NTIS HC $4.75; HC also available from NTIS $37.00/set of 10 reports as PB-234263-SET CSCL 17G

The volume presents the results of the subsystem performance requirements study for an Advanced Air Traffic Management System (AATMS). The study determined surveillance and navigation subsystem requirements for terminal and enroute area operations. It also established the approach guidance requirements for VOR, Category I, and Category II landing conditions. The results of the VVOR suitability analysis indicated that approach guidance requirements for VOR landing conditions were approximately the same as those for terminal area operations. A discussion of the methodology used in the study and a description of the models and simulations used to establish the subsystem performance requirements is also presented. GRA

N75-13851*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STOL AIRWORTHINESS INVESTIGATION USING A SIMULATION OF A DEFLECTED SLIPSTREAM TRANSPORT. VOLUME 1: SUMMARY OF RESULTS AND AIRWORTHINESS IMPLICATIONS
Robert L. Stapleford, Robert K. Heffley, Robert C. Rumold, Charles S. Hynes, and Barry C. Scott Oct. 1974 44 p refs Prepared in cooperation with Systems Technol., Inc., Mountain View, Calif. and FAA, Moffett Field, Calif. 3 Vol.
(Contract NAS2-6433)
(NASA-TM-X-62392; FAA-RD-74-143-1; A-5794; STI-TR-1014-3-Vol-1) Avail: NTIS HC $3.75 CSCL 01C

A simulator study of short takeoff and landing (STOL) aircraft was conducted using a model of a deflected slipstream transport aircraft. The subjects considered are: (1) the approach, (2) flare and landing, (3) go-around, and (4) takeoff phases of flight. The results are summarized and possible implications with regard to airworthiness criteria are discussed. A data base is provided for future STOL airworthiness requirements and a preliminary indication of potential problem areas is developed. Comparison of the simulation results with various proposed STOL criteria indicates significant deficiencies in many of these criteria.

Author

N75-13852*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STOL AIRWORTHINESS INVESTIGATION USING A SIMULATION OF A DEFLECTED SLIPSTREAM TRANSPORT. VOLUME 2: SIMULATION DATA AND ANALYSIS
Robert L. Stapleford, Robert K. Heffley, Wayne F. Jewell, John M. Lehman, Charles S. Hynes, and Barry C. Scott Oct. 1974 243 p refs Prepared in cooperation with Systems Technol., Inc., Mountain View, Calif. and FAA, Moffett Field, Calif. 3 Vol.
(Contract NAS2-6433)
(NASA-TM-X-62393; FAA-RD-74-143-2; A-5795; STI-TR-1014-3-Vol-2) Avail: NTIS HC $7.50 CSCL 01C

A description of the simulation procedures used in analyzing the airworthiness criteria for short takeoff and landing (STOL) transport aircraft with deflected airstream lift augmentation is presented. The data include performance measures, pilot commentary, and pilot ratings. A pilot/vehicle analysis of glide slope tracking and an analysis of the flare maneuver are included. Author

N75-13853*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STOL AIRWORTHINESS INVESTIGATION USING A SIMULATION OF A DEFLECTED SLIPSTREAM TRANSPORT. VOLUME 3: BREGUET 941S SIMULATION MODEL
Robert K. Heffley, Wayne F. Jewell, Robert L. Stapleford, Samuel J. Craig, Charles S. Hynes, and Barry C. Scott Oct. 1974 79 p refs Prepared in cooperation with Systems Technology, Inc., Mountain View, Calif. and FAA, Moffett Field, Calif.
(Contract NAS2-6433)
(NASA-TM-X-62394; FAA-RD-74-143-3; STI-TR-1014-3-Vol-3; A-5796) Avail: NTIS HC $4.75 CSCL 01C

Flight simulation tests were conducted to determine the airworthiness of the Breguet 941S transport aircraft. The aircraft is a short takeoff and landing configuration with deflected slipstream lift augmentation. The flight regimes investigated include the following: (1) acceleration to takeoff and initial climbout, (2) transition from cruise to STOL approach configura-

tions, (3) IFR/VFR approach, (4) flare, touchdown, and landing rollout, (5) missed approach, and (6) high lift configuration stalls. The model was developed by matching actual flight test data for the BR 941S aircraft. When this was not possible, wind tunnel data and engineering estimates were used. Results of the simulation are presented in graph and tabular form. Author

N75-13854*# Boeing Commercial Airplane Co., Seattle, Wash.
JET NOISE SUPPRESSOR NOZZLE DEVELOPMENT FOR AUGMENTOR WING JET STOL RESEARCH AIRCRAFT (C-8A BUFFALO)
D. L. Harkonen, C. C. Marks, and J. V. OKeefe Dec. 1974 144 p refs
(Contract NAS2-7641)
(NASA-CR-137522; D6-41324-3) Avail: NTIS HC $5.75 CSCL 01C

Noise and performance test results are presented for a full-scale advanced design rectangular array lobe jet suppressor nozzle (plain wall and corrugated). Flight design and installation considerations are also discussed. Noise data are presented in terms of peak PNLT (perceived noise level, tone corrected) suppression relative to the existing airplane and one-third octave-band spectra. Nozzle performance is presented in terms of velocity coefficient. Estimates of the hot thrust available during emergency (engine out) with the suppressor nozzle installed are compared with the current thrust levels produced by the round convergent nozzles. Author

N75-13855# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.
INFLUENCE OF VELOCITY DEPENDENT PITCHING MOMENTS ON THE LONGITUDINAL STABILITY [UNTERSUCHUNG UEBER DEN EINFLUSS GESCHWINDIGKEITSABHAENGIGER NICKMOMENTE AUF DIE LAENGSSTABILITAET]
Gottfried Sachs 15 Jul. 1973 62 p refs In GERMAN
(IFD-1/73) Avail: NTIS HC $4.25

The effect of velocity dependent pitching moments on longitudinal stability was investigated for three velocity ranges relating to gliding flight of VTOL aircraft, slow flight (including the aerodynamically lifted STOL range), and fast flight (high subsonic and supersonic). The effect on the principal ratio of pitch velocity and pitch control systems was investigated for gliding flight. The variation of the eigenvalues for slow flight is presented, and it is shown that the effect of pitching moments on the phygoid damping depends on the angle of incidence. The effects of density gradients were examined for fast flight. ESRO

N75-13856# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.
EFFECT OF DOWNSPRINGS AND BOBWEIGHTS ON THE DYNAMIC LONGITUDINAL STABILITY [UNTERSUCHUNG UEBER DIE AUSWIRKUNGEN VON ZUSATZFEDERN UND ZUSATZGEWICHTEN AUF DIE DYNAMISCHE LAENGSSTABILITAET]
Gottfried Sachs 31 Jul. 1973 42 p refs In GERMAN
(IFD-2/73) Avail: NTIS HC $3.75

The effect was investigated of downsprings and bobweights on dynamic stability. Separate treatment of aircraft motion and the control system was assumed. The degree of angle of incidence instability to which an aircraft can be stabilized statically and dynamically is presented. The critical ranges with regard to lowest stability range for the application of downsprings and bobweights are indicated, and the flight mechanical parameters which have a determining effect are described. Conditions were derived under which it is not possible to apply a downspring without increasing the existing dynamic instability. ESRO

N75-13857# Bell Helicopter Co., Fort Worth, Tex.
EVALUATION OF THE ADHESIVE BONDING PROCESSES USED IN HELICOPTER MANUFACTURE. PART 7: PREPRODUCTION EVALUATION OF IMPROVED TITANIUM SURFACES PREPARATION
Narvel L. Rogers Sep. 1974 68 p refs
(Contract DAAA21-74-C-0109)
(AD-785597; PA-TR-4700-Pt-7) Avail: NTIS CSCL 13/8

The phosphate-fluoride treatment (stabilized) has been compared directly to a standard Phosphate-Fluoride treatment for the surface preparation of commercially pure titanium sheet. The stabilized treatment process was found to provide an improvement in the durability of adhesive bonded joints exposed to moisture and stress. The treatment processes were compared for their effect on the properties of the basis metal as well as for bondability and durability. Laboratory evaluations included standard specification qualification testing as well as special durability tests. Author (GRA)

N75-13858# Fiber Service, Inc., Gardena, Calif.
STRUCTURAL EVALUATION OF UH-1D TUBULAR ROTOR BLADE Final Report
Don Cook Aug. 1974 63 p refs
(Contract DAAJ02-73-C-0042; DA Proj. 1F1-62208-A-170)
(AD-786560; USAAMRDL-TR-74-41) Avail: NTIS CSCL 01/3

The purpose of this evaluation was to determine the effects of static loading, cyclic loading and ballistic damage/repairs on the stiffness and resonant behavior of three full-scale, filament-wound tubular-reinforced UH-1D main rotor blades (S/N 001, S/N 002, and S/N 003) previously fabricated under Contract DAAJ02-72-C-013. Blades S/N 001 and S/N 002 were made predominately from glass fibers. Blade S/N 003 included the use of Kevlar 49 as the skin fiber. All three blades were subjected to static deflection, dynamic, proof, creep, fatigue, and ultimate testing. In addition, blades S/N 002 and S/N 003 were subjected to ballistic impact, ball drop, and simulated tree strike testing. (Modified author abstract) GRA

N75-13859# Army Foreign Science and Technology Center, Charlottesville, Va.
AERODYNAMICS OF AIR CUSHION CRAFT, CHAPTER 6, SECOND EDITION
I. T. Egprov 19 Feb. 1974 100 p refs Transl. into ENGLISH from the book "Gidrodinamika Bystrokhodnykh Sudov" Lenigrad, Sudostroyeniye, 1971 100 p
(AD-786800; FSTC-HT-23-2547-72) Avail: NTIS CSCL 01/3

The principles of support on an air cushion and classification of air cushion devices and craft are presented. Calculations of power consumption for creation of lift and for overcoming drag are presented. The components of supporting forces and of the drag forces are analyzed and approximate methods for estimating them are discussed. Detailed calculations of flexible skirts, as well as data and specific examples are presented. A final long section is devoted to presentation of calculations, results of calculations and of wind tunnel and towing basin tests, as well as extensive supporting data in the form of graphs and nomograms. GRA

N75-13860# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN DEVELOPMENT TRENDS IN THE MECHANICS OF DEFORMABLE BODY IN KAZAN
K. Z. Galimov 29 Jul. 1974 53 p refs Transl. into ENGLISH from Issledovaniya Po Teorii Plastin I Obolochek, (USSR), no. 9, 1972 p 55-92
(AD-786118; FTD-MT-24-341-74) Avail: NTIS

Scientific work of the collective of the department of structural mechanics of flying vehicles of KAI (Kazan Aviation Institute), from the day the department was created, is progressing in the following two basic directions: the development of the calculation methods for the structural strength of flying vehicles and experimental studies of their static and dynamic strength; and the development and perfection of methods of the theory elasticity. This work is devoted only to the first direction. GRA

N75-13861# Army Aviation Systems Test Activity, Edwards AFB, Calif.
DETERMINATION OF AIRCRAFT CABIN RADIATION, CONDUCTION, AND CONVECTION HEAT TRANSFER COEFFICIENTS
Emmett J. Laing 1974 15 p refs
(AD-785646) Avail: NTIS CSCL 01/3

To properly design aircraft instruments, avionics, and other equipment, which is installed in aircraft cabin areas, it is necessary to accurately know the cabin temperature environment. Aircraft cabin temperatures vary widely depending on the aircraft operating condition, basic design parameters, and type of environmental control system installed. It is suspected that high aircraft cabin static temperatures may increase aircraft component failure rates, cause equipment to temporarily malfunction, and directly cause equipment failure. However, accurate temperature data for the static environment are not available for many aircraft. To obtain this type of data, USAASTA, with the assistance of the United States Army Air Mobility Research and Development Laboratory Eustis Directorate, has conducted comprehensive static temperature survey on five first-line United States Army helicopters. GRA

N75-13862# Tyco Labs., Inc., Pomona, Calif. Nucleonics Div.
NUCLEAR HELICOPTER AIR DENSITY INDICATING SYSTEM FLIGHT TEST PROGRAM
Donald W. Blincow Jul. 1974 68 p refs
(Contract DAAJ02-73-C-0015; DA Proj. 1F1-62203-A-434)
(AD-786565; ER-9016; USAAMRDL-TR-74-19) Avail: NTIS CSCL 01/1

This report describes the design, construction, and testing of the Nuclear Helicopter Air Density Indicating (NUHADI) system. The NUHADI measures the scattering of X-rays, generated by an isotopic source, from the air volume outside the helicopter. The number of X-rays backscattered into the detector is proportional to the number of molecules per unit volume, i.e., the air density. The air scatter signal is compared to an internal signal, from the same source, during each cycle to provide a continuous self calibration. (Modified author abstract) GRA

N75-13863# Instrument Flight Center, Randolph AFB, Tex.
EVALUATION OF THE BENDIX ALTITUDE WARNING SYSTEM Final Report
James M. Rogers Sep. 1974 20 p
(IFC Proj. TE-72-6)
(AD-786461; IFC-TR-74-3) Avail: NTIS CSCL 01/4

A pilot factors evaluation of an altitude warning system (AWS) to determine its acceptability for use in Air Force aircraft. The system has the primary function of assisting pilots in attaining and was conducted maintaining assigned of desired (command) altitudes. A secondary function was to examine the concept of altitude warning during landing approaches. Eleven AWS sorties were flown in a Northrup T-38 Talon, and 33 sorties in a North American T-39 Sabreliner. The majority of pilots considered that an altitude warning devise served as a viable altitude reminder and warning system, reducing the possibility of altimeter misinterpretation. Although several deficiencies were found, the major problem associated with the AWS is the inaccuracy of the trigger levels. (Modified author abstract) GRA

N75-13865*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SCRAMJET NOZZLE DESIGN AND ANALYSIS AS APPLIED TO A HIGHLY INTEGRATED HYPERSONIC RESEARCH AIRPLANE
William J. Small, John P. Weidner, and P. J. Johnston Nov. 1974 56 p refs
(NASA-TM-X-71972) Avail: NTIS HC $4.25 CSCL 21E

The configuration and performance of the propulsion system for the hypersonic research vehicle are discussed. A study of the interactions between propulsion and aerodynamics of the highly integrated vehicle was conducted. The hypersonic research vehicle is configured to test the technology of structural and thermal protection systems concepts and the operation of the propulsion system under true flight conditions for most of the hypersonic flight regime. The subjects considered are: (1) research vehicle and scramjet engine configurations to determine fundamental engine sizing constraints, (2) analytical methods for computing airframe and propulsion system components, and (3) characteristics of a candidate nozzle to investigate vehicle stability and acceleration performance. Author

N75-13867*# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
ORDERED STRUCTURES AND JET NOISE
R. A. Petersen, R. E. Kaplan, and J. Laufer Oct. 1974 58 p refs
(Contract NAS3-17857)
(NASA-CR-134733) Avail: NTIS HC $4.25 CSCL 20A

A series of measurements of near field pressures and turbulent velocity fluctuations were made in a jet having a Reynolds nuber of about 50,000 in order to investigate more quantitatively the character and behavior of the large scale structures, and to ascertain their importance to the jet noise problem. It was found tyat the process of interaction between vortices can be inhibited by artificially exciting the shear layers with periodic disturbances of certain frequency. The turbulent fluctuation amplitudes measured at four diameters downstream decreased considerably. Finally, it was observed that the passage frequency of the structures decreased with x in a similar manner as the frequency corresponding to the maximum intensity radiation emanating from the same value of x. Author

N75-13868*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE COST OF NOISE REDUCTION IN COMMERCIAL TILT ROTOR AIRCRAFT
Henry B. Faulkner Aug. 1974 161 p refs
(Contract NAS2-7620)
(NASA-CR-137552; FTL-R74-5) Avail: NTIS HC $6.25 CSCL 01C

The relationship between direct operating cost (DOC) and departure noise annoyance was developed for commercial tilt rotor aircraft. This was accomplished by generating a series of tilt rotor aircraft designs to meet various noise goals at minimum DOC. These vehicles were spaced across the spectrum of possible noise levels from completely unconstrained to the quietest vehicle that could be designed within the study ground rules. A group of optimization parameters were varied to find the minimum DOC while other inputs were held constant and some external constraints were met. This basic variation was then extended to different aircraft sizes and technology time frames. It was concluded that reducing noise annoyance by designing for lower rotor tip speeds is a very promising avenue for future research and development. It appears that the cost of halving the annoyance compared to an unconstrained design is insignificant and the cost of halving the annoyance again is small. Author

N75-13870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTION OF AXIAL-FLOW INSTABILITIES IN A TURBOJET ENGINE BY USE OF A MULTISTAGE COMPRESSOR SIMULATION ON THE DIGITAL COMPUTER
Carl J. Daniele, Ronald J. Blaha, and Kurt Seldner Washington Jan. 1975 36 p refs
(NASA-TM-X-3134; E-8008) Avail: NTIS HC $3.75 CSCL 21E

A method of estimating the undistorted stall line for an axial-flow compressor by using the digital computer is presented. The method involves linearization of nonlinear dynamic equations about an operating point on a speed line, and then application of the first method of Lyapunov to determine the stability of the nonlinear system from the stability of the linear system. The method is applied to a simulation of the J85 compressor, which utilizes stage stacking and lumped volume techniques for the interstage regions to simulate steady-state and dynamic compressor performance. The stability boundary predicted by the digital simulation compares quite well with the stall line predicted by a dynamic simulation of the J85 compressor programmed on the analog computer. Since previous studies have shown that the analog-predicted stall line agrees well with the stall line of the compressor, the digital method presented is also a good means of estimating the stall line. Author

N75-13871*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIABLE COMBUSTOR GEOMETRY FOR IMPROVING THE ALTITUDE RELIGHT CAPABILITY OF A DOUBLE ANNULAR COMBUSTOR
Donald F. Schultz Washington Jan. 1975 26 p refs
(NASA-TM-X-3163; E-8058) Avail: NTIS HC $3.75 CSCL 21E

A test program was conducted to evaluate several ways of improving the altitude relight capability of a double annular ram-induction combustor designed for Mach 3.0 cruise operation. Using various techniques including two modes of simulated combustor variable geometry, altitude relights were obtained down to a pressure of 3.6 newtons per square centimeter against 7.05 newtons per square centimeter for the unmodified combustor. This was at a test condition of 0.05 reference Mach number using ambient temperature inlet air and fuel. Author

N75-13872# Technische Hochschule, Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE DEVELOPMENT OF A SUPERSONIC COMPRESSOR STAGE [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUR ENTWICKLUNG EINER UEBERSCHALLVERDICHTERSTUFE]
H. Simon and D. Bohn Bonn Bundeswehramt 1974 102 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(BMVG-FBWT-74-5) Avail: NTIS HC $5.25; Bundeswehramt 30 DM
the method of characteristics to stream surfaces. Experimental results on the supersonic rotor agree with calculated design values. Test results show lower values for the shock-in-rotor/type compared with the supersonic rotor as a result of shock-boundary layer interactions. The measured values indicate a deviation from the design values due to the higher stator upstream Mach numbers and to stator incidences. A static pressure ratio of 3.5 at a total isentropic efficiency of about 70% was attained for the supersonic compressor stage. ESRO

N75-13874# Hamilton Standard, Windsor Locks, Conn.
ADVANCED FEASIBILITY INVESTIGATION FOR DETERMINING ARMY HELICOPTER GAS TURBINE ENGINE MAXIMUM POWER AVAILABLE Final Report
Edward V. Fox, Salvador Ledesma, Anthony J. Martin, Allen Rapp, and Roy W. Schneider Aug. 1974 175 p refs
(Contract DAAJ02-73-C-0047; DA Proj. 1F1-62203-AH-86)
(AD-786546; HSER-6392; USAAMRDL-TR-74-49) Avail: NTIS CSCL 21/5

The purpose of the first investigation was to determine the feasibility of developing a method to predict, with an accuracy of better than plus or minus 1%, the maximum power which can be produced by a helicopter gas turbine engine at full-power conditions. The prediction was to be made using information obtained from the engine while the engine was operated prior to lift-off at a partial-power condition of no more than 30% of normal rated power. The prediction method was to be capable of identifying the changes in maximum engine power available due to all possible types of engine deterioration and all ambient conditions. This is a follow-on program to determine the effects of higher power levels, a continuous update system, and improved sensor accuracies on the possible improvement of MPA prediction accuracy. GRA

N75-13876# Mitre Corp., McLean, Va.
AIRCRAFT SOUND DESCRIPTION SYSTEM (ASDS) APPLICATION PROCEDURES. VOLUME 2: MANUAL APPLICATION PROCEDURES
Donald Goldman and Francis X. Maginnis Mar. 1974 56 p ref
(Contract DOT-FA69NS-162)
(AD-786613; MTR-6616-Vol-2; FAA-EQ-74-2-2) Avail: NTIS

The Aircraft Sound Description System (ASDS) is a method of describing aircraft noise. It has been established as the basic FAA technique for predicting community noise exposure caused by aircraft operations. This report (in four volumes) is a description of the manual and computer techniques for applying ASDS as well as a current set of noise exposure contours. This volume presents the manual procedure for developing an Aircraft Sound Description System (ASDS) application in a step-by-step fashion. This procedure develops the aircraft noise exposure values and the Situation Index. Data forms and pictorial layouts are used to illustrate the procedure. A sample application is presented to explain the details of each step. Author (GRA)

N75-13877*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MOVING-BASE VISUAL SIMULATION STUDY OF DECOUPLED CONTROLS DURING APPROACH AND LANDING OF A STOL TRANSPORT AIRCRAFT
G. Kimball Miller, Jr. and Perry L. Deal Washington Jan. 1975 76 p refs
(NASA-TN-D-7790; L-9721) Avail: NTIS HC $4.75 CSCL 01C

The simulation employed all six rigid-body degrees of freedom and incorporated aerodynamic characteristics based on wind-tunnel data. The flight instrumentation included a localizer and a flight director which was used to capture and to maintain a two-segment glide slope. A closed-circuit television display of a STOLport provided visual cues during simulations of the approach and landing. The decoupled longitudinal controls used constant prefilter and feedback gains to provide steady-state decoupling of flight-path angle, pitch angle, and forward velocity. The pilots were enthusiastic about the decoupled longitudinal controls and believed that the simulator motion was an aid in evaluating the decoupled controls, although a minimum turbulence level with root-mean-square gust intensity of 0.3 m/sec (1 ft/sec) was required to mask undesirable characteristics of the moving-base simulator. Author

N75-13878*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CURVED DESCENDING LANDING APPROACH GUIDANCE AND CONTROL M.S. Thesis - George Washington Univ.
Daniel J. Crawford Dec. 1974 74 p refs
(NASA-TM-X-72200) Avail: NTIS HC $4.25 CSCL 01C

Linear optimal regulator theory is applied to a nonlinear simulation of a transport aircraft performing a helical landing approach. A closed form expression for the quasi-steady nominal flight path is presented along with the method for determining the corresponding constant nominal control inputs. The Jacobian matrices and the weighting matrices in the cost functional are time varying. A method of solving for the optimal feedback gains is reviewed. The control system is tested on several alternative landing approaches using both three and six degree flight path angles. On each landing approach, the aircraft was subjected to large random initial state errors and to randomly directed crosswinds. The system was also tested for sensitivity to changes in the parameters of the aircraft and of the atmosphere. Performance of the optimal controller on all the three degree approaches was very good, and the control system proved to be reasonably insensitive to parametric uncertainties. Author

N75-13879# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
FLIGHT MECHANICS AND CONTROL ACTIVITIES OF THE COMMITTEES IN 1972 [DGLR-FACHGRUPPE 4 FLUGMECHANIK UND FLUGFUEHRUNG. TAETIGKEIT DER FACHAUSSCHUESSE 1972]
Gerhard Bruening 12 Jun. 1974 52 p In GERMAN; ENGLISH summary
(DLR-MITT-74-24) Avail: NTIS HC $4.25; ZLDI, Munich 13,50 DM

Two supersonic compressor stages, a supersonic rotor/shock-instator type stage and a shock-in-rotor/shock-in-stator stage, were designed and tested. Both include a tandem diffusor row. Fluid flow through the supersonic rotor was calculated by applying

Summaries of lectures held during 1972 in the fields of flight mechanics, flight control, and guidance are presented. A name and keyword is included. ESRO

N75-13880# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

ON THE PROPERTIES OF THE GENERALIZED INTEGRAL OF SQUARED ERROR (GISE) Ph.D. Thesis - Brunswick Univ. [UEBER DIE EIGENSCHAFTEN DER VERALLGEMEINERTEN QUADRATISCHEN REGELFLAECHE]

Tuncer Miski 10 Jun. 1974 110 p refs In GERMAN; ENGLISH summary

(DLR-FB-74-45) Avail: NTIS HC $5.25; DFVLR, Porz, West Ger. 22 DM

It is shown that a system minimizing a GISE approximates a model. The poles and zeros of this model can be determined from the weighting factors of the GISE. Inversely, a GISE can be selected such that the associated optimal system meets practical engineering specifications. For linear time-invariant single input systems, it is shown that any admissible quadratic cost functional is equivalent to a GISE. By minimizing this GISE, a suboptimal control law can be established when some state variables are not accessible. Results are illustrated by designing an altitude controller and a flight path angle controller for an executive aircraft. Author (ESRO)

N75-13881# Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.

MILITARY TRANSPORT (C-141) FLY-BY-WIRE PROGRAM. VOLUME 1: CONTROL LAW DEVELOPMENT, SYSTEM DESIGN AND PILOTED SIMULATION EVALUATION Final Report, 15 Apr. 1971 - 31 Jan. 1974

David Lair, John Bunnell, Howard B. Larson, Laurence D. Roberts, and Charles R. Zimmer Apr. 1974 216 p refs

(Contract F33615-71-C-1286; AF Proj. 1987)

(AD-786896; GAPD-2760-45554-Vol-1; AFFDL-TR-74-52-Vol-1) Avail: NTIS CSCL 01/4

This program was conducted to prove the feasibility of using fly-by-wire (FBW) control system technology to improve the controllability of a large military transport aircraft during the performance of specific difficult mission tasks, and to reduce pilot workload. The program consisted of (1) investigation of FBW control laws for typical large military jet transports; (2) computer evaluation of FBW control laws utilizing a moving base piloted simulator; (3) design and development of hardware utilizing off-the-shelf components, insofar as possible, to evaluate the control laws; (4) system integration testing; (5) aircraft installation and ground testing; and (6) flight testing of the FBW system on board a C-141 aircraft. (Modified author abstract) GRA

N75-13882*# Scientific Translation Service, Santa Barbara, Calif.

MISSION AND ORGANIZATION OF THE DFVLR: TWO YEARS OF INTEGRATED SOCIETY OF GERMAN AERONAUTICAL AND SPACE FLIGHT RESEARCH

Volker Aschoff Washington NASA Dec. 1974 34 p Transl. into ENGLISH from Ueber die Aufgabe und die Organisation der DFVLR: Zwei Jahre Einheitsgesellschaft der Deutschen Luft- und Raumfahrtforschung, (Porz), Sep. 1971 p 114-146

(Contract NASw-2483)

(NASA-TT-F-16086) Avail: NTIS HC $3.75

A historical review on organizational developments of the German aeronautical societies is followed by a description of management methods for modern aerospace research facilities. The development history of the German Society for Aerospace Research is outlined and its scientific and geographic organizations are described. The various institutes of the society are assigned individual research on flow mechanics; flight mechanics and control materials and construction; propulsion and energy electronics and aerospace physics, simulation, and medicine. Author

N75-13883# National Aviation Facilities Experimental Center, Atlantic City, N.J.

FLIGHT TESTS OF THE ROME AIR DEVELOPMENT CENTER TARGET ENHANCING LINEAR RELAY SYSTEM Final Report, Jan. - Mar. 1974

Dominick Offi Oct. 1974 27 p

(AD-787309; FAA-RD-74-141) Avail: NTIS HC $3.75

An aircraft echo-area enhancement device, developed by the Stanford Research Institute for the USAF Rome Air Development Center, was flight tested at the National Aviation Facilities Experimental Center. The device, known as a target enhancing linear relay system was installed aboard a Piper Cherokee 180 aircraft and tracked with the airport surveillance radar-5 test bed. The data was analyzed to determine the extent of improved target detection capability afforded by the enhancer. Flight tests indicated the system was an effective echo-area enhancer when the aircraft was at long ranges in a tail-on aspect, and that performance was affected by antenna shielding problems. It was recommended that development of similar systems be continued, with emphasis on solving possible radiofrequency interference, economic, and antenna problems. Author

N75-13884# IIT Research Inst., Annapolis, Md.

COMPATIBILITY ANALYSIS OF THE TEXAS INSTRUMENTS, ITT/GILFILLAN, BENDIX, AND HAZELTINE MICROWAVE LANDING SYSTEM PROPOSALS Final Report

Robert A. Frazier Jun. 1974 92 p Sponsored in part by DOD

(Contract DOT-FA70WAI-175)

(AD-787180; FAA-RD-74-98; ECAC-PR-74-021) Avail: NTIS HC $3.25

The microwave landing system (MLS) proposal was modeled in a 1980 high density environment. Its channel scheme and signal format were analyzed with the aid of a computer program to determine its adequacy in such a high density environment. Three other MLS proposals were also examined. A comparison was made between the technical parameters of each and the parameters recommended by the Radio Technical Commission for Aeronautics Special Committee-117 (RTCA SC-117) to determine if the results of a previous analysis of the SC-117 MLS format could be applied to any of the three proposals. Author

N75-13885# Avcon Universal Consultants Corp., Baden, Pa.

DEVELOPMENT OF MICROWAVE LANDING SYSTEM IMPLEMENTATION CRITERIA Final Report

Thomas L. Croswell Jun. 1974 49 p ref

(Contract DOT-FA74WI-5138-1)

(AD-785220; AV-MLS-74-1; FAA-RD-74-121) Avail: NTIS HC $3.25

Guidelines are derived for MLS implementation planning from basic safety requirements for landing systems, from contemporary qualification criteria, and from existing system status. A quantitative method was developed to facilitate evaluation of alternative MLS implementation plans, based on the conclusion that instrument approaches to ILS and MLS represent an increase in safety over approaches made to nonprecision facilities. Substantiation of this conclusion, validation of the method, projection of instrument approaches, and other steps leading to a detailed MLS implementation schedule are defined and their accomplishment recommended. Author

N75-13886*# Virginia Univ., Charlottesville. Dept. of Engineering Science and Systems.

DEVELOPMENT OF A SUPERCONDUCTOR MAGNETIC SUSPENSION AND BALANCE PROTOTYPE FACILITY FOR STUDYING THE FEASIBILITY OF APPLYING THIS TECHNIQUE TO LARGE SCALE AERODYNAMIC TESTING Final Report, 1 Sep. 1969 - 30 Sep. 1974

R. N. Zapata, R. R. Humphris, and K. C. Henderson Jan. 1975 59 p

(Grant NGR-47-005-112)

(NASA-CR-141284; ESS-4009-102-75) Avail: NTIS HC $4.25 CSCL 01A

The basic research and development work towards proving the feasibility of operating an all-superconductor magnetic suspension and balance device for aerodynamic testing is presented. The feasibility of applying a quasi-six-degree-of freedom free support technique to dynamic stability research was studied along with the design concepts and parameters for applying magnetic suspension techniques to large-scale aerodynamic facilities. A prototype aerodynamic test facility was

implemented. Relevant aspects of the development of the prototype facility are described in three sections: (1) design characteristics; (2) operational characteristics; and (3) scaling to larger facilities. Author

N75-13889# Hughes Aircraft Co., Culver City, Calif.
TACTICAL DATA SYSTEMS DESIGN CONCEPTS EVALUATION Research and Development Report, Apr. 1973 - Mar. 1974
D. K. Eto, E. Streeter, and J. W. Weber May 1974 115 p refs
(Contract F33615-73-C-3123; AF Proj. 1987)
(AD-786469; SD-45087; AFFDL-TR-74-53) Avail: NTIS CSCL 15/7

Portions of a flight data management system for a single-seat multiple-role fighter bomber were simulated in a man/machine simulation facility. The effects of various combinations of manual or automatic target tracking and manual or automatic aircraft steering-on system performance and pilot workload were investigated. Starting from a normal configuration of automatic target tracking, manual aircraft steering, and manual weapon release, the increase in pilot workload and degradation of release point error caused by manual target tracking was shown to be considerable. Additionally, the increase in system performance and reduction of pilot workload with the addition of a flight command function that integrates the weapon delivery calculations with the flight control system was demonstrated. (Modified author abstract) GRA

N75-13891# Army Material Command, Texarkana, Tex. Intern Training Center.
APPLICATIONS OF HELICOPTER MOCKUPS TO MAINTAINABILITY AND OTHER RELATED ENGINEERING DISCIPLINES Final Report
Edwin David Hawkins Mar. 1974 59 p refs
(AD-786500; USAMC-ITC-02-08-73-105) Avail: NTIS CSCL 01/3

The purpose of the study is to present applications of helicopter mockups to the engineering disciplines involved in the design. The paper consists of a series of examples and suggestions, discussing how mockups can be used for: (1) Integration and coordination between customer/contractor/subcontractor/vendor levels; (2) coordination between engineering design and support groups at the contractor level; (3) improved design and demonstration of human factors and maintainability related functions. Proper application of mockups results in a savings of time, materials, and money during the later states of development. The final outcome is a more cost effective project. Author (GRA)

N75-13892# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
COMPUTER PROGRAM FOR THE PREDICTION OF AIRCRAFT RESPONSE TO RUNWAY ROUGHNESS. VOLUME 2: USER'S MANUAL Final Report, Oct. 1971 - Apr. 1973
Anthony G. Gerardi and Adolph K. Lohwasser Apr. 1974 101 p refs
(AF Proj. 683M)
(AD-786490; AFWL-TR-73-109-Vol-2) Avail: NTIS CSCL 01/5

A computer program has been developed for use in determining the dynamic response of an aircraft to runway roughness during takeoff and constant speed taxi. The mathematical model has been programmed in FORTRAN for a CDC 6600 digital computer. A typical takeoff simulation requires less than 200 seconds of computer time and less than 77,000 octal storage locations. The output from the program is in two formats, a digital listing and a Calcomp-plotted time history. The plotted output is very useful in evaluating results. Author (GRA)

N75-13893# Ung (Man T.), El Segundo, Calif.
RECOMMENDED REQUIREMENTS FOR THE UNIVERSAL AIRCRAFT FLIGHT SIMULATOR/TRAINER Final Report
Man T. Ung Jun. 1974 32 p refs
(Contract F04700-74-C-0328)
(AD-786047; AFFTC-TR-74-23) Avail: NTIS CSCL 14/2

This report investigates various forms of computation and makes recommendations on one computing system most suitable for the UAFS/T on the basis of performance and economy. It is determined that, at this time, hybrid computation is still the least expensive means of doing real-time flight simulation of two concurrent aircraft systems without compromising the high-frequency variables. Based upon the present and future needs of the AFFTC, a representative hybrid computer configuration is drawn up. Author (GRA)

N75-14005# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
KEROSENE TYPE AVIATION TURBINE FUEL PROPERTIES SURVEY Final Report, Mar. 1971 - Sep. 1972
Royce P. Bradley Apr. 1974 81 p refs
(AF Proj. 3048)
(AD-786452; AFAPL-TR-74-7) Avail: NTIS CSCL 21/4

A survey was conducted to determine the physical properties, and particularly the thermal stabilities, of kerosene type commercial jet fuels produced by refineries throughout the world. The fuels were evaluated on the American Society for Testing and Materials-Coordinating Research Council (ASTM-CRC) Fuel Coker (Coker), Jet Fuel Thermal Oxidation Tester (JFTOT), and MINEX III thermal stability test devices. The average failure temperatures of the fuels are 369, 543, and the 510F for the Coker JFTOT, and MINEX III test devices, respectively. The physical properties of the fuels are documented. (Modified author abstract) GRA

N75-14065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF THE DYNAMIC RESPONSE OF A SUPERSONIC INLET TO FLOW-FIELD PERTURBATIONS UPSTREAM OF THE NORMAL SHOCK
Gary L. Cole and Ross G. Willoh Washington Jan. 1975 38 p refs
(NASA-TN-D-7839; E-7969) Avail: NTIS HC $3.75 CSCL 20D

A linearized mathematical analysis is presented for determining the response of normal shock position and subsonic duct pressures to flow-field perturbations upstream of the normal shock in mixed-compression supersonic inlets. The inlet duct cross-sectional area variation is approximated by constant-area sections; this approximation results in one-dimensional wave equations. A movable normal shock separates the supersonic and subsonic flow regions, and a choked exit is assumed for the inlet exit condition. The analysis leads to a closed-form matrix solution for the shock position and pressure transfer functions. Analytical frequency response results are compared with experimental data and a method of characteristics solution. Author

N75-14090# Army Air Mobility Research and Development Lab., Moffett Field, Calif. Ames Directorate.
NUMERICAL SIMULATION OF TRANSONIC FLOW ABOUT AIRPLANES AND HELICOPTER ROTORS
W. F. Ballhaus and F. X. Caradonna 1973 16 p refs
(AD-785605) Avail: NTIS CSCL 20/4

Most modern aircraft achieve optimum cruise performance and maneuverability when flying at high subsonic Mach numbers in the transonic regime. As the Mach number increases beyond the optimum, the extent and strength of these shock waves increases, and performance deteriorates rapidly giving way to flow separation and buffet. Predictions of in-flight performance for new configurations are often unreliable. It seems to attempt to use numerical simulations to supplement wind tunnel tests whenever possible. This method is discussed. (Modified author abstract) GRA

N75-14155# Boeing Vertol Co., Philadelphia, Pa.
TEST RESULTS REPORT AND DESIGN TECHNOLOGY DEVELOPMENT REPORT. HLH/ATC HIGH-SPEED TAPERED ROLLER BEARING DEVELOPMENT PROGRAM Final Report

Joseph W. Lenski, Jr. Jun. 1974 173 p refs
(Contract DAAJ01-71-C-0840; DA Proj. 1X2-63203-D-156)
(AD-786561; T301-10248-1; USAAMRDL-TR-74-33) Avail: NTIS CSCL 13/9

The high-speed and load capability of tapered roller bearings has been demonstrated by several research and development programs conducted jointly by the Boeing Vertol Company and the Timken Company. Tests were conducted on a 3.5-inch bore (6500 series) tapered roller bearing operating at 16,000 rpm (20,000 fpm) and supporting a thrust load of 5500 pounds and a radial load of 7500 pounds. Although the tests were successful and demonstrated the high-speed capability of tapered roller bearings, additional experimental testing appeared necessary to evaluate the tapered roller bearings selected for the HLM/ATC drive system. (Modified author abstract) GRA

N75-14182# Royal Aircraft Establishment, Farnborough (England).
LIGHTNING STRIKES IN AIRCRAFT AND MISSILES. THE NEED FOR PROTECTION AGAINST LIGHTNING
K. Hoffmann Oct. 1974 17 p refs Transl. into ENGLISH from Wehrtechnik (West Germany), v. 1/74, 1974 p 27-31
(RAE-Lib-Trans-1794; BR44350) Avail: NTIS HC $3.25

The generation and characteristics of the lightning discharge process and the effects to be anticipated are described. The current levels reached are given and discussed, together with the possible damage and the precautionary measures available. Author

N75-14480*# Computer Sciences Corp., Mountain View, Calif.
A STANDARD KINEMATIC MODEL FOR FLIGHT SIMULATION AT NASA AMES Final Report
Richard E. McFarland Washington NASA Jan. 1975 53 p refs
(Contract NAS2-7806)
(NASA-CR-2497) Avail: NTIS HC $4.25 CSCL 09B

A standard kinematic model for aircraft simulation exists at NASA-Ames on a variety of computer systems, one of which is used to control the flight simulator for advanced aircraft (FSAA). The derivation of the kinematic model is given and various mathematical relationships are presented as a guide. These include descriptions of standardized simulation subsystems such as the atmospheric turbulence model and the generalized six-degrees-of-freedom trim routine, as well as an introduction to the emulative batch-processing system which enables this facility to optimize its real-time environment. Author

N75-14573*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MODEL FOR JET-NOISE ANALYSIS USING PRESSURE-GRADIENT CORRELATIONS ON AN IMAGINARY CONE
Thomas D. Norum Washington Dec. 1974 29 p refs
(NASA-TN-D-7751; L-9469) Avail: NTIS HC $3.75 CSCL 20A

The technique for determining the near and far acoustic field of a jet through measurements of pressure-gradient correlations on an imaginary conical surface surrounding the jet is discussed. The necessary analytical developments are presented, and their feasibility is checked by using a point source as the sound generator. The distribution of the apparent sources on the cone, equivalent to the point source, is determined in terms of the pressure-gradient correlations. Author

N75-14632 Advisory Group for Aerospace Research and Development, Paris (France).
AGARD HANDBOOK
Aug. 1974 47 p
(AGARD-Handbook-722.28.00-Rev) Copyright. Avail: Issuing Activity

A handbook on the organization and functions of the Advisory Group for Aerospace Research and Development (AGARD) is presented. The subjects discussed are: (1) the AGARD mission, (2) the AGARD staff, (3) the AGARD panels, (4) the consultant and exchange program, and (5) the AGARD publications. P.N.F.

N75-14650# Air Force Human Resources Lab., Brooks AFB, Tex.
SYLLABUS AND SYLLABUS DEVELOPMENT TECHNIQUES USED IN EVALUATING THE A/F37A/T-4G FLIGHT SIMULATOR Final Report
Steven K. Rust, James F. Smith, and Robert R. Woodruff Jun. 1974 36 p
(AF Proj. 1123)
(AD-786412; AFHRL-TR-74-44) Avail: NTIS CSCL 05/9

The report describes the A/F37A/T-4G (T-4G) simulator syllabus developed by the Flying Training Division of the Air Force Human Resources Laboratory, to demonstrate the effectiveness of a limited visual, limited motion flight simulator in T-37 undergraduate pilot training. This report describes the syllabus development procedures employed, clarifies the resulting syllabus content and format, and provides a guide for development of future special purpose syllabi. Author (GRA)

N75-14709*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND ANALYTICAL STUDY OF AN INLET FOREBODY FOR AN AIRFRAME-INTEGRATED SCRAMJET CONCEPT
Earl H. Andrews, Jr., Anthony M. Agnone (New York Univ.), and S. Z. Pinckney Washington Jan. 1975 60 p refs
(NASA-TM-X-3158; L-9836) Avail: NTIS HC $4.25 CSCL 01B

Preliminary analytical and experimental inlet forebody investigations have been conducted at Mach numbers of 6.0 and 8.5. The forebody design concept consisted of a sharp-nosed right circular cone followed by elliptical cross sections. This concept resulted in swept isentropic compression which would allow swept cowl leading edges. Measurements were made to define the condition of the inviscid flow field developed by the forebody, including flow profiles in the vicinity of cowl leading-edge stations, and the three-dimensional boundary-layer effects. The investigation verified some of the expected differences between the predicted and the experimental results. Author

N75-14710# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD HIGHLIGHTS, MARCH 1974
Mar. 1974 30 p
(AGARD-Highlights-74/1) Avail: NTIS HC $3.75

The activities and accomplishments of the Advisory Group for Aerospace Research and Development (AGARD) during the first quarter of 1974 are discussed. Some of the subjects considered are: (1) using science and technology to meet military requirements at reduced cost, (2) preliminary design applications for reducing development, production, and operational costs of aircraft systems, (3) atmosphere pollution by aircraft engines, and (4) design and development of large wind tunnels. Author

N75-14711# Advisory Group for Aerospace Research and Development, Paris (France).
THE PERKINS-GLASSER LECTURES, MARCH 1974
Sep. 1974 27 p In ENGLISH; partly in FRENCH
(AGARD-Highlights-74/2) Avail: NTIS HC $3.75

An address to the Advisory Group for Aerospace Research and Development (AGARD) which was delivered in September, 1974 is presented. The subject of the address is the Impact of Research and Development on the United States Air Force. Some of the topics considered in the address are: (1) the National support of research, (2) basic and applied research in the Air Force, (3) development of inertial guidance systems, and (4) development of electronic digital computer. Areas of interest involved the methods for funding research and development activities and the process for making new technology available to industry. Author

N75-14712 + Engineering Sciences Data Unit, London (England).
SUBSONIC LIFT-DEPENDENT DRAG DUE TO BOUNDARY LAYER OF PLANE, SYMMETRICAL SECTION WINGS
Nov. 1966 2 p
(ESDU-66032-Amend-A) Copyright. Avail: NTIS HC $12.00

The variation of the coefficient of drag with the coefficient of lift for a wing or wing-body combination at subcritical Mach numbers is expressed as two straight lines intersecting at a lift coefficient. A mathematical model is developed to show the relationships of these aerodynamic coefficients. The effects of wing section, planform, Mach number, and Reynolds number are analyzed. The data are based on wind tunnel tests of wings and wing-body combinations in which the wings have conventional airfoil sections. Author

N75-14713*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DAMPING AND OSCILLATORY STABILITY OF A MODEL OF A PROPOSED HL-10 VEHICLE IN PITCH AT MACH NUMBERS FROM 0.20 TO 2.86 AND IN YAW AT MACH NUMBERS FROM 0.20 TO 1.20
Robert A. Kilgore and Edwin E. Davenport 15 Oct. 1974 41 p refs
(NASA-TM-X-72619) Avail: NTIS HC $3.75 CSCL 01B

Wind tunnel tests of a proposed HL-10 lifting body vehicle were conducted to determine the subsonic and transonic aerodynamic characteristics. The conditions under which the tests were conducted are described. The tests indicate that the configuration has slightly positive damping in pitch except at higher angles of attack at Mach numbers of 0.8, 0.9, and 1.0. At supersonic speeds, the configuration has positive damping in pitch for all test conditions. At subsonic and transonic speed, the configuration has positive damping and positive stability in yaw for all test conditions. Author

N75-14714*# Tennessee Univ., Knoxville.
INVESTIGATION OF THE KLINE-FOGLEMAN AIRFOIL SECTION FOR ROTOR-BLADE APPLICATIONS Semiannual Report, 1 May - 30 Nov. 1974
Edward Lumsdaine, William S. Johnson, Lynn M. Fletcher, and Judith E. Peach 15 Dec. 1974 26 p refs
(Grant NsG-1054)
(NASA-CR-141282; AE-74-1054-1) Avail: NTIS HC $3.75 CSCL 01B

Wind tunnel tests of a wedgeshaped airfoil with sharp leading edge and a spanwise step were conducted. The airfoil was tested with variations of the following parameters: (1) Reynolds number, (2) step location, (3) step shape, (4) apex angle, and (5) with the step on either the upper or lower surface. The results are compared with a flat plate and with wedge airfoils without a step having the same aspect ratio. Water table tests were conducted for flow visualization and it was determined that the flow separates from the upper surface at low angles of attack. The wind tunnel tests show that the lift/drag ratio of the airfoil is lower than for a flat plate and the pressure data show that the airfoil derives its lift in the same manner as a flat plate. Author

N75-14716*# Old Dominion Univ. Research Foundation, Norfolk, Va. School of Engineering.
POWER REQUIREMENT OF ROTATING RODS IN AIRFLOW
P. S. Barna and Gary R. Crossman Sep. 1974 19 p refs
(Contract NAS1-11707)
(NASA-CR-132556; TR-74-M6) Avail: NTIS HC $3.25 CSCL 01B

Experiments were performed to determine the power required for rotating a rotor disc fitted with a number of radially arranged rods placed into a ducted airflow. An array of stationary rods, also radially arranged, were placed upstream close to the rotor with a small gap between the rods to cause wake interference. The results show that power increased with increasing airflow and the rate of increase varied considerably. At lower values of airflow the rate of increase was larger than at higher airflow and definite power peaks occurred at certain airflow rates, where the power attained a maximum within the test airflow range. During the test a maximum blade passage frequency of 2037 Hz was attained. Author

N75-14717*# New Technology, Inc., Huntsville, Ala.
STUDY OF DYNAMIC CHARACTERISTICS OF AEROELASTIC SYSTEMS UTILIZING RANDOMDEC SIGNATURES Final Report
C. S. Chang 30 Jan. 1975 150 p refs
(Contract NAS1-12249)
(NASA-CR-132563) Avail: NTIS HC $5.75 CSCL 01B

The feasibility of utilizing the random decrement method in conjunction with a signature analysis procedure to determine the dynamic characteristics of an aeroelastic system for the purpose of on-line prediction of potential on-set of flutter was examined. Digital computer programs were developed to simulate sampled response signals of a two-mode aeroelastic system. Simulated response data were used to test the random decrement method. A special curve-fit approach was developed for analyzing the resulting signatures. A number of numerical 'experiments' were conducted on the combined processes. The method is capable of determining frequency and damping values accurately from randomdec signatures of carefully selected lengths. Author

N75-14718*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR ANNULAR-CASCADE INVESTIGATION OF AERODYNAMIC PERFORMANCE OF COOLED TURBINE VANES. 2: TRAILING-EDGE EJECTION, FILM COOLING, AND TRANSPIRATION COOLING
Louis J. Goldman and Kerry L. McLallin Washington Jan. 1975 36 p refs
(NASA-TM-X-3180; E-8049) Avail: NTIS HC $3.75 CSCL 21E

The aerodynamic performance of four different cooled vane configurations was experimentally determined in a full-annular cascade at a primary- to coolant-total-temperature ratio of 1.0. The vanes were tested over a range of coolant flow rates and pressure ratios. Overall vane efficiencies were obtained and compared, where possible, with the results obtained in a four-vane, annular-sector cascade. The vane efficiency and exit flow conditions as functions of radial position were also determined and compared with solid (uncooled) vane results. Author

N75-14719*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC PERFORMANCE OF A FULLY FILM COOLED CORE TURBINE VANE TESTED WITH COLD AIR IN A TWO-DIMENSIONAL CASCADE
Roy G. Stabe and John F. Kline Washington Jan. 1975 20 p refs
(NASA-TM-X-3177; E-8131) Avail: NTIS HC $3.25 CSCL 01B

The aerodynamic performance of a fully film cooled core turbine vane was investigated experimentally in a two-dimensional cascade of 10 vanes. Three of the 10 vanes were cooled; the others were solid (uncooled) vanes. Cold air was used for both the primary and coolant flows. The cascade test covered a range of pressure ratios corresponding to ideal exit critical velocity ratios of 0.6 to 0.95 and a range of coolant flow rates to 7.5 percent of the primary flow. The coolant flow was varied by changing the coolant supply pressure. The principal measurements were cross-channel surveys of exit total pressure, static pressure, and flow angle. The results presented include exit survey data and overall performance in terms of loss, flow angle, and weight flow for the range of exit velocity ratios and coolant flows investigated. The performance of the cooled vane is compared with the performance of an uncooled vane of the same profile and also with the performance obtained with a single cooled vane in the 10-vane cascade. Author

N75-14720*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR PERFORMANCE OF A 12.766-CENTIMETER-TIP-DIAMETER AXIAL-FLOW COOLED TURBINE. 1: DESIGN AND PERFORMANCE OF A SOLID BLADE CONFIGURATION
Jeffrey E. Haas and Milton G. Kofskey Washington Jan. 1975 23 p refs Prepared in cooperation with Army Air Mobility

Res. and Develop. Lab., Cleveland
(NASA-TN-D-7881; E-8124) Avail: NTIS HC $3.25 CSCL 01A

A solid blade version of a single-stage, axial-flow turbine was investigated to determine its performance over a range of speeds from 0 to 105 percent of equivalent design speed and over a range of total to static pressure ratios from 1.62 to 5.07. The results of this investigation will be used as a baseline for comparison with those obtained from a cooled version of this turbine. Author

N75-14721*# Old Dominion Univ. Research Foundation, Norfolk, Va.

FAST RESPONSE VANES FOR SENSING FLOW PATTERNS IN HELICOPTER ROTOR ENVIRONMENT

P. S. Barna and Gary R. Crossman Jun. 1974 30 p refs
(Contract NAS1-11707)
(NASA-CR-132545) Avail: NTIS HC $3.75 CSCL 01B

Wind tunnel experiments were conducted on four small-scale flow-direction vanes for the determination of aerodynamic response. The tests were further extended to include a standard sized low-inertia vane currently employed in aircraft flight testing. The four test vanes had different aspect ratios and were about 35 percent of the surface area of the standard vane. The test results indicate satisfactory damping and frequency response for all vanes tested and compare favorably with the standard design. Author

N75-14722*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FAIL-SAFE SYSTEM FOR ACTIVITY COOLED SUPERSONIC AND HYPERSONIC AIRCRAFT

Robert A. Jones, Dorothy O. Braswell, and Christine B. Richie Washington Jan. 1975 21 p
(NASA-TM-X-3125; L-9685) Avail: NTIS HC $3.25 CSCL 01C

A fail-safe-system concept was studied as an alternative to a redundant active cooling system for supersonic and hypersonic aircraft which use the heat sink of liquid-hydrogen fuel for cooling the aircraft structure. This concept consists of an abort maneuver by the aircraft and a passive thermal protection system (TPS) for the aircraft skin. The abort manuever provides a low-heat-load descent from normal cruise speed to a lower speed at which cooling is unnecessary, and the passive TPS allows the aircraft skin to absorb the abort heat load without exceeding critical skin temperature. On the basis of results obtained, it appears that this fail-safe-system concept warrants further consideration, inasmuch as a fail-safe system could possibly replace a redundant active cooling system with no increase in weight and would offer other potential advantages. Author

N75-14723*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AERODYNAMIC ANALYSIS OF SEVERAL HIGH THROAT MACH NUMBER INLETS FOR THE QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE

James A. Albers, Norbert O. Stockman, and John J. Hirn Washington NASA Jan. 1975 21 p refs
(NASA-TM-X-3183; E-8132) Avail: NTIS HC $3.25 CSCL 01A

The results of an analytical study to investigate internal and external surface Mach numbers on several inlet geometries for possible application to the nacelle of the Quiet Clean Short-Haul Experimental Engine (QCSEE) are presented. The effects of external forebody geometry and internal lip geometry were illustrated at both low-speed and cruise conditions. Boundary-layer analyses were performed on several geometries to determine if lip flow separation might exist. The results indicated that inner-surface Mach number level and gradient could be reduced with inlets at a 50 deg incidence angle by blunting the external forebody geometry. The external Mach numbers at cruise conditions indicated that a compromise in the external forebody bluntness might be required to satisfy both low-speed and cruise conditions. For a fixed value of bluntness parameter, no lip flow separation was indicated for the 1.46- and 1.57-area-contraction-ratio inlets at low-speed conditions. However, a lip separation condition was obtained with the 1.37-contraction-ratio inlet. The QCSEE nacelle design takeoff operating condition (incidence angle of 50 deg and free-stream Mach number of 0.12) resulted in higher peak surface Mach numbers than the design crosswind (incidence angle of 90 deg and free-stream Mach number of 0.05) or static condition. Author

N75-14724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AERODYNAMIC PERFORMANCE OF A CERAMIC-COATED CORE TURBINE VANE TESTED WITH COLD AIR IN A TWO-DIMENSIONAL CASCADE

Roy G. Stabe and Curt H. Liebert Washington NASA Jan. 1975 15 p refs
(NASA-TM-X-3191; E-8137) Avail: NTIS HC $3.25 CSCL 01A

The aerodynamic performance of a core turbine vane with a ceramic coating was investigated experimentally in a two-dimensional cascade of 10 vanes. The vane was first tested with a rough coating and then retested after the coating had been smoothed. The test fluid was atmospheric air. The cascade tests covered a range of pressure ratios corresponding to ideal exit critical velocity ratios of 0.6 to 0.95. The principal measurements were cross-channel surveys of exit total pressure, static pressure, and flow angle. The results presented include exit survey results and overall performance in terms of flow angle, weight flow, and kinetic energy loss. The performance of the ceramic-coated vanes is compared with the performance of an uncoated vane having a similar profile. Author

N75-14725*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

USER'S MANUAL FOR COMPUTER PROGRAM ROTOR

Masahiro Yasue Aug. 1974 235 p refs
(Contract NAS2-7262)
(NASA-CR-137553; ASRL-TR-174-2) Avail: NTIS HC $7.50 CSCL 01B

A detailed description of a computer program to calculate tilt-rotor aircraft dynamic characteristics is presented. This program consists of two parts: (1) the natural frequencies and corresponding mode shapes of the rotor blade and wing are developed from structural data (mass distribution and stiffness distribution); and (2) the frequency response (to gust and blade pitch control inputs) and eigenvalues of the tilt-rotor dynamic system, based on the natural frequencies and mode shapes, are derived. Sample problems are included to assist the user. Author

N75-14726*# Rochester Applied Science Associates, Inc., N.Y.

DEVELOPMENT OF AN ANALYSIS FOR THE DETERMINATION OF COUPLED HELICOPTER ROTOR/CONTROL SYSTEM DYNAMIC RESPONSE. PART 2: PROGRAM LISTING Final Report

Lawrence R. Sutton Washington NASA Jan. 1975 94 p
(Contract NAS1-10856)
(NASA-CR-2453) Avail: NTIS HC $4.75 CSCL 01C

A theoretical analysis is developed for a coupled helicopter rotor system to allow determination of the loads and dynamic response behavior of helicopter rotor systems in both steady-state forward flight and maneuvers. The effects of an anisotropically supported swashplate or gyroscope control system and a deformed free wake on the rotor system dynamic response behavior are included. Author

N75-14727*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

COMPUTER PROGRAMS FOR CALCULATING THE STATIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF WING-BODY-TAIL CONFIGURATIONS

Michael R. Mendenhall, Frederick K. Goodwin, Marnix F. E. Dillenius, and David M. Kline Washington NASA Jan. 1975 223 p refs
(Contract NAS2-7347)
(NASA-CR-2474) Avail: NTIS HC $7.25 CSCL 01B

Four computer programs developed to calculate the longitudinal aerodynamic characteristics of wing-body and wing-body-tail combinations are presented. The R1307 program is based on a linear method and is limited to the small range of angles of attack for which the lift and moment characteristics of wings and bodies are linear with angle of attack. The CRSFLW program is based on a crossflow method of predicting the forces and

moments on bodies alone or wing-body combinations over a large angle of attack range. The SUBSON program predicts the longitudinal aerodynamic characteristics of wing-body-tail combinations at subsonic speeds and at angles of attack for which symmetrical pairs of vortices are shed from the body nose and the leading and side edges of the lifting surfaces. Program SUPSON predicts the longitudinal aerodynamic characteristics of wing-body-tail combinations at supersonic speeds in the same angle-of-attack range. A description of the use of each program, instructions for preparation of input, a description of the output, program listings, and sample cases for each program are included. Author

N75-14728# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Rettungs- und Bergungssysteme.

PROGRAM FOR TESTING THE INFLUENCES OF THE MASS AND VELOCITY PARAMETERS ON PERFORMANCE DATA AND CHARACTERISTICS OF PARACHUTE LOAD SYSTEMS

Karl-Friedrich Doherr and Christos Saliaris 7 Aug. 1974 22 p refs In GERMAN; ENGLISH summary

(DLR-MITT-74-31) Avail: NTIS HC $3.25; DFVLR, Porz, West Ger. 9 DM

A test program was designed for investigating the effects of mass and velocity parameters on the performance characteristics of parachute load systems. Both parameters can be investigated in a parachute gun launcher with relatively small effort and at low costs. But for comparison purposes full scale tests must be performed at different altitudes (gas densities) to assure the validity of experimental rresults gained from model tests at sea level. Therefore, both free flight drop tests from aircraft and rocket boosted parachute tests were envisaged. ESRO

N75-14729# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.

THRUST AUGMENTED WING SECTIONS IN POTENTIAL FLOW

James Dennis Wilson, John L. Loth, and Subrato Chandra Aug. 1974 147 p refs

(Contract N00014-68-A-0512; NR Proj. 215-163)

(AD-786221; TR-25) Avail: NTIS CSCL 01/1

A method is presented for calculating the incompressible, potential flow for an arbitrary thrust augmented wing section, possibly experiencing inflow over portions of its surface. The solution includes the shape of an inviscid jet leaving the airfoil calculated by an automatic iteration procedure. The problem is formulated by covering the airfoil-jet surface with line segments which carry velocity discontinuity distributions and satisfy the boundary condition on velocity at the midpoints of the segments. Applying the boundary condition for a particular jet shape leads to a set of linear algebraic equations to be solved for the velocity discontinuity strengths. The final jet geometry is found when the net pressure force for each set of surface elements on the front and back of the jet is balanced by the centrifugal force acting on the fluid within the jet et the corresponding location. (Modified author abstract) GRA

N75-14730# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.

NAVAL V/STOL AERODYNAMICS Final Summary Report, 15 Jul. 1968 - 28 Feb. 1974

Jerome B. Fanucci, John L. Loth, Nathan Ness, and Richard E. Walters Feb. 1974 161 p refs

(Contract N00014-68-A-0512; NR Proj. 215-163)

(AD-786222; TR-40) Avail: NTIS CSCL 01/1

This report is a summary of a large number of research tasks performed in the area of low speed aerodynamics. The research projects are fundamental in nature but of relevance to the Navy. Both the theoretical and experimental aspects of each problem have been studied and the results are compared. Numerical methods have been used in self contained computer programs to calculate the aerodynamic performance of the following configurations: Two dimensional circulation controlled wings with blowing and regions of separated flow; two dimensional thrust augmented VTOL wings with jet entrainment effects; and rotors in hover with arbitrary twist, taper, and airfoil cross section using nonlinear lifting surface theory. Additional experimental work has been done in the area of rotor wake instabilities in and out of ground effect. (Modified author abstract) GRA

N75-14731# Army Foreign Science and Technology Center, Charlottesville, Va.

UT-15, SERIES 2 PARACHUTE

L. Kalabukhova and S. Rudevskaya 17 Oct. 1973 9 p Transl. into ENGLISH from Krylya Rodiny (USSR), no. 4, 1973 p 18-19

(AD-786817; FSTC-HT-23-1783-73) Avail: NTIS CSCL 01/3

The 24-shroud, capron sports parachute opens at speeds up to 225 km/h; descent rate is 5.1 m/sec; canopy area is 51 sq m. Construction, maneuvering, rigging and user adjustment of the parachute are discussed. GRA

N75-14732# Ballistic Research Labs., Aberdeen Proving Ground, Md.

BOUNDARY-LAYER STUDIES ON SPINNING BODIES OF REVOLUTION

Walter B. Sturek 1973 15 p refs

(AD-785688) Avail: NTIS CSCL 19/1

This paper describes some results from a series of experimental studies of the viscous boundary-layer on spinning bodies of revolution. The objectives of these studies are: (1) provide data which will help guide the development of a useful procedure for computing Magnus effects on aerodynamic shapes of interest in artillery projectile design; (2) verify the significance of the boundary-layer configuration--laminar, transitional, turbulent--on the resulting Magnus force; and (3) develop a better understanding of the physics of the three-dimensional boundary-layer on spinning bodies of revolution at angle of attack. GRA

N75-14733# Army Foreign Science and Technology Center, Charlottesville, Va.

WORLD CHAMPIONSHIP PARACHUTES

L. Kalabukhova Jan. 1974 10 p Transl. into ENGLISH from Krylya Rodiny (USSR), no. 1, 1973 p 32-34

(AD-786838; FSTC-HT-23-1511-73) Avail: NTIS CSCL 01/3

The article discusses the different types of parachutes used for sport jumping. These include French, Czech, Russian and American chutes. Results of the XI world championships are given. Improvements in the design and engineering of parachutes are given and development of new types of chutes such as the Para-Plane is included. GRA

N75-14734# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

REVIEW OF METHODS OF SOLUTION OF AFTERBODY/EXHAUST NOZZLE FLOW FIELDS

Wladimiro Calarese Jan. 1974 165 p refs

(AF Proj. 1476)

(AD-787459; AFFDL-TR-74-108) Avail: NTIS CSCL 20D

A review is made of methods of solution for afterbody/exhaust nozzle flow fields in different flight regimes. For the transonic regime airfoil solutions are also presented. A comparison between various theories and experiments is made wherever considered necessary to show the state-of-the-art. Most of the available theories are selected and correlated. Author (GRA)

N75-14735*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUMMARY OF THE RECENT SHORT-HAUL SYSTEMS STUDIES

Raymond C. Savin, Thomas L. Galloway, Darrell E. Wilcox, George C. Kenyon, Mark D. Ardema, and Mark H. Waters Washington Jan. 1975 60 p refs

(NASA-TM-X-3010; A-5333) Avail: NTIS HC $4.25 CSCL 01C

The results of several NASA sponsored high density short haul air transportation systems studies are reported as well as analyzed. Included are the total STOL systems analysis approach, a companion STOL composites study conducted in conjunction with STOL systems studies, a STOL economic assessment study, an evaluation of STOL aircraft with and without externally blown flaps, an alternative STOL systems for the San Francisco Bay

Area, and the quiet, clean experimental engine studies. Assumptions and results of these studies are summarized, their differences, analyzed, and the results compared with those in-house analyses performed by the Systems Studies Division of the NASA-Ames Research Center. Pertinent conclusions are developed and the more significant technology needs for the evaluation of a viable short haul transportation system are identified. Author

N75-14736# Naval Postgraduate School, Monterey, Calif.
A RISK AND COMPARATIVE ANALYSIS OF AIRCRAFT ACCIDENT DATA M.S. Thesis
James Michael Burin Sep. 1974 91 p refs
(AD-787426) Avail: NTIS CSCL 01/2

Aircraft accident data was analyzed to investigate the differences in risk of Naval aircraft and to develop some overall risk measure. To analyze risk, a flight was divided into four risk areas: takeoff, inflight, transition, and landing. Accidents were assumed to occur according to a Poisson process and tests were carried out to prove the validity of the Poisson assumption. The poisson model yielded two factors, the exposure to the risk areas and the performance in them. A procedure to predict risk was developed. A statistic, improvement index, was developed to allow a direct comparison between different types of aircraft with respect to safety performance. (Modified author abstract) GRA

N75-14742# Army Electronics Command, Fort Monmouth, N.J.
ROTOR EFFECTS ON L-BAND SIGNALS RECEIVED BY HELICOPTER ANTENNAS: A THEORETICAL STUDY. PART 1: AMPLITUDE REDUCTION AND PHASE SHIFT. SHIELDING EFFECT Final Report
F. Schwering and C. M. DeSantis Sep. 1974 65 p
(DA Proj. 1T1-61102-B-31A)
(AD-787363; ECOM-4254) Avail: NTIS CSCL 17G

Rotor effects on L-band navigation signals received by helicopter antennas are examined theoretically. Two types of distortions are distinguished: (1) the amplitude reduction and phase shift of CW-signals due to periodic shadowing of the antenna by the rotor (shielding effect), and (2) the distortion of phase reversals assumed to occur at predetermined intervals in the incident signals. Numerical evaluations have been performed using the pertinent dimensions of a UH-1 heldicopter. It was found that the shielding effect may reduce the received power by 10 db while the phase shift does not exceed 90 degrees. (Modified author abstracts). GRA

N75-14743# Army Electronics Command, Fort Monmouth, N.J.
ROTOR EFFECTS ON L-BAND SIGNALS RECEIVED BY HELICOPTER ANTENNAS: A THEORETICAL STUDY. PART 2: DISTORTION OF PHASE REVERSALS Final Report
F. Schwering and C. M. DeSantis Sep. 1974 25 p
(DA Proj. 1T1-61102-B-31A)
(AD-787364; ECOM-4255) Avail: NTIS CSCL 17G

It was found that the distortion of phase reversals depends on the bandwidth of the navigation signals. However, rotor induced transients will be negligible after one or two carrier periods. (Modified author abstract) GRA

N75-14745*# Continental Airlines, Inc., Los Angeles, Calif.
INFLIGHT DATA COLLECTION FOR RIDE QUALITY AND ATMOSPHERIC TURBULENCE RESEARCH Final Report
Paul W. Kadlec and Roger C. Buckman Dec. 1974 57 p refs
(Contract NAS4-1982)
(NASA-CR-127492) Avail: NTIS HC $4.25 CSCL 01C

A flight test program to investigate the effects of atmospheric turbulence on passenger ride quality in large, wide-body commercial aircraft was conducted. Data were collected on a series of flight on a Boeing 747 aircraft. Atmospheric and aircraft performance data were obtained from special sensors, as well as conventional instruments and avionics systems normally available. Visual observations of meteorological conditions encountered were manually recorded during the flights. Author

N75-14746*# Rockwell International Corp., Los Angeles, Calif.
CONCEPTUAL DESIGN STUDY OF IMPROVED 1985 REMOTE LIFE-FAN V/STOL COMMERCIAL TRANSPORTS
Robert L. Cavage et al Washington NASA Jan. 1975 86 p refs
(Contract NAS2-6564)
(NASA-CR-2481) Avail: NTIS HC $4.75 CSCL 01C

A design study was conducted for a remote lift-fan commercial V/STOL transport for the 1985 time period. The investigation centered on the commercial short haul transportation application to carry 100 passengers over trip distances of 400 nautical miles from a vertical takeoff and landing, and 800 nautical miles after a 1600 foot STOL takeoff. The study included investigation of alternate numbers and arrangements of lift fans and gas generators, fan control margins, and structural concepts. The sensitivity of direct operating costs to major airframe parameters, airframe costs, propulsion costs, yearly aircraft utilization rate, and trip distances are evaluated. Author

N75-14747*# Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
INFLUENCE OF PROPULSION SYSTEM SIZE, SHAPE, AND LOCATION ON SUPERSONIC AIRCRAFT DESIGN
Ellwood Bonner, Marshall H. Roe, Ray M. Tyson, and Ronald Y. Mairs Dec. 1974 200 p refs
(Contract NAS1-13105)
(NASA-CR-132544) Avail: NTIS HC $7.00 CSCL 01C

The effects of various propulsion system parameters on the characteristics of a supersonic transport were investigated. The effects of arbitrarily scaling engine size on wave drag, friction drag, drag-due-to-lift, wing sizing, airplane balance, and airplane weight were studied. These evaluations were made for two families of nacelle shapes, resulting from typical turbojet and turbofan installations. Also examined were effects of nacelle location, and the wing camber plane deformations required to cancel the nacelle interference pressure field at cruise Mach number (2.7 M) were determined. The most drag-sensitive parameter is found to be nacelle shape. Similarly, wing deformation requirements are found to be primarily affected by nacelle shape. Effects of engine size variations are noted primarily in airplane gross weight. Author

N75-14748*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
FLIGHT INVESTIGATION OF ROTOR/VEHICLE STATE FEEDBACK
Stanley J. Briczinski and Dean E. Cooper [1974] 173 p refs
(Contract NAS1-11563)
(NASA-CR-132546; SER-50905) Avail: NTIS HC $6.25 CSCL 01C

Analytic and test results of the Rotor/Vehicle State Feedback Investigation indicate that feedback networks can be used successfully to simulate the important flying quality and ride comfort aspects of mechanical flapping-feathering coupled arrangements. Factors such as accuracy of tip-path-plane resolution, computer time lags, control system hysteresis, and actuator dynamics are either negligible, can be compensated for, or do not sufficiently influence the results to alter this general conclusion. A ruggedized commercial computer, installed on a CH-53A helicopter, was programmed successfully to handle a wide variety of rotor and fuselage feedback schemes and related operating logic which was investigated during the flight test phase of this study. The program cycle time was approximately twice as fast as the most demanding sampling rate studied (24 samples per revolution). The investigation indicates that the dynamically varying first harmonic contributions (tip-path-plane coefficients) of main rotor blade flapping can be resolved from blade flapping measurements when data supplied to the resolver meet particular requirements. Author

N75-14749# McDonnell-Douglas Corp., St. Louis, Mo.
AERODYNAMIC DESIGN OF HIGH PERFORMANCE BIPLANE WINGS
Robert B. Addoms (Aerojet-General Corp., Tacoma, Wash.) and Frank W. Spaid 12 Sep. 1974 37 p refs Backup document

for AIAA Synoptic scheduled for publication in Journal of Aircraft in July 1975
Avail: NTIS HC $3.75

A procedure for improving the maximum lift coefficient for biplanes is discussed. The procedure consists of tailoring the shape of a parent monoplane airfoil to the induced flowfield of a given biplane configuration. Such airfoils have greater camber than the sections from which they are derived, although the drag coefficient at cruise is not increased significantly. Results of an aircraft performance analysis indicate that a biplane may be superior to a monoplane when low speed maneuverability, short field performance, load carrying ability, and low cost are more important than maximum speed for a given power. Author

N75-14750# Boeing Vertol Co., Philadelphia, Pa.
DESIGN AND OPTIMIZATION ON STUDY OF THE ACTIVE ARM EXTERNAL LOAD STABILIZATION SYSTEM (AAELSS) FOR HELICOPTERS Final Report, Jun. 1973 - May 1974
Eugene Kisielowski, James H. Smith, and Robert W. Spittle Aug. 1974 136 p refs
(Contract DAAJ02-73-C-0100; DA Proj. 1F1-63209-DB-33)
(AD-787325; D210-10764-1; USAAMRDL-TR-74-55) Avail: NTIS CSCL 01/3

Presented are the results of the analytical study involving design optimization of the Active Arm External Load Stabilization System (AAELSS), whose technical and operational feasibility was conclusively demonstrated under Contract DAAJ02-72-C-0046. The program consisted of two phases: the analytical study, under which basic design parameters of the AAELSS were optimized, and the preliminary design phase of the improved system, under which a variety of different configurations were considered, including the conceptual design for the heavy lift helicopter (HLH). The final design configuration, although specifically tailored to the CH-47C helicopters, contains basic design elements directly applicable to the HLH and represents a considerable design improvement over the experimental system. Author (GRA)

N75-14751# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
HELICOPTER SECONDARY STRUCTURES RELIABILITY AND MAINTAINABILITY INVESTIGATION Final Report, May 1972 - Jun. 1974
Kenneth B. Krieger Jul. 1974 168 p refs
(Contract DAAJ02-72-C-0070; DA Proj. 1F1-62205-A-11)
(AD-787334; SER-40846; USAAMRDL-TR-74-52) Avail: NTIS CSCL 01/3

Maintenance man-hours and downtime charged against secondary structures of aircraft have been excessive. It is assumed that this has been due to deficiencies in the design and test procedures for these components. This report investigates these problems and makes recommendations to alleviate them. Standards and specifications were reviewed for application to secondary structures on rotary-wing aircraft. A list was made up for detailed review. This study indicates that design and test criteria for secondary structure components subject to handling use and abuse must be expanded to include the functional loads applied in handling. The usual flight and ground load criteria are inadequate for designing and testing adequate secondary structures of the hinged-opening variety. (Modified author abstract) GRA

N75-14752# Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
INVESTIGATION OF INSPECTION AIDS Final Report, 18 Apr. 1973 - 24 May 1974
Richard L. Calhoon, Fred W. Hohn, James A. McNamee, Bruce B. Wierenga, and T. N. Cook Jul. 1974 199 p refs
(Contract DAAJ02-73-C-0059; DA Proj. 1F1-62205-A-11903)
(AD-787333; USAAMRDL-TR-74-44) Avail: NTIS CSCL 15/5

The investigation of inspection aids was performed to identify specific inspection requirements and recommend relatively small aids or indicators, current or conceptual, that will enhance the troubleshooting inspection/preventive maintenance process for Army helicopters. Inspection requirements and procedures for six helicopter types (AH-1, UH-1, CH-47, CH-54, OH-6, OH-58) were analyzed. Significant inspections were identified and the effectiveness and adequacy of presently used procedures and techniques was assessed. Areas where the inspector is highly dependent upon subjective judgment or cumbersome or ineffective procedures are employed were determined. Surveys of available off-the-shelf vendor aids and candidate conceptual inspection aids which offer improved inspection efficiency in these areas were performed. (Modified author abstract) GRA

N75-14753# Army Missile Command, Redstone Arsenal, Ala.
APPLICATION OF IMPEDANCE METHODS TO THE DESIGN OF ISOLATORS FOR HELICOPTER MOUNTED WEAPONS STORES
James M. Oliver 31 Jul. 1974 29 p refs
(DA Proj. 1M3-62303-A-214)
(AD-787293; RL-75-3) Avail: NTIS CSCL 01/3

The so-called mobility method of dynamic analysis is reviewed. How measurements under nonideal conditions can be carried out is described. A means of utilizing the method as a part of the design and testing of helicopter mounted equipment is presented. Author (GRA)

N75-14754# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THE RESPONSE OF AIRCRAFT ENCOUNTERING AIRCRAFT WAKE TURBULENCE Final Report, Sep. 1972 - Apr. 1974
Robert C. Nelson Jun. 1974 141 p refs
(AF Proj. 1929)
(AD-787193; AFFDL-TR-74-29) Avail: NTIS CSCL 01/2

The investigation deals with the dynamic behavior of an airplane encountering aircraft wake turbulence. A digital computer simulation was developed to study the response of an aircraft flying into a trailing vortex wake. The simulation includes the complete six degree of freedom equations of motion, a description of the vortex velocity field, unsteady aerodynamics, and pilot control input. The parameters included the penetration angle, separation distance, aircraft size, and pilot control input. Predicted vortex induced motions are presented for general aviation, business, and light jet transport type aircraft. (Modified author abstract) GRA

N75-14755# Cranfield Inst. of Technology (England).
A PROPOSAL FOR A SELF-CONTAINED INSTRUMENTATION SYSTEM FOR FLIGHT RESEARCH ON STABILITY AND CONTROL
V. Klein and R. Gregory Mar. 1974 74 p refs
(Cranfield-Aero-21) Avail: NTIS HC $4.25

The concept and possible realization of a self-contained instrumentation system for the measurement of stability and control characteristics of an aircraft are described. The recommended accuracy of the system is based on its relation to the accuracy of aerodynamic derivatives of an aircraft evaluated from flight data. Therefore several sets of simulated and measured data were analyzed. A survey of techniques used for the evaluation of these derivatives is also presented. Author

N75-14756# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
DESIGN FABRICATION, AND DEMONSTRATION OF A MINIATURIZED TIP CLEARANCE MEASURING DEVICE Final Report, Jul. 1973 - Apr. 1974
M. J. Ford, J. R. Hildebrand, and J. C. Prosser Sep. 1974 80 p refs
(Contract DAAJ02-73-C-0084)
(AD-787318; PWA-FR-6447; USAAMRDL-TR-74-67) Avail: NTIS CSCL 21C

This report describes the design, fabrication, and demonstration of a miniaturized turbine blade tip clearance measurement system for use with small gas turbine engines during engine operation. This system was originated by Pratt and Whitney Aircraft and uses laser light that is focused on the blade tips. The light reflected from the blade tips is imaged onto an output

device. The relationship between the change in tip clearance and the change in position of the output light spot provides a direct indication of tip clearance. (Modified author abstract)
GRA

N75-14757# McDonnell-Douglas Corp., Long Beach, Calif.
DC-9 NOISE RETROFIT FEASIBILITY. VOLUME 2: UPPER GOAL NOISE, PERFORMANCE AND COST EVALUATION Final Report, Jan. - Sep. 1973
H. D. Whallon et al Dec. 1973 160 p refs
(Contract DOT-FA72WA-3116)
(AD-777895; MDC-J4355-Vol-2; FAA-RD-73-124-Vol-2) Avail: NTIS HC $5.00

Noise reduction of 4, 4, 5, and 10 EPNdB at the Federal Aviation Regulations (FAR) Part 36 sideline, takeoff, cutback, and approach measurement conditions, respectively was investigated. Exhaust system development tests were conducted on an engine static test stand to evaluate the upper goal exhaust system. Components of the upper goal nacelle were designed and fabricated. The components were ground static tested for effect on engine performance and noise. The initial daisy-with-ejector configuration showed good acoustical results but with

This study describes and analyzes military and FAA liaison efforts which impact on the management of the National Aviation System. It begins with the historical development of the National Aviation System (NAS). The system is evolutionary in nature and most innovations have come from user demands and outside sources. Long term government responsibility to manage the system has been secondary to the operation and maintenance functions. There has been duplication of effort due to poor coordination on developing technology that led to improvement of the system. The methodology used was research of historical and contemporary literature, supplemented by personal interviews with individuals currently involved directly in the liaison process. The combination of extensive personal interviews and the many general and technical reports available emphasize the fractionalized responsibilities within the system and provide a diverse information base that is unavoidably large. (Modified author abstract)
GRA

N75-14760# Committee on Science and Astronautics (U. S. House).
AIRCRAFT NOISE ABATEMENT
Cotter, Wydler, William G. Wells, Jr., Carl Swartz, Darrell Branscome, and Patricia Schwartz Washington GPO Dec. 1974 47 p ref Rept. prepared by Subcomm. on Aeron. and Space Technol. of Comm. on Sci. and Astronaut., 93d Congr., 2d Sess., 5-6, and 18 Dec. and 24-25 Jul. 1974
(GPO-42-539) Avail: US Capitol, House Document Room

Various programs discussed before the subcommittee on aeronautics and space technology are analyzed. The following major areas are included: (1) results of the 23-airport study by the Department of Transportation; (2) two-segment landing approach program; (3) retrofit of civilian narrow-body jet aircraft and fleet; (4) aircraft noise abatement operating procedures, and (5) coordinated national aircraft noise abatement program. Recommendations and achievements of the subcommittee are summarized.
J.M.S.

N75-14761*# General Electric Co., Cincinnati, Ohio.
ACOUSTIC RESULTS FROM TESTS OF A 36-INCH (0.914 m) DIAMETER STATORLESS LIFT FAN
D. L. Stimpert Jun. 1973 114 p refs
(Contract NAS2-5462)
(NASA-CR-137621; R73AEG360) Avail: NTIS HC $5.25 CSCL 21E

A statorless, turbotip lift fan was tested statically outdoors to determine its acoustic characteristics. Spectral and directivity results are presented with comparison to data from the same family of lift fan designs having stator vanes. Modifications to the fan were tested to evaluate circular inlet guide vanes and exhaust treatment. A comparison was made of results obtained at General Electric Edwards Flight Test Center and NASA Ames Research Center with regards to test data and differences in site characteristics.
Author

N75-14763# Cranfield Inst. of Technology (England). Coll. of Aeronautics.
SUBSONIC JET TRANSPORT NOISE: THE RELATIVE IMPORTANCE OF VARIOUS PARAMETERS
D. Howe Jul. 1974 22 p refs
(Cranfield-Aero-25) Avail: NTIS HC $3.25

The area of the 80 PNdB noise footprint of subsonic jet transport aircraft was evaluated using a simple expression for powerplant noise level. The parameters varied were the bypass ratio, field strength, climb out and descent angle, installed thrust, standard of engine acoustic treatment, and the rate of noise attenuation. Curves are presented for typical ranges of the variables. It was concluded that the bypass ratio is the most important influence on the footprint area. The attenuation rate also has a very significant effect but it is outside the control of the designer. Field length has only a secondary effect on noise footprint.
Author

N75-14765*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACOUSTIC AND AERODYNAMIC PERFORMANCE OF A 1.83 METER (6 FOOT) DIAMETER 1.2 PRESSURE RATIO FAN (QF-6)
Richard P. Woodward, James G. Lucas, and Edward G. Stakolich Washington Dec. 1974 117 p refs
(NASA-TN-D-7809; E-7996) Avail: NTIS HC $5.25 CSCL 21E

A 1.2-pressure-ratio, 1.83-meter-(6-ft-) diameter experimental fan stage with characteristics suitable for use in STOL aircraft engines was tested for acoustic and aerodynamic performance. The design incorporated features for low noise, including absence of inlet guide vanes, low rotor-blade-tip speed, low aerodynamic blade loading, and long axial spacing between the rotor and stator rows. The stage was run with four nozzles of different area. The perceived noise along a 152.4 meter (500-ft) sideline was rear-quadrant dominated with a maximum design-point level of 103.9 PNdb. The acoustic 1/3-octave results were analytically separated into broadband and pure-tone components. It was found that the stage noise levels generally increase with a decrease in nozzle area, with this increase observed primarily in the broadband noise component. A stall condition was documented acoustically with a 90-percent-of-design-area nozzle.
Author

N75-14767*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC PERFORMANCE OF 0.5 METER-DIAMETER, 337 METER-PER-SECOND-STAGE FAN DESIGNED FOR LOW NOISE AIRCRAFT ENGINES
Thomas F. Gelder and George W. Lewis, Jr. Washington Dec. 1974 185 p refs
(NASA-TN-D-7836; E-7779) Avail: NTIS HC $7.00 CSCL 21E

Overall and blade-element aerodynamic performance of a 0.271-scale model of QF-1 are presented, examined, and then compared and evaluated with that from similar low noise fan stage designs. The tests cover a wide range of speeds and weight flows along with variations in stator setting angle and stator axial spacing from the rotor. At design speed with stator at design setting angle and a fixed distance between stage measuring stations, there were no significant effects of increasing the axial spacing between rotor stator from 1.0 to 3.5 rotor chords on stage overall pressure ratio, efficiency or stall margin.
Author

N75-14770# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
HIGH SPEED ROTOR DYNAMICS: AN ASSESSMENT OF CURRENT TECHNOLOGY FOR SMALL TURBOSHAFT ENGINES
John M. Vance Jul. 1974 50 p refs
(DA Proj. 1G1-62207-AA-72)
(AD-787319; USAAMRDL-TR-74-6616) Avail: NTIS CSCL 21/5

Problem areas connected with rotor dynamics which are peculiar to the special requirements of rotor-bearing systems in

the class of small turboshaft engines being developed for U.S. Army helicopters are identified. The present and past philosophy of design is discussed, including the impact of the demand for front drives. Methods for critical speed prediction and high-speed balancing are reviewed. The trend to higher speeds is seen to require consideration of new approaches to balancing through flexural modes. The major parameters available for control by the designer are shown to be the bearing support properties, and recommendations are made for improving the accuracy of prediction of these properties. Modified author abstract (GRA)

N75-14771# Ultrasystems, Inc., Phoenix, Ariz. Dynamic Science Div.

FUEL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATION, VOLUME 1 Final Report May 1973 - May 1974

Neva B. Johnson Jul. 1974 90 p refs

(Contract DAAJ02-73-C-0072; DA Proj. 1F1-62205-A-11903)

(AD-786563; Dyn-Sci-1560-74-12-Vol-1; USAAMRDL-TR-74-51A) Avail: NTIS CSCL 01/3

Developmental and operational experience and applicable specifications, handbooks, and technical reports pertaining to current U.S. Army helicopter fuel systems were analyzed to determine deficiencies in the existing documentation as it relates to Army helicopter fuel system reliability and maintainability. Justifiable revisions to applicable military specifications were proposed. The revisions and newly established requirements, along with other viable alternatives which were considered, are discussed, and the rationale behind the final selections is presented. Volume II, containing all revisions and the two complete draft specifications, can be appended to or referenced by Government and/or industry specifications. (Modified author abstract) GRA

N75-14772# Ultrasystems, Inc., Phoenix, Ariz. Dynamic Science Div.

FUEL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATION. VOLUME 2: SUPPLEMENTAL DESIGN GUIDE Final Report, May 1973 - May 1974

Neva B. Johnson Jul. 1974 111 p

(Contract DAAJ02-73-C-0072; DA Proj. 1F1-62205-A-11903)

(AD-786564; Dyn-Sci-1560-74-12A-Vol-2; USAAMRDL-TR-74-51B) Avail: NTIS CSCL 01/3

The volume contains a list of documents, including applicable military specifications, that should be considered in the design of helicopter fuel systems. Recommended specification revisions and newly established requirements in the form of two complete draft specifications are also included. Author (GRA)

N75-14776*# Atlantic Research Corp., Alexandria, Va. EMM Dept.

DEVELOPMENT AND MODIFICATION OF A DIGITAL PROGRAM FOR FINAL APPROACH TO LANDING

William G. Duff and Charles R. Guarino [1974] 125 p refs

(Contract NAS1-11992)

(NASA-CR-132562) Avail: NTIS HC $5.25 CSCL 01E

The development and implementation of a dynamic digital computer simulator which may be used to evaluate aircraft performance when operating under the control and guidance of various navigation, landing, and flight control systems are discussed. The digital computer program may be used to simulate and evaluate the relationships and interactions between various factors such as the microwave landing system, avionics receivers and onboard processors, aircraft aerodynamics, aircraft automatic control systems, control surfaces, and wind and other external effects. The models used to represent aircraft aerodynamics, control system and control surfaces; weather and wind effects; and the microwave landing system are described. Example results are presented for a simulation of a Boeing 737 using two sample control systems while subjected to various atmospheric conditions and microwave landing system errors. The limitations and performance capabilities of these control systems are discussed in terms of their ability to utilize the microwave landing system signal. Author

N75-14780*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA LEWIS 10 BY 10 FOOT SUPERSONIC WIND TUNNEL

Robert A. Aiello Nov. 1974 47 p

(NASA-TM-X-71625; E-8151) Avail: NTIS HC $3.75 CSCL 01E

Performance data are presented for this tunnel, which has a Mach number range from 2.0 to 3.5. The tunnel circuit, model support systems, auxiliary systems, instrumentation, control room equipment, and automatic recording and computing equipment are described. Information is presented on criteria for designing models, and on shop facilities available to users. Author

N75-14785# Air Force Human Resources Lab., Brooks AFB, Tex.

USE OF THE T-4G SIMULATOR IN USAF UNDERGRADUATE PILOT TRAINING (UPT), PHASE 1 Final Report

Robert R. Woodruff, James F. Smith, and Robert A. Morris Jul. 1974 41 p refs

(AF Proj. 1123)

(AD-786413; AFHRL-TR-74-61) Avail: NTIS CSCL 14/2

The A/F37A/T-4G, a T-37 flight training simulator with limited visual and motion capability, was evaluated to determine the extent to which its technology could be used to substitute for flying hours in the UPT T-37 syllabus. S special syllabus maximizing T-4G capabilities was used. This report describes the first phase in which six UPT students were trained in the T-4G/T-37 program. The six students completed contact training in 23.4 flying hours (a savings of 3.8 hours), and they completed instrument training in 9.7 flying hours (a savings of 11.1 hours). Author (GRA)

N75-14788# Tactical Air Command, Langley AFB, Va. Directorate Force Development and Analysis.

CONCEPT OF OPERATIONS FOR A FULL MISSION FIGHTER SIMULATOR (FMFS)

10 Sep. 1974 9 p

(AD-785901) Avail: NTIS CSCL 01/3

This document sets forth the concept of operations of a full mission fighter simulator which provides visual and radar simulation for supplemental training in air-to-air, air-to-ground, formation/refueling and ECM/ECCM mission profiles.

Author (GRA)

N75-14842*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

IMPACT RESISTANCE OF COMPOSITE FAN BLADES Technical Report, Jul. 1972 - May 1974

Dec. 1974 142 p

(Contract NAS3-16777)

(NASA-CR-134707; R74AEG320) Avail: NTIS HC $5.75 CSCL 11D

Results are presented of a program to determine the impact resistance of composite fan blades subjected to foreign object damage (FOD) while operating under conditions simulating a short take-off and landing (STOL) engine at takeoff. The full-scale TF39 first-stage fan blade was chosen as the base design for the demonstration component since its configuration and operating tip speeds are similar to a typical STOL fan blade several composite configurations had already been designed and evaluated under previous programs. The first portion of the program was devoted toward fabricating and testing high impact resistant, aerodynamically acceptable composite blades which utilized only a single material system in any given blade. In order to increase the blade impact capability beyond this point, several mixed material (hybrid) designs were investigated using S-glass and Kevlar as well as boron and graphite fibers. These hybrid composite blades showed a marked improvement in resistance to bird impact over those blades made of a single composite material. The work conducted under this program has demonstrated substantial improvement in composite fan blades with respect to FOD resistance and has indicated that the hybrid design concept, which utilizes different types of fibers in various portions of a fan blade design depending on the particular requirements of

the different areas and the characteristics of the different fibers involved, shows a significant improvement over those designs utilizing only one material system. Author

N75-14916# National Materials Advisory Board, Washington, D.C.
AEROSPACE STRUCTURAL ADHESIVES Final Report
Jul. 1974 299 p refs
(Contract MDA903-74-C-0167)
(AD-787040; NMAB-300) Avail: NTIS CSCL 11C

A study has been made of problems associated with use of aerospace structural adhesives. Consideration is given to the state of the art and future needs in synthesis and formulation of adhesives. The role of interfaces is discussed from a physical chemical point of view. Manufacturing and processing aspects of adhesive use are considered. Data and theory are given for mechanical behavior, permanence, and related areas. Problems of design analysis, specification, and test methods are taken up. Performance, reliability, strategies, and future applications conclude this study. (Modified author abstract) GRA

N75-14919# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
AIRCRAFT TURBINE ENGINE FUEL CORROSION INHIBITORS AND THEIR EFFECTS ON FUEL PROPERTIES Final Technical Report
Charles R. Martel, Royce P. Bradley, James R. McCoy, and Joseph Petrarca Jul. 1974 42 p refs
(AF Proj. 3048)
(AD-787191; AFAPL-TR-74-20) Avail: NTIS CSCL 21/4

This report discusses the effects of corrosion inhibitors on the thermal stability, filterability, and lubricity of aircraft turbine engine fuels. (Modified author abstract) GRA

N75-14927# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM, SUMMARY Final Report, Apr. 1969 - Jul. 1973
Apr. 1973 153 p refs
(Contract DOT-FA69WA-2109)
(AD-783581; D6-60176; FAA-RD-73-57) Avail: NTIS HC $5.00 CSCL 17G

A summary description of an L-band multipath/ranging/digital data communication experimental program is given. Tests involved an FAA KC-135 jet airplane, the NASA ATS-5 satellite, the NASA/Rosman ground station, and the FAA NAFEC facility. All tests were conducted within the 1545- to 1655-MHz frequency band allocated for future aeronautical services. Tests included 30 overocean multipath and ranging flights in the North Altantic region, 16 digital data communication tests, eight overland multipath flights including both summer and winter conditions, six overocean multipath flights in the Pacific region, and nine fixed-link scintillation tests. Summary test results are presented and discussed relative to theoretical expectation. Author

N75-14928# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 1: EXPERIMENTAL PROGRAM-AIRCRAFT COMMUNICATIONS/SURVEILLANCE VIA SATELLITE AT L-BAND Final Report, 23 Apr. 1969 - 1 Jun. 1970
Apr. 1973 399 p refs
(Contract DOT-FA69WA-2109)
(AD-783582; D6-60177; FAA-RD-73-57-1) Avail: NTIS HC $8.50 CSCL 17G

A program definition study (phase 1) for an experimental flight test program intended to establish the capabilities and limitations of an L-band aeronautical satellite system has been completed. Three experiments are defined: aircraft position surveillance via satellite, voice and digital communications via satellite, and multipath propagation characterization. The test program was designed to use the NASA ATS-5 satellite, scheduled for launch in August 1969, and two FAA airplanes, a KC-135 and a DC-6B. Ground terminals were to be located at the NASA Mojave facility in California and at the FAA NAFEC facility near Altantic City, N.J. Descriptions of the aircraft experimental L-band antennas and functional requirements for the airborne and ground-based terminals are given. Due to failure of the ATS-5 satellite to achieve proper stabilization in orbit, the test program and hardware described herein were extensively revised prior to implementation and flight test as described in subsequent program phases. Author

N75-14929# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 2: TERMINAL DESIGN AND FLIGHT TEST PLAN FOR PHASE 1 PROGRAM. VOLUME 1: TERMINAL DESIGN Final Report, 1 Jul. 1969 - 1 Jun. 1970
Apr. 1973 108 p, refs
(Contract DOT-FA69WA-2109)
(AD-783583; D6-60178-1-Vol-1; FAA-RD-73-57-2-Vol-1)
Avail: NTIS HC $4.50 CSCL 17G

Airborne and ground station terminal designs for implementation of the phase I test plan are defined. Hardware configurations for the KC-135, DC-6B, and the NAFEC and Mojave ground terminals are described. Preliminary subsystem performance specifications, intended to form the basis for either in-house development or outside procurement, are given. Due to failure of the ATS-5 satellite to achieve proper stabilization in orbit, extensive program revisions occurred prior to the phase 4 flight test program. Only a few of the hardware items described herein were actually procured or fabricated, and the overall terminals were not implemented. Author

N75-14931# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 3: DEFINITION OF REVISED EXPERIMENT, TERMINAL DESIGN, AND SUBSYSTEM PERFORMANCE CHARACTERISTICS Final Report, 1 Jun. 1970 - 1 Mar. 1971
Apr. 1973 115 p refs
(Contract DOT-FA69WA-2109)
(AD-783584; D6-60179; FAA-RD-73-57-3) Avail: NTIS HC $4.50 CSCL 17G

A revised overocean multipath propagation and CW tone-ranging flight test experiment specifically designed to accommodate the ATS-5 spin is described. The test program will employ the 1540-to 1660-MHz frequency band and will involve an FAA KC-135 jet airplane, the spinning NASA ATS-5 satellite, and a ground station at the FAA NAFEC facility. Four experimental L-band antennas are designed for installation on the KC-135: a steerable quad helix, a crossed-dipole multipath array, and two low-gain slot dipoles. The ground station and airborne terminal hardware are defined. Detailed measured performance data are given for the antennas and major equipment subsystems. The field test program and analysis of the data acquired are accomplished under phases 4 and 5 of the contract. Author

N75-14933# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 4D: ADDITIONAL TESTS. VOLUME 1: SATELLITE/AIRCRAFT L-BAND DATA COMMUNICATION TESTS Final Report
Apr. 1973 130 p refs
(Contract DOT-FA69WA-2109)
(AD-783586; D6-60186-1-Vol-1; FAA-RD-73-57-4D-Vol-1)
Avail: NTIS HC $4.75 CSCL 17G

A digital data transmission experiment conducted between the NASA/Rosman ground station and an FAA KC-135 jet airplane a L-band via the geostationary NASA ATS-5 satellite is described. Sixteen tests were conducted during March and April 1973. All tests employed PSK transmission of alphanumeric text and pseudonoise sequences over the link to obtain a quantitative comparative evaluation of CPSK, DECPSK, and DPSK detection techniques. Significant results included performance characterization of the detection techniques for both the AWGN channel and the Rician fading channel in the presence of overocean

multipath. Reception of message using slot dipole antennas on the aircraft was also successfully demonstrated. Results are presented and discussed relative to theoretical expectation.
Author

N75-14934# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 4D: ADDITIONAL TESTS. VOLUME 2: OVERLAND MULTIPATH, PACIFIC MULTIPATH, SCINTILLATION TESTS Final Report
Apr. 1973 101 p refs
(Contract DOT-FA69WA-2109)
(AD-783652; D6-60186-2-Vol-2; FAA-RD-73-57-4D-Vol-2) Avail: NTIS HC $3.75 CSCL 17G

Experimental results at L-band are presented for eight overland multipath flights, six overocean multipath flights in the Pacific region, and a series of fixed-link scintillation measurements within the 1545- to 1655-MHz frequency band allocated for future aeronautical satellite services. Test signals were transmitted from the NASA/Rosman ground station to an FAA KC-135 jet airplane via the NASA ATS-5 satellite. Overland multipath data were acquired at elevation angles between 14 deg and 19 deg over marshy, hilly, and mountainous terrain in northern Canada and Alaska for both summer and winter conditions. These data together with the Pacific region overocean multipath data were analyzed to determine scatter reflection coefficients, circular polarization sense reversal characteristics, and power spectral density. Scintillation test data were analyzed to determine signal time histories, amplitude histograms, S2 scintillation parameter, statistical fade depths, and power spectra. Author

N75-14935# Boeing Commercial Airplane Co., Seattle, Wash.
ATS-5 MULTIPATH/RANGING/DIGITAL DATA L-BAND EXPERIMENTAL PROGRAM. PHASE 5: MULTIPATH/RANGING ANALYSIS AND RESULTS Final Report, 1 Jun. - 30 Sep. 1972
Apr. 1973 242 p refs
(Contract DOT-FA69WA-2109)
(AD-783588; D6-60181; FAA-RD-73-57-5) Avail: NTIS HC $6.00 CSCL 17B

Experimental results are presented for 30 multipath and ranging test flights involving an FAA KC-135 jet airplane, the NASA ATS-5 satellite, the NASA/Rosman ground station, and the FAA NAFEC facility. Tests included overocean multipath measurements and one-way tone ranging between the ground station and airplane via the satellite. Data were acquired over the North Atlantic at satellite elevation angles between 9 deg and 31 deg, within the 1545 to 1655 MHz frequency band allocated for future aeronautical satellite services. Significant multipath experiment results include determination of the multipath signal amplitude statistics, power spectral density, polarization properties, and selective fading characteristics. Multipath results are correlated with theoretical predictions based on use of the physical optics scatter model. Ranging experiment results include performance confirmation of a narrow-band CW tone ranging technique, characterization of the effect of multipath on ranging accuracy, and concept demonstration using low-gain slot dipole aircraft antennas. Comparison of experimental ranging results with theoretical predictions is given. Author

N75-15024# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
ENGINE FAILURE PREDICTION (ION) PROBE PROGRAM Final Technical Report, Feb. 1971 - May 1974
Richard L. Hall and Wayne M. Shaffernocker Jun. 1974 50 p refs
(Contract F33615-73-C-2048)
(AD-786889/6; AFAPL-TR-74-46) Avail: NTIS HC $3.75 CSCL 21/5

The program reported herein was directed toward the evaluation of the electrical ion probe developed by the Air Force Flight Dynamics Laboratory. Extensive testing was conducted in an effort to determine the potential utility of the ion probe system. Detailed descriptions of the testing performed and the resulting conclusions are provided. Author (GRA)

N75-15095# Cranfield Inst. of Technology (England). Dept. of Aircraft Design.
OPTIMUM DESIGN OF THIN WALLED STRUCTURES Final Report, 1 Jun. 1972 - 31 May 1973
D. M. Richards and A. Rothwell 9 Sep. 1974 6 p refs
(Grant AF-AFOSR-2390-72; AF Proj. 9767)
(AD-787223; CODP-11; EOARD-TR-75-9) Avail: NTIS CSCL 01/3

The research program relating to the optimum design of thin walled structures is a broadly based effort which reflects the continuing interest of the Aircraft Design Division in fundamental aspects of the analysis and design of highly efficient structures for aero-space applications. Topics briefly discussed include the following: Post-buckled design, design of shear webs; foam stabilized plates; compression panel design including plasticity effects. GRA

N75-15157*# United Air Lines, Inc., San Francisco, Calif.
FUEL CONSERVATION CAPABILITY AND EFFORT BY COMMERCIAL AIR CARRIERS
May 1974 19 p
(Contract NAS2-7208)
(NASA-CR-137624) Avail: NTIS HC $3.25 CSCL 10B

Computer capability weather input data, performance data, and ATC interface are discussed in terms of their role in preflight and inflight planning for commercial flights. The effect of preflight and inflight planning on fuel efficient operation was evaluated along with the impact of avionics. It was found that there is a potential fotr saving fuel through use of avionics, especially in the area of vertical guidance in all phases of flight. Other results of the study indicate: (1) preflight planning as it now stands is adequate with the exception that more accurate and up-to-date weather information is desirable; (2) better inflight information about existing weather conditions is needed; and (3) ATC can aid in fuel conservation. M.J.S.

N75-15399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF NOISE PRODUCED BY JET IMPINGEMENT NEAR THE TRAILING EDGE OF A FLAT AND A CURVED PLATE
Daniel J. McKinzie, Jr. and Robert J. Burns Washington Jan. 1975 32 p refs
(NASA-TM-X-3171; E-8080) Avail: NTIS HC $3.75 CSCL 20A

The sound fields produced by the interaction of a subsonic cold gas jet with the trailing edge of a large flat plate and a curved plate were analyzed. The analyses were performed to obtain a better understanding of the dominant noise source and the mechanism governing the peak sound-pressure-level frequencies of the broadband spectra. An analytical expression incorporating an available theory and experimental data predicts sound field data over an arc of approximately 105 deg measured from the upstream jet axis for the two independent sets of data. The dominant noise as detected on the impingement side of either plate results from the jet impact (eighth power of the velocity dependence) rather than a trailing-edge disturbance (fifth or sixth power of the velocity dependence). Also, the frequency of the peak SPL may be governed by a phenomenon which produces periodic formation and shedding of ring vortices from the nozzle lip. Author

N75-15499# Office of the Chief of Research and Development (Army), Washington, D.C.
PROCEEDINGS OF THE 1974 ARMY SCIENCE CONFERENCE. VOLUME 1: PRINCIPAL AUTHORS A THROUGH H
26 Aug. 1974 475 p refs Presented at the 1974 Army Sci. Conf., West Point, N. Y., 18-21 Jun. 1974
(AD-785600) Avail: NTIS CSCL 05/2

This is Volume I of the 1974 Army Science Conference Proceedings. This volume contains the unclassified papers by principal authors A thru H which were presented at the conference, 18-21 June 1974, U.S. Military Academy, West Point, New York. GRA

N75-15597# Air Force Human Resources Lab., Brooks AFB, Tex.

THE VALUE OF AN AIR COMBAT MANEUVERING RANGE TO THE TACTICAL AIR COMMAND

Joe A. Fitzgerald Jun. 1974 9 p

(AF Proj. 1123)

(AD-786850; AFHRL-TR-74-52) Avail: NTIS CSCL 14/2

The author takes the position that the Tactical Air Command needs an instrumented range for training in air-to-air combat-Air Combat Maneuvering Range (ACMR) as early as possible, and makes a case for a coordinated plan of utilization for the Simulator for Air-to-Air Combat (SAAC) and an ACMR. It is asserted that the complimentary capabilities of the two systems can make important contributions to tactical fighter training, tactics development, and simulator development. Author (GRA)

N75-15598# RAND Corp., Santa Monica, Calif.

PROBE 1: A DIFFERENTIAL EQUATION MODEL FOR COMPARING FIGHTER ESCORT AND AIRBASE ATTACK SYSTEMS IN A COUNTER-AIR OPERATION

F. A. Tatum and L. N. Rowell Jul. 1974 135 p refs

(Contract F44620-73-C-0011)

(AD-786023; R-1413-PR) Avail: NTIS CSCL 15/7

PROBE I models an attack air force versus an interceptor defense in a conflict extending over as many as thirty missions. For any mission, the attack sorties may be allocated to any combination of (1) aircraft with bombs only, assigned to prime targets, (2) similar aircraft targeting hostile interceptor bases, or (3) aircraft with only air-combat weapons that defend the bombers. The model shows the results of one or a series of missions in which the experimenter specifies the allocations; alternatively, it can determine, mission-by-mission, the allocations that (with the total number of missions specified) will maximize a given objective, such as total bomb tonnage reaching prime targets. The heart of the model is a set of differential equations that represent the rates at which aircraft change from one state to another, e.g., loaded to unloaded -- engaged to disengaged, etc. PROBE I is programmed for the IBM 370/158. Author (GRA)

N75-15599# Kaman Avidyne, Burlington, Mass.

EVALUATION OF BACK-BLAST PRESSURES PRODUCED BY A WING-MOUNTED 105-mm RECOILLESS RIFLE Final Report, Oct. 1972 - Jul. 1973

William N. Lee, Robert Similey, J. Ray Reutenik, and Norman P. Hobbs Jul. 1974 71 p refs

(Contract DAAF07-73-C-0163; DA Proj. 1F1-63206-D-050)

(AD-786528; KA-TR-97; WVT-CR-74023) Avail: NTIS CSCL 19/6

Results are presented from an analytical study to develop means of reducing the back-blast pressures produced on the tail boom of an AH-1G helicopter by the firing of a 105-mm wing-mounted recoilless rifle. Computer codes were developed for predicting the back-blast fields and are partially substantiated by comparisons of calculated pressures with results from recent Picatinny firing tests. The desirability of reducing back-blast pressures through use of a multiple nozzle and by varying the firing chamber pressure profile is explored. It is found that the blast-field pressures can be reduced significantly by decreasing the average chamber pressure during the first 4 milliseconds after diaphragm burst. Author (GRA)

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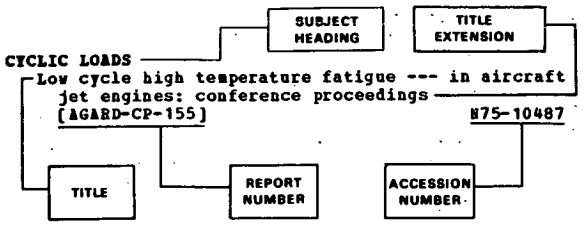

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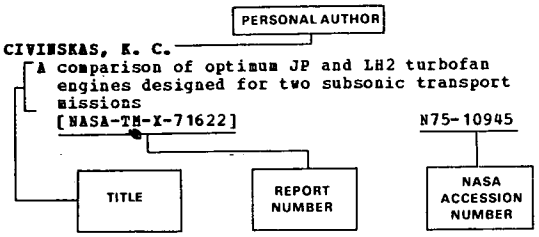

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