AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 11

NOVEMBER 1971

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PREVIOUS BIBLIOGRAPHIES IN THIS SERIES

Document	*Date*	*Coverage*
NASA SP-7037	September 1970	Jan.–Aug. 1970
NASA SP-7037 (01)	January 1971	Sept.–Dec. 1970
NASA SP-7037 (02)	February 1971	January 1971
NASA SP-7037 (03)	March 1971	February 1971
NASA SP-7037 (04)	April 1971	March 1971
NASA SP-7037 (05)	May 1971	April 1971
NASA SP-7037 (06)	June 1971	May 1971
NASA SP-7037 (07)	July 1971	June 1971
NASA SP-7037 (08)	August 1971	July 1971
NASA SP-7037 (09)	September 1971	August 1971
NASA SP-7037 (10)	October 1971	September 1971

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget June 23, 1971.

NASA SP-7037 (11)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 11

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 October 1971 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.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 375 reports, journal articles, and other documents originally announced in October 1971 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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 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 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. An annual cumulative index will be published.

AVAILABILITY OF CITED PUBLICATIONS

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies are available at $5.00 per document up to a maximum of 20 pages. The charge for each additional page is 25 cents. Microfiche[1] are available at the rate of $1.00 per microfiche for documents identified by the # symbol following the accession number. A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library. Minimum airmail postage to foreign countries is $1.00. Please refer to the accession number, e.g., A71-10613, when requesting publications.

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TABLE OF CONTENTS

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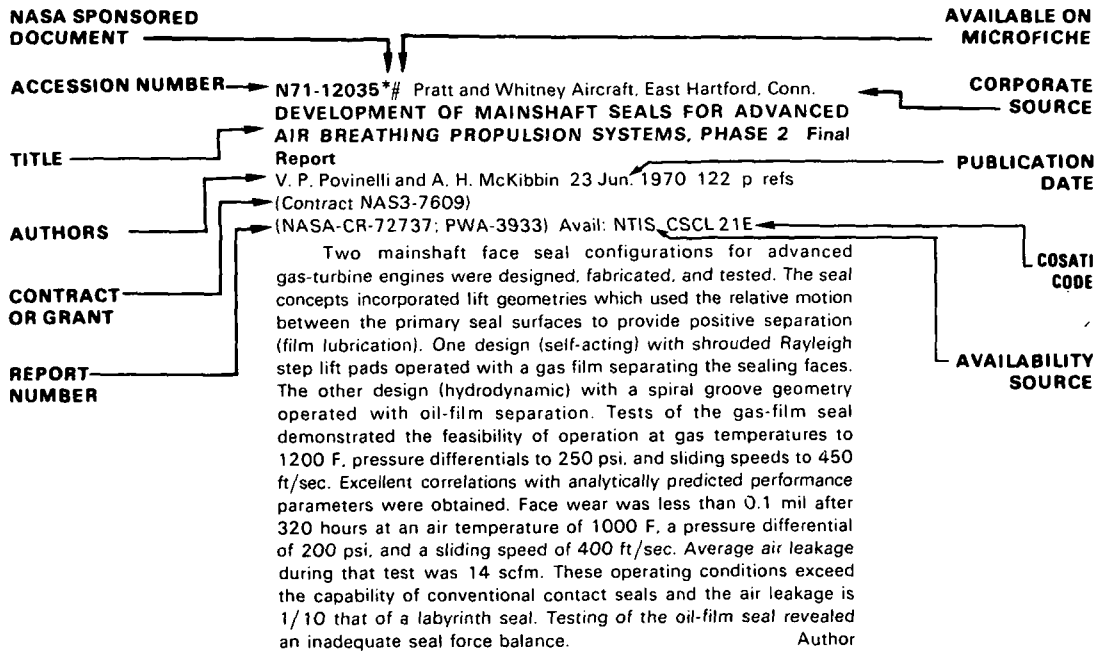

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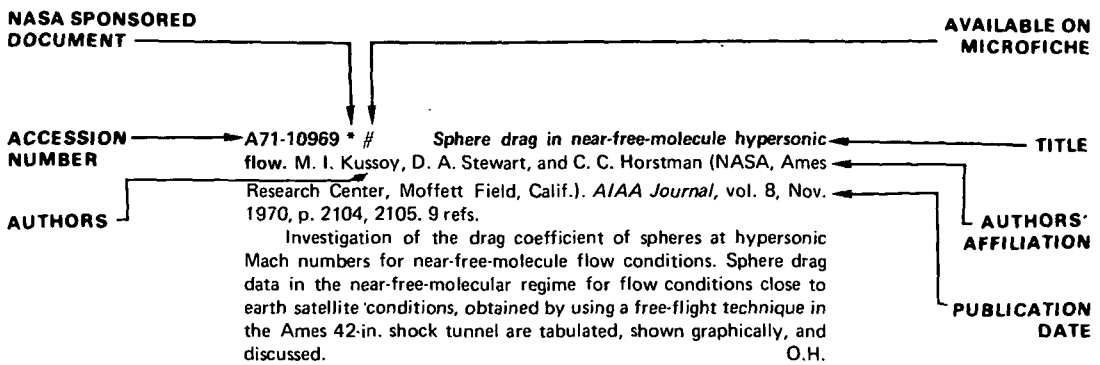


AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 11) NOVEMBER 1971

IAA ENTRIES

A71-37094 # **Optimization of the behavior of distributed systems with random properties (Optimizatsiia povedeniia raspredelennykh sistem so sluchainymi svoistvami).** N. N. Golub'. *Prikladnaia Matematika i Mekhanika,* vol. 35, May-June 1971, p. 393-405. 10 refs. In Russian.

Consideration of two problems involving the construction of a time-optimal control for distributed systems with random properties. In the first problem the distributed system is described by a set of n integral relations in the presence of a constraint imposed on the control norm in L sub 2 space. In the second problem a study is made of the construction of a time-optimal control for angular motions and torsional vibrations of an idealized model of an elastic flight vehicle of 'flying wing' type. In the case where this model is flying in a homogeneous turbulent atmosphere an inequality type constraint is imposed on the energy required to produce the control action. A.B.K.

A71-37123 * # **Prospects for actively cooled hypersonic transports.** John V. Becker (NASA, Langley Research Center, Hypersonic Vehicles Div., Hampton, Va.). *Astronautics and Aeronautics,* vol. 9, Aug. 1971, p. 32-39.

Disadvantages of a hot wing structure for hypersonic transports are pointed out. In principle, an exposed conventional alloy structure cooled to normal working temperatures would avoid all the problems of the hot structure. This approach had been rejected in connection with the design of reentry vehicles. However, the situation is different for the hypersonic aircraft. The heat load is an order of magnitude lower. In addition the liquid hydrogen fuel of the aircraft can be used as fuel. Various designs for actively cooling the transport are discussed. G.R.

A71-37124 # **Thinking 'hypersonic.'** Rene H. Miller (MIT, Cambridge, Mass.). *Astronautics and Aeronautics,* vol. 9, Aug. 1971, p. 40-44. 11 refs.

The discussion is partly based upon the study of a useful and detailed optimization of a two-stage reusable airbreathing launch vehicle with stage separation at Mach 10 conducted by Gregory et al. (1970). An aircraft capable of flying to any point on the globe within an hour and a half at a cost comparable to that of existing aircraft is envisaged as a result of the analysis conducted. Missions for disposing of nuclear wastes by dumping them into the sun at a cost of less than 5% of the usage value of the electricity obtained from the material are considered. It is pointed out that the hypersonic transport will alleviate many of the problems delaying ready acceptance of the SSTs today. G.R.

A71-37152 * # **Unified error analysis of terrestrial inertial navigation systems.** Kenneth R. Britting (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-901.* 20 p. 14 refs. Members, $1.50; nonmembers, $2.00. U.S. Department of Transportation Contract No. TSC-143; Grant No. NGR-22-009-229.

Demonstration of the development possibility of a unified error analysis applicable to a very broad class of altimeter-aided inertial navigation systems. In particular, it is shown that error equations for virtually all terrestrial inertial navigation systems can be written in one concise expression. The unified theory is applied to obtain the error equations for space-stabilized, local level, free azimuth, rotating azimuth, and strapdown configurations. M.V.E.

A71-37155 # **Flight evaluations of steep approach landings to reduce pilot's workload.** James A. Burke (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.) and Howard L. Chevalier (Texas A & M University, College Station, Tex.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-904.* 7 p. 6 refs. Members, $1.50; nonmembers, $2.00. Army-sponsored research.

A flight research program was conducted to determine the effects of increased landing approach angles on the handling characteristics of a typical light single engine aircraft using various visual approach angles. The paper discusses the significant factors which contributed to workload variations. It was found that the lateral control stick motions was the largest single contributor of pilot workload for approach angles above five degrees. Specific design changes which could reduce the increased workload associated with a steep approach are presented. These include a wing leveling device, use of direct lift, and a control stick trim. (Author)

A71-37156 * # **Flight investigation of the influence of turbulence on longitudinal flying qualities.** James A. Franklin (Princeton University, Princeton, N.J.; NASA, Ames Research Center, Flight and Systems Research Branch, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-905.* 11 p. 10 refs. Members, $1.50; nonmembers, $2.00. NASA-supported research; Contract No. N 00019-70-C-0156.

Flight evaluations using a variable stability airplane were made to determine the independent and interacting effects of turbulence disturbances and longitudinal dynamics on flying qualities for the ILS approach task. Turbulence was described in terms of the rms magnitudes of pitch and heave disturbances and the bandwidth of the turbulence power spectrum. Variations in dynamics included the frequency and damping of the short-period mode and the slope of the lift curve. Trends in pilot rating obtained in the test program with variations in turbulence disturbances and airplane dynamics are explained in terms of measures of precision of task performance and the pilot's control workload derived from time histories of the ILS approach. (Author)

A71-37157 # **Direct lift control for improved automatic landing safety and performance for a large transport aircraft.** L. O. Lykken and N. Shah (Lear Siegler, Inc., Santa Monica, Calif.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-906.* 16 p. Members, $1.50; nonmembers, $2.00.

Direct lift control (DLC) has been integrated into the L-1011 All Weather Landing System design to enhance the performance and safety capabilities of this Category III aircraft. The merits of the improved aircraft behavior achieved with DLC not only provide a higher degree of performance capability for a large vehicle of this nature, but are also firmly reflected in many subtle areas relating to the design, safety margin, and reliability of a complex, fail operational all weather landing system. The result in terms of influence on autoland system design to problems and limitations that constrained the design, and resulting improvements in performance and safety characteristics are the subject of this paper. (Author)

A71-37158 # **A method for predicting the static directional aerodynamic characteristics of typical air cushion vehicle configurations through 180 degrees of sideslip.** Eugene N. Brooks, Jr. and Walter Zeitfuss, Jr. (U.S. Naval Material Command, Ship Research and Development Center, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-907.* 10 p. Members, $1.50; nonmembers, $2.00.

The method consisted in first analyzing the vehicle in ground effect with no cushion efflux, and in accounting for the vehicle geometry effects. The second step was to add in the cushion efflux effects on the external aerodynamics. The aerodynamic characteristics investigated include only external aerodynamic forces and moments, and do not include the forces and moments produced by the cushion itself. The method is applicable for vehicle airspeeds up through 120 knots and accounts for such geometrical changes as bow contour, aft-end contour, superstructure geometry, and length-to-beam ratio. The method is programmed for a digital computer and requires only the vehicle geometry characteristics and velocity as inputs. The prediction is based on linear and nonlinear variations from the aerodynamic characteristics of a basic configuration. Comparisons of the prediction method with experimental data are presented to demonstrate the accuracy of the method. M.M.

A71-37159 # **Forward speed effects on peripheral-jet ground support systems.** George C. Cooke (Bell Aerospace Co., Buffalo, N.Y.) and Robert E. Duffy (Rensselaer Polytechnic Institute, Troy, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-908.* 19 p. 18 refs. Members, $1.50; nonmembers, $2.00. U.S. Department of Transportation Contract No. C-117-66.

Description of a theory for the effect of forward speed on a two-dimensional peripheral-jet ground effect support. New analytical models are proposed for the flow at the nozzle exit of the peripheral jets and the cross flow underneath the support. The analysis is carried to the point of determining upper and lower-surface pressure distributions as well as lift and ideal pumping power. The theory is supported by the results of a comprehensive experimental study made with a two-dimensional model in a moving-ground wind tunnel. The model was externally fed and had a flat bottom. At low subcritical speeds the effect of forward speed was found to be adverse in the absence of upper-surface lift. At critical speeds the theory predicted the freestream dynamic pressure to be less than the average cushion pressure for this model. At high subcritical speeds performance improved such that lift-power requirements at critical speeds were 20-30% below those at hover. Throughout the subcritical speed regime there was general agreement between theory and experiment. M.M.

A71-37163 * # **Three-dimensional, minimum-fuel turns for a supersonic aircraft.** J. K. Hedrick and A. E. Bryson, Jr. (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-913.* 9 p. 9 refs. Members, $1.50; nonmembers, $2.00. Grant No. NGL-05-020-007.

Using the energy-state approximation, turns are calculated for a particular aircraft where the initial energy, the change in heading angle, and the final energy are specified. Angle-of-attack and thrust are constrained. In general, the optimum turns are composed of variable altitude, variable bank angle programs, which use either maximum thrust or zero thrust. There are three types of minimum fuel turns: (1) powered accelerating turns, (2) coasting decelerating turns, and (3) combinations of powered-coast or coast-powered arcs. Numerical results are presented for (1) coasting turns, (2) climbing turns from take-off, and (3) general three-dimensional turns. (Author)

A71-37166 # **A nonlinear guidance scheme for intercept mission.** Robert F. Webber and Giovanni Bonfanti (Martin Marietta Corp., Orlando, Fla.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-916.* 9 p. Members, $1.50; nonmembers, $2.00.

A guidance law has been devised to reduce the airborne computational load associated with forward prediction (by numerical integration) of the state vectors of both interceptor and target. The scheme provides a solution for the guidance command in essentially closed form and considers the nonlinear effects of maneuver-induced drag on the interceptor. The maneuver histories derived are optimal in nature, in the sense that they maximize the interceptor velocity at the time of intercept, thus minimizing the energy loss due to drag. Results are presented that compare the derived guidance law with a sophisticated predictive law. (Author)

A71-37172 # **On the application of modern estimation techniques to air traffic control.** Balraj G. Sokkappa (Mitre Corp., Atlantic City, N.J.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-926.* 6 p. 12 refs. Members, $1.50; nonmembers, $2.00.

The application of automatic estimation techniques to track aircraft in real time has its genesis in the development of Air Defense Systems. With the increasing urgency of automation of the control of regular air traffic, the advancement of analytical estimation techniques and the improvements in the speed and capacity of digital computers, increased attention is being paid to the application of sophisticated estimation techniques to track air traffic. However,

considering the current requirements on the En Route Air Traffic Control (ATC) Systems the success of these techniques has not been outstanding enough to replace the present simple algorithm. While much attention has been devoted in recent literature to the accuracy attainable with these techniques, very little appears to have been achieved in the area of positive identification in a congested traffic environment. Correct identification is an aspect equally, if not more, important as accuracy in the design of ATC System. The effectiveness of modern estimation techniques from the point of view of computing time and storage as well as accuracy and correct identification in ATC environment is herein discussed. (Author)

A71-37173 # **The computation of position errors for air traffic control surveillance models.** D. E. Stepner and J. S. Tyler, Jr. (Systems Control, Inc., Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-927.* 11 p. 13 refs. Members, $1.50; nonmembers, $2.00.

This paper considers the development of a mathematical model for specifying parameters of a surveillance system in accordance with accepted standards of collision risk. The overall objective of a surveillance system is to increase the efficiency and capacity of the ATC system without compromising the risk of collision. The key parameter for specifying collision risk is the probability of overlap in a given direction (lateral, longitudinal, vertical). The mathematical procedure presented here relates probability of overlap to the surveillance system parameters (fix rate, alarm threshold, lane separation) by modeling the time dependent behavior of an aircraft under the influence of a surveillance system. (Author)

A71-37174 * # **Improved navigation by combining VOR/DME information and air data.** A. E. Bryson, Jr. (Stanford University, Stanford, Calif.) and J. C. Bobick. *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-928.* 10 p. 14 refs. Members, $1.50; nonmembers, $2.00. Grant No. NGR-05-020-431.

Combining VOR/DME information (from one or two stations) and air data (airspeed and heading) by means of a maximum likelihood filter is shown to result in substantial improvements in navigational accuracy. In some cases, RMS position errors are only 5% of those obtained when using a single VOR/DME (current practice). Much of this reduction results from estimating the bias errors associated with the VOR/DME system. The use of this filter, implemented by a small airborne computer, results in sufficient accuracy for area navigation - i.e., navigation using flight paths that do not overfly VOR stations. (Author)

A71-37175 # **An airborne traffic situation display system.** R. W. Bush, H. Blatt, and F. X. Brady (MIT, Lexington, Mass.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-929.* 7 p. Members, $1.50; nonmembers, $2.00. USAF-sponsored research.

An airborne traffic situation display system which could be used as an adjunct to the evolving National Airspace/Automatic Radar Control Terminal System (NAS/ARTS) is described. In the proposed system, a contemporary realization of an old concept, the NAS/ARTS data are broadcast. A small digital computer in an aircraft then selects from the message stream data on its own aircraft, nearby aircraft, and a local map. These data plus aircraft heading data from a directional gyro are used to generate a situation display which can be aircraft centered and heading oriented. (Author)

A71-37196 * # **Analytic design of digital flight controllers to realize aircraft flying quality specifications.** Raymond C. Montgomery (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-955.* 15 p. Members, $1.50; nonmembers, $2.00.

Description of a method for the design of discrete-time digital control systems for aircraft that will result in closed-loop aircraft response characteristics that approximate, to any prescribed degree of precision, arbitrarily prescribed flying quality specifications. This is accomplished using a two-step design process. First, a continuous-time control system is designed, using the techniques described by Montgomery and Hatch (1969), to provide a model of aircraft responses that meet the prescribed flying quality specifications. Then, a digital flight control system is designed, using optimal control theory, so that the responses of the digitally controlled aircraft follow, as closely as possible, those of the model. M.M.

A71-37197 # **Design of desirable airplane handling qualities via optimal control.** Gerhard K. L. Kriechbaum and Russell W. Stineman (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-956.* 8 p. 17 refs. Members, $1.50; nonmembers, $2.00.

The technique known as implicit model following allows desired closed-loop characteristics of a system to be included in an optimal control algorithm. Previous authors have used a model of the form x = Lx, where x is the state vector. The optimal control algorithm then computes the feedback which makes the system response optimally close to the model. This paper extends this approach to include all desired handling qualities by using the model x = Lx + N delta, where delta is the vector of pilot commands. The algorithm which is derived computes both optimal feedback and optimal feedforward from delta to the controls. Algorithms are given for both sampled-data and continuous control. General guidelines for choosing L and N are presented. An example is given of the design of the landing approach control for a short takeoff and landing (STOL) airplane. (Author)

A71-37198 # **Performance limitation of a simplified radio-inertial lateral control system for automatic landing.** Duncan MacKinnon and Paul Madden (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-957.* 12 p. 6 refs. Members, $1.50; nonmembers, $2.00. U.S. Department of Transportation Contract No. TSC-91.

Exploitation of parameter optimization methodology to explore performance limitations of a set of simplified radio-inertial lateral path guidance systems subject to stochastic gusts, radio measurement noise, and a constraint on rms control surface activity. Minimum Hardware Modification (MHM) inertial radio couplers are described which achieved rms gust and measurement-induced path errors of less than 50 ft, compared to an approximately 100-ft rms error for the conventional Autoland radio-coupler design in 10 ft/sec rms turbulence. In addition, the reference MHM designs displayed superior transient response characteristics. Optimization of the designs resulted in system configurations which displayed rms lateral position errors 2 to 5 times smaller than those of the reference MHM configurations. An MHM design which utilizes inertial position as well as inertial velocity appears to provide the best combination of transient response characteristics and stochastic performance. F.R.L.

A71-37199 # **Principles of performance monitoring, with application to automatic landing.** J. M. Smith, P. B. Schoonmaker, E.

E. Pyron, and R. L. Benbow (McDonnell Douglas Astronautics Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-958.* 13 p. 18 refs. Members, $1.50; nonmembers, $2.00.

Application of a new development in the field of control systems, the Performance Monitor, to aircraft automatic landing systems. In this application performance monitoring will provide levels of safety and economy of utilization beyond the level possible by the traditional means of redundancy and internal monitoring alone. Attention is given to the principles of autoland performance monitoring from basic mathematics through design and testing. Hypothetical numerical examples are provided to clarify the concepts presented. F.R.L.

A71-37200 # **Payoffs and problems of fly-by-wire control systems.** Edward A. Bumby (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-959.* 8 p. Members, $1.50; nonmembers, $2.00.

Discussion of the weight reduction possible for high-performance aircraft by using an electronic or fly-by-wire (FBW) flight control system, together with the control configured vehicle concept. The weight reduction due to incorporation of a FBW system and the control configured vehicle design leads to the fuel-structure weight reduction cycle. An FBW system requires quadruple-redundant mechanization in order to achieve two-failure survivability. However, before FBW is applied to an aircraft, there are several problems which require extensive investigation. Mechanization of a quadruple-redundant system and its interface with a single control surface presents the major problem. The various techniques developed to deal with this problem are discussed, and a preferred configuration is indicated. Examples of signal selection and failure monitoring circuits are discussed. It is pointed out that FBW enhances the neutral vehicle stability design due to the inherent SAS (stability augmentation system) function of the FBW flight control system. M.M.

A71-37201 # **Sight line autopilot - A new concept in air weapons.** Bradford W. Parkinson, Leonard R. Kruczynski, and Michael W. Wynne (U.S. Air Force Academy, Colorado Springs, Colo.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-960.* 11 p. 5 refs. Members, $1.50; nonmembers, $2.00.

Description of SLAP (sight line autopilot), which was designed to greatly improve the accuracy of a pilot's pointing of his side-firing aircraft. The design accounts for the linearized motions of the sight line as seen in the pilot's reference frame and adjoins these to the aircraft attitude states and two oscillating wind states. Using optimal regulator theory, the control gains are generated. Using these gains, extensive simulations were run to validate the controller. Winds and sensor noise were included. The results show that the concept of a SLAP will significantly improve the capability of the side-firing weapons system. M.M.

A71-37202 # **The theory and flight verification of the model-following control system for the Air Force Total In-Flight Simulator.** P. Motyka, E. Rynaski, and P. Reynolds (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Mechanics Conference, Hofstra University, Hempstead, N.Y., Aug. 16-18, 1971, Paper 71-961.* 9 p. Members, $1.50; nonmembers, $2.00. Contract No. AF 33(615)-67-C-1157.

The content of this paper describes the theoretical development and flight test results of the model-following control system of the Air Force Total In-Flight Simulator (TIFS). A discussion of the conceptual design and detailed development of the system configuration is given. The manner in which the feedforward, gust compensator and lateral-directional feedback gains are obtained is developed. The feedforward and gust compensator gains are obtained by simple matrix algebra calculations. A sensitivity minimization approach using modern control theory is used to obtain the lateral-directional feedback gains. Digital simulation results are included to show the improvement in model-following achieved with the feedback gains determined by this approach. Time histories of the model and TIFS responses from flight test are also included to show the quality of model-following obtained with the system for both the lateral-directional and longitudinal modes of operation. These results verify the theory and design procedure used to obtain the TIFS model-following control system. (Author)

A71-37273 **The development of European air tourism (Die Entwicklung des europäischen Flugtourismus).** Wolfgang Sauer (Deutsche Airbus GmbH, Munich, West Germany). *Flug Revue/Flugwelt International,* Aug. 1971, p. 31-34, 39. In German.

It is tried to forecast the extent and the characteristics of the European air traffic employed in the transportation of tourists for the present decade. Particular attention in the analysis is given to the number of foreign air charter inclusive tours in relation to the population density. Flows of European nonscheduled inclusive tour traffic for 1970 are shown together with the situation expected for 1980. Various aircraft types available for the tourist traffic are discussed, giving attention also to the European Airbus A-300 B 'Super-Twin.' G.R.

A71-37290 # **Prediction of interference loading on aircraft stores at supersonic speeds.** F. Dan Fernandes (General Dynamics Corp., Pomona, Calif.). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 633-636. 10 refs.

A method for theoretically predicting forces and moments on aircraft stores in supersonic flow is investigated. Linear theory is used to predict the flowfield due to a jet fighter-bomber type aircraft, representing aircraft wing, nose, pylons, and inlets. The interference loading is integrated over the store length by considering crossflow effects and buoyancy effects. The method is computerized. Theoretical pitching and yawing moment calculations for a store under an F-4C aircraft at Mach 1.2 are compared with wind-tunnel data. The results show reasonably good agreement, with the exception that finite shock effects shift the experimental data axially forward of the linear theory prediction. (Author)

A71-37291 # **Effect of air injection into the core of a trailing vortex.** E. D. Poppleton (Sydney, University, Sydney, Australia). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 672, 673. 8 refs. Research supported by the Australian Department of Civil Aviation and McGill University; Defence Research Board of Canada Grant No. 9551-12.

Some results of preliminary investigations of the possibility that, if air is injected along the axis in the early stages of formation of a trailing vortex, its subsequent behavior may be modified by changing conditions in the nascent core. All the results group fairly well about the line given by the equation proposed by Owen (1970) for the maximum circumferential velocity in a turbulent vortex which has reached an equilibrium structure, although there is considerable scatter. The four results of the tests with no jet flow exhibit a very low rate of decay and, taken by themselves, would indicate a very different behavior from that of the proposed equation. However, they group about the line, well within the scatter of other measurements. M.M.

A71-37293 # **Parachute critical opening velocity.** Kenneth E. French (Lockheed Missiles and Space Co., Sunnyvale, Calif.). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 675, 676.

A rudimentary analysis is used to obtain dimensionless products associated with scale factor effects of a parachute critical opening velocity, or squidding velocity. The only experimental data which appear available to check the validity of the analysis are tabulated. The data shown are reasonably well correlated. However, whether the correlation is real or merely fortuitous remains open to question, since the two sets of tabulated data do not meet the constraint of geometrical similarity. The data are presented in the hope of stimulating further research and experimentation on parachute critical opening velocity. M.M.

A71-37294 # **Coriolis coupled bending vibrations of hingeless helicopter rotor blades.** Maurice I. Young (Delaware, University, Newark, Del.). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 676, 677. 6 refs. Grant No. DA-ARO(D)-31-12471-G112.

Demonstration of the potential importance of Coriolis coupling by a sample calculation performed for a typical fundamental uncoupled out-of-plane frequency ratio and an uncoupled in-plane frequency ratio which is typical of a helicopter designed with in-plane flexural rigidity close to that for out-of-plane bending. It is pointed out that the relatively small numerical differences between the coupled and uncoupled frequencies in the sample calculation can be significant in the flying qualities and ground resonance stability of the helicopter. Perhaps equally important in the case considered is that the out-of-plane component caused by Coriolis coupling contributes some aerodynamic coupling which should be included in the ground resonance analysis of hingeless rotor helicopters. M.M.

A71-37296 # **A nonvarying-C* control scheme for aircraft.** Edward R. Rang (Honeywell, Inc., Hopkins, Minn.; U.S. Naval Postgraduate School, Monterey, Calif.). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 679, 680. 7 refs.

This scheme for accommodating an automatic flight control system to the wide variations in dynamic characteristics of the airframe provides a response that is uniform for all flight conditions without using measurements of dynamic pressure, altitude or angle of attack. The modification is based on the observation that the equation for handling qualities C^* criterion is very similar to a basic short-period equation for the motion of the aircraft. A modest feedback and feedforward with variable gains holds the coefficients of this equation fixed. The C^* requirement may be met by choosing these coefficients to be the same as demanded by the criterion or by adding a fixed outer loop. M.M.

A71-37297 # **Comment on 'Spanwise distribution of induced drag in subsonic flow by the vortex lattice method.'** G. J. Hancock (Queen Mary College, London, England). *Journal of Aircraft,* vol. 8, Aug. 1971, p. 681; Author's Reply, p. 681, 682.

The overall philosophy of approach is critically reviewed. It is noted that the authors, in their approximate technique, bypassed without comment the point that, although the vortex lattice method leads to a finite lift, strictly it implies an infinite induced drag, because the induced drag of each single horseshoe vortex line is itself infinite. There is no explanation of the manner in which the authors calculated the induced drag. It is pointed out that the method outlined by the authors would give completely the wrong answer; to start with, even the sign would be wrong. M.M.

A71-37314 # **Analysis of some aspects of aeronautical communications via satellite (Analisi di alguni aspetti delle comunicazioni aeronautiche via satellite).** Giuliano Rossi (CNR, Centro Ricerche Aerospaziali, Rome, Italy). In: Prospects in the next decade for the use of orbiting stations and space shuttles; Technical and Scientific International Space Convention, 11th, Rome, Italy, April 1-3, 1971, Proceedings (Prospettive nel prossimo decennio per la utilizzazione delle stazioni orbitali e delle navette spaziali; Convegno Internazionale Tecnico-Scientifico sullo Spazio, 11th, Rome, Italy, April 1-3, 1971, Atti). Convention sponsored by the Ministero degli Affari Esteri and the Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare e Teleradiocinematografica, 1971, p. 227, 229-235. 12 refs. In Italian.

Survey of the more critical aspects of connections between aircraft and ground stations via satellite, and definition of a possible configuration of a communications system. Criteria for the selection of the transmission frequency, the effects of ionosphere on propagation, attenuation in the free space, antenna polarization, aircraft on-board antenna, and satellite antenna are discussed. The system considered calls for a transponder with the capacity of 3 telephone channels which should be adequate to handle aeronautical traffic over Atlantic routes, for instance. The use of frequencies in the uhf band seems to be advisable. The three channels can be used for the transmission of sound as well as digital data. M.M.

A71-37344 **Radionavigation (La radionavigation).** P. Fombonne (Thomson - CSF, Paris, France), E. Giboin (Institut Français de Navigation, Paris, France), M. Giraud, Ph. Gufflet, L. Lewden (Service Technique de la Navigation Aérienne, Paris, France), M. Lecerf (Service Technique Aéronautique, Paris, France), and J. Villiers (Aviation Civile, France). *L'Onde Electrique,* vol. 51, July-Aug. 1971, p. 605-619. In French.

Results of fifty years of electronics development to improve civil aviation safety and effectiveness. Air navigation in the 1919-1940 period is briefly reviewed, during which air-to-ground communication, radio triangulation, and systems of radio beacons were established. After WW II long distance navigation and radiotelephone systems were developed, and the use of radio made effective flying control possible. The use of radar greatly simplified the task of controlling large numbers of aircraft. Various self-contained navigation systems such as pressure pattern flying, Doppler-effect systems, and inertia systems are discussed, as well as cooperative systems of navigation and tracking. Satellite navigation systems are considered. F.R.L.

A71-37454 **Theory and experiment regarding transonic flows (Theorie und Experiment bei schallnahen Strömungen).** J. Zierep. In: Surveys on gasdynamics (Übersichtsbeiträge zur Gasdynamik). Edited by E. Leiter and J. Zierep. Vienna, Springer-Verlag, 1971, p. 117-162. 49 refs. In German.

The most important methods of calculation used are briefly considered, including the hodograph method, the integral equation method, the parabolic method, and the method of characteristics. Flow conditions for the transonic case are discussed, giving attention to the computation of the flow field for a given body by a combination of the parabolic method and the method of characteristics. Profile flows for the subsonic case in which the Mach number approaches one are considered together with the supersonic case involving Mach numbers near one. Problems including bodies at angle of attack and blunt bodies are examined, and transonic flows involving a transfer of heat are investigated. The entropy theorem of Oswatitsch for transonic flows is also considered. G.R.

A71-37457 **Detonation processes in gases (Detonationsvorgänge in Gasen).** F. Bartlmä. In: Surveys on gasdynamics (Übersichtsbeiträge zur Gasdynamik). Edited by E. Leiter and J. Zierep. Vienna, Springer-Verlag, 1971, p. 208-229. 58 refs. In German.

It is pointed out that important advances in the study of detonations have been made during the last decade mainly in

connection with the utilization of detonative combustion for the propulsion of hypersonic aircraft. The theory of planar reaction fronts is discussed, giving attention to the Zeldovich-Döring-Neumann model and to aspects of reaction kinetics. Recent investigations concerning the fine structure of fronts of detonation and their pulsation characteristics are considered as a basis for a physical explanation of the spin detonation. Problems of the origin of detonation fronts are investigated together with questions regarding the transition from combustion to detonation. G.R.

A71-37491 F101 engine keyed to milestone concept. Michael L. Yaffee. *Aviation Week and Space Technology,* vol. 95, Aug. 9, 1971, p. 32-34.

Description of the GE F101 30,000-lb thrust augmented turbofan engine being developed for the North American Rockwell B-1 bomber under the DOD fly-before-buy policy. Fan air and core engine exhaust gases are mixed behind the turbine. Fuel is injected and the two gas streams burn together. The engine is designed with a minimum amount of external clutter for ease of maintainability. The use of inlet guide vanes in front of the fan should provide greater tolerance to bird ingestion. The blades of the two-stage fan are fabricated from titanium alloy, as are the blades of the 9-stage high-pressure compressor. Details of the annular combustor, the turbines, the turbine nozzles, the thrust augmentor, and the exhaust system are given. F.R.L.

A71-37497 Jet aircraft noise in metropolitan Los Angeles under air route corridors. P. Hurdle, S. R. Lane, and W. C. Meecham (California, University, Los Angeles, Calif.). *Acoustical Society of America, Journal,* vol. 50, July 1971, pt. 1, p. 32-39. 7 refs.

Study of noise intrusion problems due to overflights of jet aircraft in the approach and departure air routes over the communities of the Los Angeles metropolitan area, which problems are considered to have been largely ignored. Preliminary measurements indicate that in at least 10 peripheral residential communities the noise levels caused by jet aircraft overflights exceed 20 dB(A) above the average ambient noise levels. Each flight in this area appears to have the potential to subject about 500,000 people to significant noise intrusion levels. F.R.L.

A71-37516 North American's big bomber. *Flight International,* vol. 100, Aug. 5, 1971, p. 224-227.

On June 5, 1970 North American Rockwell was awarded the contract to begin development of the variable-geometry B-1A, successor to the B-52. The benefits of variable geometry will enable a smaller aircraft than the B-52 to carry significantly larger loads at speeds greater than Mach 2 at altitude or high subsonic at ground level, while operating from shorter runways. The unrefueled range is described as 'intercontinental.' A crew of four will manage this 350,000-lb- to 400,000-lb-gross aircraft. G.R.

A71-37536 # Natural vibrations of coaxial rotors (Avtokolebaniia soosnykh rotorov). D. K. Ovcharova and E. G. Goloskokov (Khar'kovskii Politekhnicheskii Institut, Kharkov, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 7, June 1971, p. 85-90. In Russian.

A system of two coaxial rotors with unbalanced disk, rotating at different angular velocities is analyzed under the assumption that the outer shaft is absolutely rigid, that the masses of the shafts are concentrated in the disk, and that the gyroscopic moments of the disks are small. The equations of motion in quasi-normal coordinates are solved by the energy balance method. The stability of the stationary solutions which correspond to natural vibration modes is analyzed, and the influence of the various system parameters on the buildup of vibrations is determined. It is shown that the biharmonic mode of the rotor natural vibrations is unstable, and that stable natural vibrations at the first natural frequency occur beyond the first critical speed. An increase in the eccentricity of the outer rotor disk leads to a decrease in the amplitudes of the natural vibrations in the case of rotation in the same direction, and to an increase in the amplitudes in the case of rotation in opposed directions. V.P.

A71-37592 The third London airport - The process of decision. D. Keith-Lucas (Cranfield Institute of Technology, Cranfield, Beds., England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/1.* 18 p. Members, $1.25; nonmembers, $2.00.

Review of the procedures by which the timing and siting of the Third London Airport was determined. The Commission of Inquiry (The Roskill Commission) engaged a research team and a number of outside consultants to gather the facts and carry out a large scale cost benefit analysis. The whole process took 2-1/2 yr and included the identification of 78 possible sites, the reduction to a medium list of 29 sites, and ultimately to a short list of 4 sites. Public hearings were held locally at each of the short listed sites to establish the detailed facts. The completed exercise was not only an investigation into airport siting, but also an experiment in technological decision making in a democratic society. F.R.L.

A71-37593 Siting of a major airport - The Canadian experience. D. R. Hemming (Ministry of Transport, Canadian Air Transportation Administration, Ottawa, Canada). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/2.* 17 p. Members, $1.25; nonmembers, $2.00.

Discussion of the problem of site selection for a major airport, which is a complex task because the site selected is expected to serve more than one objective. The final selection of a site is usually a compromise reached by assigning weights of importance to the various aspects affecting the decision. These are applied by the decision maker, who must consider the facts presented to him by the planner in the framework of political realities. The task of the planner is to narrow down the choice of a few alternatives and to present the facts in such a way that all the important implications of a choice can be assessed at a glance. To illustrate the process examples are drawn from the experience gained during the planning of the Montreal and Toronto area airport systems. F.R.L.

A71-37594 Greater utilization of today's airport system. Neal R. Montanus (Port of New York Authority, New York, N.Y.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/3.* 6 p. Members, $1.25; nonmembers, $2.00.

The Port of New York Authority operates John F. Kennedy, LaGuardia, and Newark airports. The capacity of the complex of airports to meet demand is strained and will be inadequate in the near future. Approaches of the airport operators to reduce aircraft noise are discussed together with problems of airport expansion. Efforts to ensure the best possible utilization of existing airport facilities are examined, and questions of STOL development and improvements in passenger handling capacity are considered. G.R.

A71-37595 **The sonic boom - Weighing its implications for policy considerations.** P. L. Eggleton (Ministry of Transport, Transportation Development Agency, Ottawa, Canada). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/4.* 19 p. 14 refs. Members, $1.25; nonmembers, $2.00.

Outline of the relevant factors of the sonic boom and the implications that should be considered by a state in reaching its decision on the acceptability of the boom, with exploration of possible policy alternatives. These alternatives include the complete barring of the supersonic airliner; adopting the concept of strictly controlled supersonic corridors; or the acceptance that overflight limitations for sonic boom considerations are not justifiable in light of the anticipated benefits that supersonic aviation could bring to a state. F.R.L.

A71-37596 * **Aircraft wake turbulence avoidance.** William A. McGowan (NASA, Washington, D.C.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/6.* 19 p. 13 refs. Members, $1.25; nonmembers, $2.00.

Discussion of aircraft trailing vortex systems and the hazard potentials they present to other aircraft. These systems are made up of two counter-rotating cylindrical air masses, about a wing span apart, extending aft along the flight path. Results of analytical studies and flight tests are used to describe the formation and severity of trailing vortices and the spatial extent of their influence. This information is then used to outline procedures for ready application by pilots, tower operators, and others concerned with the flow of traffic. Some particulars of a comprehensive research effort conducted by NASA to better describe aircraft trailing vortex behavior are presented. F.R.L.

A71-37597 **Some meteorological problems of supersonic flight.** George H. Gilbert and Roy Lee (Department of Mines and Technical Surveys, Meteorological Service, Ottawa, Canada). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/7.* 14 p. 8 refs. Members, $1.25; nonmembers, $2.00.

The main features of the atmosphere that are pertinent to the operation of commercial supersonic aircraft are described, and the meteorological aspects of the sonic boom phenomenon are briefly reviewed. The meteorological requirements and implications of the climb, cruise and descent phases of SST that are peculiar to this type of aircraft are discussed in some detail, including the effect of the meteorological parameters on the intensity and areal extent of the sonic boom. Certain problem areas where further meteorological research may be required are indicated. (Author)

A71-37598 * **Transonic transports.** Lloyd T. Goodmanson (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/8.* 12 p. Members, $1.25; nonmembers, $2.00. NASA-supported research.

Maximum speeds at which a transonic transport can fly without producing a sonic boom are in the range between 1.05 and 1.25 Mach depending on wind conditions and the temperature. An analysis of the design, performance, and economics of Mach 1.2 and 0.98 transports is conducted. The results are compared to an advanced technology transport designed to cruise at a conventional speed of Mach 0.84. Wind tunnel studies and typical airline routes for a Mach 0.98 transport are discussed. G.R.

A71-37599 **Concorde navigation system.** H. Hill (British Aircraft Corp., Ltd., London, England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/9.* 16 p. Members, $1.25; nonmembers, $2.00.

The navigation system of Concorde, as it will be introduced into airline service, is conventional by today's standards. It has evolved into this arrangement over a period of more than ten years. It began with a definition of requirements which was discussed and agreed with many different interests. Studies were carried out of the means of meeting these requirements. They have led to a definition of the basic aircraft system which is described in the paper. The performance capabilities are presented. Whilst the basic system results in a viable aircraft capable of being operated in commercial service it has to be accepted that individual operators will require various options to be introduced to suit their routes and operating procedures. Consideration is being given to such features in order that the aircraft shall be capable of accepting them. They include new forms of display and so introduce problems in flight deck arrangement. This is a subject which is particularly critical in a supersonic aircraft because of the tight volumetric constraints. Possible solutions are shown in the paper. (Author)

A71-37600 **Trends in aircraft propulsion.** George Rosen (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/10.* 16 p. 8 refs. Members, $1.25; nonmembers, $2.00.

Propulsion requirements for the next generation of civil aircraft are examined and some new and quite demanding needs are defined - larger engine sizes, higher take-off thrusts, and much lower noise levels. The remarkable propulsion advances over the past two decades are charted and, from these, projections are made for the next round of improvements. All of the propulsion systems considered incorporate advanced technology gas turbine engines coupled with propulsors having a broad range of bypass ratio - from fans to propellers. This encompasses a new class of high-thrust, low-noise propulsor - the Prop-Fan - which is introduced as a needed intermediate propulsor between today's fans and propellers. This widening scope of available propulsors is shown to offer the aircraft designer much more flexibility in powerplant selection and a better opportunity to optimalize his design. Although the primary focus is on civil aviation, wherever appropriate the commonality with military requirements has been indicated. (Author)

A71-37601 **All weather operations - Present achievements and future prospects.** K. W. Smith (Royal Aircraft Establishment, Blind Landing Experimental Unit, Bedford, England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/14.* 14 p. Members, $1.25; nonmembers, $2.00.

The philosophies of approach to All Weather Operations initially differed considerably in the U.K. and U.S.A. However events have conspired to produce the present situation where we are achieving common objectives. The pilot's role is still vital and his adaptability contributes to the benefits which are about to be achieved as the

result of many years of technical and financial investment. The ultimate capability of present generation all-weather systems (in terms of weather minima and traffic handling) will depend upon I.L.S. and can only be determined from operational experience, adopting a pragmatic attitude. However we must prepare for a guidance aid to succeed I.L.S. The definition of the requirement is a formidable task since it intimately involves the complete operation of traffic around and on to the airport, both for present-day and future aircraft types. (Author)

A71-37602 Automation in air traffic control. Glen A. Gilbert (Glen A. Gilbert and Associates). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/15.* 19 p. Members, $1.25; nonmembers, $2.00.

Examination of the need for an upgraded third generation system of air traffic control which could be expected to serve at least through the 1980s. Such a system must effectively accommodate all categories of users so that air transportation will not be constrained in its progress by ATC capacity limitations. To achieve this objective, distributed management is required. This approach involves greater delegation to the pilot for separation and spacing functions and better airspace/airport utilization by means of airborne equipment which will provide new pilot/controller tools in the ATC system. A mix of automation and the human element is combined with suitable interfaces. F.R.L.

A71-37603 Mediator - A programme for a British advanced ATC system. E. D. Crew (National Air Traffic Control Services, London, England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/16.* 12 p. Members, $1.25; nonmembers, $2.00.

The characteristics of the air traffic situation of the UK airspace are examined, giving attention also to the relationship between air defense and ATC. The history of the development of the present ATC system is discussed, taking into account studies conducted for the establishment of a joint Civil/Military Air Traffic Control System. The current ATC situation is evaluated and plans for future developments are described. It is hoped to build a system which will provide controllers with facilities for automatic initiation and tracking of all SSR equipped aircraft. G.R.

A71-37604 Synchronized time and frequency for aeronautical collision avoidance, communication, navigation and surveillance. James E. Blouin (McDonnell Douglas Astronautics Co., St. Louis, Mo.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/17.* 12 p. Members, $1.25; nonmembers, $2.00.

The successful implementation and ensuing years of operational use of the EROS airborne collision avoidance system are significant achievements in their own right. However, the underlying time and frequency synchronization subsystem developed for EROS may well have its own, and possibly more significant, impact on the thinking of aeronautical communication, navigation and surveillance system designers. This paper briefly describes the basic synchronization technique (known as RESYNC) and several refinements which have evolved from our flight operations and those which were defined, tested and adopted as a result of the Air Transportation Association collision avoidance program. The RESYNC capabilities resulting from these efforts are primarily oriented toward serving the collision avoidance function. However, without burdening the CAS, the signal in space will also provide communication, navigation and surveillance functions. (Author)

A71-37605 V/STOL developments in Hawker Siddeley Aviation Limited. M. J. Brennan (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/18.* 24 p. Members, $1.25; nonmembers, $2.00.

Review of the future requirements for civil air transport, following a brief historical statement on the growth of civil air transport. An alternative to the building of more conventional airports is to design an intercity STOL or V/STOL air transport system. The work done by Hawker Siddeley in its search for a satisfactory solution to the problem is reviewed. The work carried out on the National Gas Turbine Establishment's circulation controlled rotor concept is described in some detail, and the characteristics of the HS 141 aircraft are outlined. F.R.L.

A71-37606 * The aerodynamics of high lift illustrated by augmentor-wing research. Donald C. Whittley (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/20.* 20 p. Members, $1.25; nonmembers, $2.00. Research supported by the Defence Research Board of Canada, de Havilland Aircraft of Canada, and NASA.

Description of the more important aerodynamic features which have come to light showing how some of the difficulties associated with high lift may be overcome. The level of maximum lift coefficient for the jet-STOL transport would be higher than that for current jets by a factor of about three. This suggests some form of 'powered lift' and in the case of a transport aircraft it probably dictates a blown flap or blown wing concept. There are two major classifications of the blown flap: the externally blown flap (EBF) in which the conventional jet efflux is made to impinge on highly deflected mechanical flaps, and the internally blown flap (IBF) in which compressed air from the powerplant is ducted along the wing and is made to issue from thin spanwise nozzles to form a trailing jet sheet or jet flap. Results of experience gained from research effort into the augmentor-wing (a form of IBF) are described. F.R.L.

A71-37607 V/STOL certification. James F. Rudolph (FAA, Washington, D.C.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/21.* 11 p. Members, $1.25; nonmembers, $2.00.

The new generation of Vertical/Short Takeoff and Landing (V/STOL) aircraft has many novel features which are not covered by the existing aircraft airworthiness standards. This has made it necessary for the Federal Aviation Administration (FAA), together with industry, to develop standards specifically oriented toward powered lift aircraft. These tentative standards have been released to the aviation community and are intended for trial application in new Short Takeoff and Landing (STOL) type certification projects. In addition to airworthiness certification standards, the FAA is also involved in the planning and development of the entire STOL system including air traffic control techniques, navigation and guidance equipment, and intercity STOLports. Through the cooperation of the various government agencies and the aircraft industry, an important new element in our air transportation system is emerging. (Author)

A71-37724 # Aircraft performance and energy management. O. H. Lindquist (Honeywell Systems and Research Center, Minneapolis, Minn.) and G. Flohil (U.S. Navy, Office of Naval

Research, Arlington, Va.). *Naval Research Reviews,* vol. 24, June 1971, p. 1-10. 14 refs.

The historical developments in aircraft capabilities and flying techniques in the combat environment are reviewed. It is pointed out that long development cycles and enormous funding requirements are typical of today's aircraft. The result is fewer new aircraft with better defined performance capabilities. The achievement of aircraft performance which is so markedly superior that the aircraft will permit significant domination of air space is now unlikely. The use of flying skills and strategy to take advantage of available performance in the combat environment is a more crucial issue. The problems of energy management and optimal flight path control are discussed. Energy-state formulations are used to reduce the complexity of the performance optimization equations so that the equations can be solved without using complicated iteration techniques. Airborne computers are currently available which permit the real-time on-board solution of aircraft optimization problems. Z.W.

A71-37725 # **Experimental investigation of several neutrally-buoyant bubble generators for aerodynamic flow visualization.** R. W. Hale, P. Tan, and D. E. Ordway (Sage Action, Inc., Ithaca, N.Y.). *Naval Research Reviews,* vol. 24, June 1971, p. 19-24.

A new technique for flow visualization is described, involving the implantation of small bubbles, about 1/8 in. in diameter, in an air flow, and photographing their motion. The key features of this development are the unique generation scheme and neutral buoyancy of the bubbles. They are generated extremely rapidly, on the order of 15,000 per/min. Their neutral buoyancy is achieved by filling them with helium gas. This allows the bubbles to follow any air motion faithfully over an entire range of flow velocities from near 0 to more than 200 ft/sec. The technique was used to investigate the problem of the 'tip vortex' from an aircraft wing or helicopter rotor blade. Z.W.

A71-37751 **The synoptic-aerological conditions for the occurrence of clear air turbulence.** I. F. Weber (Deutsche Forschungsanstalt für Luft- und Raumfahrt, Braunschweig, West Germany). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 12th, Alpine, Tex., June 25-28, 1970.) Aero-Revue,* July 1971, p. 366.

Results of aircraft measurements of CAT involving in-flight registrations and observations under jet stream conditions over the North Atlantic and selected special routes. In this first part of the report, vertical acceleration is defined as a measure of bumpiness, and degrees of severity are established. The duration of severe and moderate turbulence encountered in 95 flights with a total cruising time of 612 hours was surprisingly low. T.M.

A71-37843 **Sonic fatigue of aircraft structures due to jet engine fan noise.** I. Holehouse (Rohr Corp., Chula Vista, Calif.). *(Conference on Current Developments in Sonic Fatigue, University of Southampton, Southampton, England, July 6-9, 1970.) Journal of Sound and Vibration,* vol. 17, Aug. 8, 1971, p. 287-298. 6 refs.

This paper deals with the effects on aircraft structures of high frequency fan noise from high by-pass ratio turbofan engines. Actual case histories and investigative details are presented. Considerations essential to a proper failure diagnosis are outlined and precautionary measures for future design efforts are suggested. (Author)

A71-37844 **Use of models to estimate fuselage pressure in VTOL aircraft.** L. Casalegno, G. Martini, and G. Ruspa (Fiat S.p.A., Turin, Italy). *(Conference on Current Developments in Sonic Fatigue, University of Southampton, Southampton, England, July 6-9, 1970.) Journal of Sound and Vibration,* vol. 17, Aug. 8, 1971, p. 309-321. 11 refs.

Near-field noise measurement results on the quarter-scale model of the V/STOL VAK 191 B aircraft are presented and discussed for the three take-off configurations: CTO, STO and VTO. The results are also compared to empirical calculations according to a method based essentially on the RAS Engineering Science Data Sheets. The agreement proves to be quite satisfactory, mainly in the conventional take-off condition, whilst in the short and vertical take-off configurations some differences appear, due to the presence of jets blowing on the ground. (Author)

A71-37845 **A note on sound radiation from a subsonically rotating source pattern.** C. L. Morfey (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 17, Aug. 8, 1971, p. 331-334. 7 refs.

The far-field pressure and radiation efficiency are approximated analytically for an annular-disk source, with uniform amplitude over the disk and linear phase variation circumferentially. The results are significantly different from those obtained by neglecting the annulus width and concentrating the source at the outer radius. Most of the radiated power is accounted for by the annulus mode component of lowest radial order. An incidental result is a rough analytical approximation to the Bessel function integral for values of the argument less than the order. (Author)

A71-37846 **Use of correlation technique for estimating in-flight noise radiated by wing-mounted jet engines on a fuselage.** W. V. Bhat (Boeing Co., Seattle, Wash.). *Journal of Sound and Vibration,* vol. 17, Aug. 8, 1971, p. 349-355.

Turbulent boundary layer pressure fluctuations and noise radiated by jet engines form two major sources of pressure fluctuations on the exterior of many commercial jet fuselages. The expressions for correlations and mean square pressures of two statistically independent noise sources are derived. A method of decomposing the two pressure fields is illustrated using flight test measurements. In flight, the jet engine noise contribution is separated from the turbulent boundary layer wall pressure fluctuations at Mach 0.78, aft fuselage location, and Mach 0.60 forward fuselage location. The flight test measurements indicated that the turbulent boundary layer pressure fluctuations and the noise radiated by jet engines are of the same order of magnitude at Mach 0.78, 25,000 ft (7620 m) altitude at the aft fuselage location. (Author)

A71-37878 # **A theory of supersonic flow past steady and oscillating blunt bodies of revolution.** S. S-H. Chang (Lockheed Missiles and Space Co., Sunnyvale, Calif.). *AIAA Journal,* vol. 9, Sept. 1971, p. 1754-1762. 14 refs. Contract No. AF 44(620)-69-C-0036.

This paper presents a new method of series truncation. The technique is to locate the singularities in the complex plane and then, by using a suitable transformation, to map them away from the region of interest. The method is applied to supersonic flow over both steady and oscillating blunt bodies of revolution. The steady blunt-body solution is obtained by using an inverse method of series truncation with the computation carried out to the third truncation. The steady solution presented yields almost four-figure accuracy throughout the subsonic region, in comparison with known exact solutions. The oscillating blunt-body problem is solved by using a direct method of series truncation with the computation carried out to the second truncation. Two types of motion are considered: 'plunging' oscillation and 'lunging' oscillation. The oscillation amplitude is assumed to be small; otherwise, within the validity of the governing differential equations, no other restriction is made. (Author)

A71-37879 # **Integral theory for the instability of laminar compressible wakes behind slender bodies.** Denny R. S. Ko (TRW Systems Group, Redondo Beach, Calif.). *AIAA Journal,* vol. 9, Sept. 1971, p. 1777-1784. 17 refs. Research supported by the Bell Telephone Laboratories.

An integral theory is developed for studying the instability of laminar compressible wakes behind slender bodies. The mean flow is assumed to be characterized by a few shape parameters and a Gaussian distribution. Distribution of the fluctuations across the wake is obtained as a function of these mean flow parameters by solving the inviscid linearized fluctuation equations using the local mean flow. The fluctuation field is coupled with the mean flow through the Reynolds stress term, and the variation of the fluctuation amplitude is then obtained, together with the mean flow parameters, by solving the integral conservation equations. Both axisymmetric and planar bodies are considered, and favorable comparison with available two-dimensional experimental results is indicated. (Author)

A71-37888 # **Allen and Vincenti blockage corrections in a wind tunnel.** C. Dalton (Houston, University, Houston, Tex.). *AIAA Journal,* vol. 9, Sept. 1971, p. 1864, 1865. 7 refs.

Critical review of the Allen and Vincenti (1944) procedure for obtaining corrected drag forces for a single cylinder from wind-tunnel data. A recent investigation by the author led to the discovery that the Allen and Vincenti method is noticeably in error when used with relatively large-diameter circular cylinders in a wind tunnel. It is pointed out that the Allen and Vincenti blockage corrections for drag coefficients on a circular cylinder in a wind tunnel should not be used for spacing ratios greater than 0.1. It is suggested that the method of Fage (1929), as outlined in Durand (1963) be used as an alternate method for circular-cylinder blockage corrections with large spacing ratios. M.M.

A71-37892 * # **Alleviation of vortex-induced heating to the lee side of slender wings in hypersonic flow.** Allen H. Whitehead, Jr. and Mitchel H. Bertram (NASA, Langley Research Center, Hampton, Va.). *AIAA Journal,* vol. 9, Sept. 1971, p. 1870-1872. 10 refs.

Demonstration of the feasibility of reducing the vortex-induced heating to the lee surface of slender wings by properly contouring the leading-edge planform. The curvature discontinuity formed at the tangency point of a delta wing was removed by providing a continuous planform curvature generated by parabolic or hyperbolic contours. It is pointed out that the heating alleviation obtained by contouring a wing leading edge must be related to the extent of the departure of the planform from the delta planform. For example, if the local sweep of the hyperbola approaches its asymptotic value too close to the apex, then the flow turns abruptly, which would probably result in vortex formation and centerline heating similar to that observed over the sharp-apex delta wings. M.M.

A71-37895 # **Hypersonic lee-surface heating alleviation on delta wing by apex-drooping.** Dhanvada Madhava Rao. *AIAA Journal,* vol. 9, Sept. 1971, p. 1875, 1876. 5 refs.

Experimental demonstration that the vortex-associated peak heating on the lee-side meridian of a delta wing at hypersonic speed can be practically eliminated by aligning the apex region with the freestream. It is pointed out that, together with the flow of visualization studies, the experimental results suggest that the near-elimination of lee-meridian heating achieved by apex-drooping may be taken to favor the original conjecture that, at least at low incidence angles, the vortices arise as a result of cross flow within the laminar boundary layer. M.M.

A71-37897 * # **Sharp slender cones in near-free-molecule hypersonic flow.** M. I. Kussoy, D. A. Stewart, and C. C. Horstman (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal,* vol. 9, Sept. 1971, p. 1879-1881. 9 refs.

Description of additional shock tunnel drag measurements in the near-free-molecule-flow regime obtained in air as well as helium. These results, which extend the data of Kussoy and Horstman (1970) and of Geiger (1969) to higher Knudsen numbers, were obtained for cones with half angles from 2.5 to 10 deg at Mach numbers of 24 and 27 for air and 35 for helium. The Knudsen number based on cone diameter varied from 0.01 to 5. For reference, the free molecule limits assuming diffuse reflection and unit thermal accommodation are also given. M.M.

A71-37980 # **Interaction of a heated jet with a deflecting stream.** J. W. Ramsey and R. J. Goldstein (Minnesota, University, Minneapolis, Minn.). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, Tulsa, Okla., Aug. 15-18, 1971, ASME Paper 71-HT-2.* 8 p. 15 refs. Members, $1.00; nonmembers, $3.00.

Experimental investigation of the interaction of a heated jet with a deflecting flow in a wind tunnel. The secondary (jet) flow is introduced at angles of 90 and 35 deg to the mainstream flow direction. Visualization studies using tufts of yarn and a carbon dioxide water fog are reported. Temperature profiles in the interaction region are presented for blowing rates (ratio of mass flux of injected gas to mass flux of free stream) from 0.1 to 2.0 for normal injection and at blowing rates of 1.0 and 2.0 for 35 deg injection. Velocity and turbulence-intensity profiles are reported for normal injection at blowing rates of 1.0 and 2.0. (Author)

A71-38002 # **Heat-transfer parameters and transport properties for air and jet fuel-air mixtures.** Fred Burggraf and Martha E. Wilton (General Electric Co., Aircraft Engine Group, Evendale, Ohio). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, Tulsa, Okla., Aug. 15-18, 1971, ASME Paper 71-HT-41.* 10 p. 25 refs. Members, $1.00; nonmembers, $3.00.

The temperature dependent laminar and turbulent heat transfer parameters are presented for 500 to 4500 R, .01 to 40 atmospheres, and for fuel-air mixtures from .0 to 2 times stoichiometric values. Transport properties for this range are presented and compared to available data. The equations and coefficients used are given for the transport properties analysis. The results obtained are in good agreement with recent NASA calculations and recent test results. The thermal conductivity in particular is higher at high temperature than much of the earlier literature. This results in a nearly constant Prandtl number over the range investigated. (Author)

A71-38015 # **Rotary seals in aircraft turbine engines (Uszczelnienia obrotowe w lotniczych silnikach turbinowych).** Konrad Okulicz. *Technika Lotnicza i Astronautyczna,* vol. 26, July 1971, p. 10-14. In Polish.

Description of materials, designs, and operating principles of rotary seals used in the gas ducts, bearing elements, and fuel systems of gas turbine engines. Operating conditions are defined in terms of the properties of the contained medium, pressure differences, mechanical forces, clearances, and electrostatic and hydrodynamic effects. Typical structural arrangements are illustrated for sliding-contact and contactless radial and axial seals. T.M.

A71-38017 # **Landing of a single-place aircraft using an automatic band switch for the ARK-5 or ARK-10 radio compass (Lądowanie samolotu jednomiejscowego z wykorzystaniem auto-**

matycznego przełacznika podzakresów radiokompasu ARK-5 lub ARK-10). Marian Grodecki. *Technika Lotnicza i Astronautyczna,* vol. 26, July 1971, p. 21-26. In Polish.

The landing of a single-place turbojet aircraft employing the USL approach system entails manual switching of the radio compass to the operating frequency of the near beacon at the moment when the aircraft is passing over the remote beacon. The operation imposes a burden on the pilot's attention at a critical time in the approach maneuver. An automatic switching unit is described which performs this function for radio compass models ARK-5 and ARK-10. Circuit diagrams, operational specifications, and equipment modifications for this unit are described. T.M.

A71-38021 Engines for civil V/STOL. E. A. White and G. L. Wilde (Rolls-Royce, Ltd., Derby, England). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/19.* 17 p. Members, $1.25; nonmembers, $2.00.

Some of the general requirements of V/STOL engines are examined, giving attention to the need for quieter engines and to thrust requirements. A number of the considerations taken into account during the project definition phase of some specific V/STOL engine proposals are described. Thus, design problems for single-function propulsion engines and for multifunction propulsion/blowing engines for STOL are discussed. Various aircraft types available for the tourist air traffic are discussed. It is pointed out that the large STOL aircraft of the future might reconsider the use of separate blowing engines. Questions regarding lift or booster fan engines for V/STOL are investigated. G.R.

A71-38022 # Application of an airfield surface system model. Donald Maddison. *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 14 p.

Development of a fast-time computer simulation model of an airfield surface system as a tool for use in airport planning. The fact that computer simulation models have the capability of predicting future operational aspects of the airfield surface system (within the limits dictated by the accuracy of the input data) is a major justification for their use as a planning tool. The knowledge from detailed observation of the system obtained during the setting up and application of the model can lead to a better understanding of the system and may frequently suggest changes in the system. The effects of these changes can then be tested via simulation before implementing them on the actual system. In its application to study of the San Francisco International Airport the operations of 500 aircraft over a 15-hr period were simulated in five minutes on a CDC 6600 computer. F.R.L.

A71-38023 # The super airport. Lloyd S. Laity (Parkin Architects Engineers Planners, Los Angeles, Calif.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 17 p.

Considerations underlying the long-range planning of a super CTOL airport are shown to lead to the concept of 'An Airport in a Park.' The evolution of a design based on principles which account for the airport/community relationships and operational efficiency is illustrated. These principles suggest that the runway pairs be not widely separated, that aircraft operations be kept toward the center of the property rather than on its flanks, that the boundaries of noise impacted lands be an influence on the shape and extent of airport lands, and that the public (and their automobiles) be restricted to a greenbelt area around the perimeter of the airport. The planning of an ideal airport using the NEF 40 zone as a basis is demonstrated. The paper is meant to stimulate thinking on the planning of tomorrow's airport. V.P.

A71-38024 # Air traffic simulation, 1- and 2-runway airports. Stephen Hall (United Aircraft Research Laboratories, East Hartford, Conn.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 27 p.

Analysis of airport congestion and delays by a Monte Carlo simulation of aircraft traffic through an airport. Details of this system are described, including components of the system, the simulation of air traffic flow, and the computational flow of the simulation. An illustrative example is given for a busy two-runway airport operating under instrument flight rules. Being written in FORTRAN, the program is compatible with a wide range of computer equipment and offers the opportunity for testing a number of variations at low computer cost. F.R.L.

A71-38025 # Unified baggage handling systems at Seattle-Tacoma. Charles Davis (Richardson Associates, Seattle, Wash.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 28 p.

Procedures and standards are described which were used to solve a number of problems associated with the development of a large complex sophisticated baggage handling system and to develop specifications for competitive bidding. General criteria which were established at an early stage to provide the framework for developing detailed requirements are examined, and the methods used to determine the equipment types and equipment control are described. Considerations underlying rate and performance analyses are outlined, and path layouts intended to provide a fully integrated system including all individual airline systems are illustrated. The outbound systems, the automobile baggage check system, the inbound systems, connecting system, customs claim system, and customs recheck system are described. V.P.

A71-38026 # Operational planning of airport facilities. James J. Browne, Rogers Lui (Port of New York Authority, New York, N.Y.), and Ravinder Nanda (New York University, New York, N.Y.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 20 p. 5 refs.

Analysis of operating procedures at airports in order to determine effective methods of utilizing the physical facilities. The operational planning of transportation facilities usually strives for a balance between level of service provided and the cost of operation. In order to show how simulation can be used effectively in operational planning two studies are discussed. A simple application for the analysis of airport parking lot operations is briefly described, in particular the evaluation of the operational feasibility of an automated parking system. The method by which simulation is being used in the planning of the expansion of the International Arrivals Building at Kennedy International Airport is then discussed in detail. E.D.I.

A71-38027 # Evaluation of airfield performance by simulation. Austin E. Brant, Jr. and Patrick J. McAward, Jr. (Tippetts-Abbett-McCarthy-Stratton, New York, N.Y.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 30 p.

Description of a simulation model developed and used to evaluate the performance of the proposed Dallas-Fort Worth Regional Airport layout plan. Total travel time, including delays, provided the measure of performance. The output included data on the total travel time for each flight accumulated over the test period by airline and aircraft type for both arrivals and departures. Conversion of the total travel times to operational costs and the inclusion of the value of passenger and cargo time provided a convenient common denominator for the comparison of alternatives. Utilization statistics for each facility (runway or taxiway segment, gate or parking area) indicated those facilities that were overutilized and, therefore, required relief or bypass facilities. In addition to statistical measures of performance, visual display of the simulation was provided through the development of a ten-minute computer generated motion picture of selected portions of the simulated future activity. Z.W.

A71-38028 # **Systematic analysis of airport congestion as a constraint on air travel.** George N. Bower and J. Robert Bennett (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 28 p. 9 refs.

Five airports having sufficient delays to cause imposition of FAA restrictions on permissible operations per hour were selected for the analysis of ways by which the airport congestion could be alleviated between now and 1980. The limits on maximum runway capacity available to scheduled airlines are examined and compared with adjusted demand for runway operations. It is concluded that there is enough elasticity within the overall system so that runway acceptance rates need not be the constraint that would choke off air traffic growth by 1980. Some of the measures to increase interim capacity result in loss in convenience to airport and airline customers, so facilities expansion will continue to be a preferred solution for the long term. Z.W.

A71-38029 # **A method for examining the costs and benefits of delay reduction with STOL air transportation.** Joan B. Barriage and Stanley P. E. Price (U.S. Department of Transportation, Washington, D.C.). *American Society of Civil Engineers and American Society of Mechanical Engineers, National Transportation Engineering Meeting, Seattle, Wash., July 26-30, 1971, Paper.* 16 p. 11 refs.

The effects of various strategies for investment in STOL fleets are studied on the basis of a heuristic computer model of the decision process. The resulting costs and benefits are computed. The model addresses the following 'what if' kind of question: what if short-haul conventional flights were replaced by STOL flights which do not require long runways. Would the resulting reduction in delays in the conventional system be of sufficient benefit to justify the costs of the STOL fleets and attendant facilities. The decision strategy employed indicates that 10 to 15 city-pair STOL routes are economically justified, and that some of the STOL fleet investments identified have very favorable benefit/cost ratios. V.P.

A71-38204 # **Orderly structure in jet turbulence.** S. C. Crow and F. H. Champagne (Boeing Co., Seattle, Wash.). *Journal of Fluid Mechanics,* vol. 48, Aug. 16, 1971, p. 547-591. 37 refs.

An attempt is made to find out whether jet turbulence is orderly in any sense, and whether the order can be enhanced and controlled by a slight periodic surging imposed on the jet exit. The technical motivation for the study was jet noise control. A periodic surging of controllable frequency and amplitude at the jet exit was imposed, and the response downstream was studied by hot-wire anemometry and schlieren photography. The forcing generated a fundamental wave, whose phase velocity accords with the linear theory of temporally growing instabilities. The fundamental grew in amplitude downstream until nonlinearity generated a harmonic. The harmonic retarded the growth of the fundamental, and the two attained saturation intensities roughly independent of forcing amplitude. The saturation amplitude depended on the Strouhal number of the imposed surging and reached a maximum at a Strouhal number of 0.30. When forced at a Strouhal number of 0.60, the jet seemed to act as a compound amplifier. It is concluded that the preferred mode having a Strouhal number of 0.30 is in some sense the most dispersive wave on a jet column. Z.W.

A71-38205 # **Aerodynamic noise.** M. J. Fisher (Southampton, University, Southampton, England) and M. V. Lowson (Loughborough University of Technology, Loughborough, Leics., England). *Journal of Fluid Mechanics,* vol. 48, Aug. 16, 1971, p. 593-603. 23 refs.

A symposium on aerodynamic noise was held at Loughborough University from Sept. 14 to 17, 1970 under the sponsorship of the Royal Aeronautical Society and the British Acoustical Society. The objective of the meeting was to focus attention on unsolved theoretical and experimental problems which will require attention over the next few years. Areas which were covered included jet noise, nonlinear acoustics, rotor noise, and diffraction theory. The symposium was successful in bringing together several new themes in aerodynamic noise research. The most significant of these were the existence of a degree of order in turbulent jet flows, and the dominant effect of inflow conditions on rotor noise radiation. In addition an improved and unified basis for jet noise theory seems to be evolving. (Author)

A71-38220 # **Investigations concerning possible methods of exchange regarding the use of loading units in air traffic (Untersuchungen zu möglichen Austauschverfahren beim Einsatz von Ladeeinheiten im Luftverkehr).** Wolfgang Hesse. *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 7, no. 7, 1971, p. 303-308. In German.

The present state of development regarding the use of loading units is examined, and proposals are made on the basis of this examination for improvements in the handling of the freight air traffic, taking into consideration the use of bigger aircraft. The organization of freight transportation using loading units is discussed, giving attention to special facilities needed, the principles for the regulation of the exchange relations, and agreements regarding the exchange of standardized container units. In order to facilitate the cooperation of the organizations engaged in air traffic, it is proposed that loading units should be operated as common property of these organizations. G.R.

A71-38221 # **Problems of the interconnection between the seasonal distribution of transportation requirements and the utilization rate of the transport capacity in passenger carriage (Probleme des Zusammenhangs zwischen der jahreszeitlichen Verteilung des Beförderungsbedarfs und der Auslastung der Beförderungskapazität im Fluggastverkehr).** Jochen Grenzdörfer and Anne-Ev Liebetrau. *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 7, no. 7, 1971, p. 309-321. 10 refs. In German.

A table showing the number of aircraft passengers for each month during the period from 1963 to 1968 is presented. The reasons for the pronounced concentration of passenger traffic during the summer months is discussed, giving attention to the traditional habits of people regarding the time for vacations. The data considered are statistically analyzed, and graphs showing the utilization rate of the transport capacity during the various months of one

year are obtained as average values for a number of years, taking into consideration conditions in the German Democratic Republic. A number of factors affecting the utilization of the offered transportation capacity are examined, taking into account safety, effective speed of air traffic, the fare, and the frequency of flights for a given route. G.R.

A71-38241 Cockpit lighting - Guidelines for evaluating the lighting of a civil aircraft cockpit. Frank H. Hawkins (KLM - Royal Dutch Airlines, Schiphol Airport, Netherlands). *Shell Aviation News,* no. 397, 1971, p. 2-9.

Provision of some basic information that will guide the pilot in analyzing the deficiencies of his lighting system, with an evaluation checklist that can be used for current or new aircraft. White light is shown to be superior to red because it permits color coding of displays, reduces eye fatigue, and improves instrument and display contrast ratio. There has been a tendency during the last 20 years to use higher brightness levels. Attention is given to glare, stray light and reflections, controls, shadows, emergency lighting, lighting systems, miscellaneous lighting, and maintenance. F.R.L.

A71-38242 Mercure - The conception of a short range design. Jacques Scherer (Avions Marcel Dassault, Vaucresson, Hauts-de-Seine, France). *Shell Aviation News,* no. 397, 1971, p. 10-15.

Discussion of the procedure by which the design concept of the Mercure short range aircraft was developed. The problem is not one of designing and building an aircraft of high technical merit and advanced performance, but of producing one that can satisfy the requirements of the market as far away as it may be foreseen. The studies indicated that a market for 1500 aircraft will open out between 1973 and 1981 for a machine optimized for stages up to 1500 km and accommodating 130 to 150 passengers depending on seat pitch. F.R.L.

A71-38274 The influence of sweep and dihedral in turbomachinery blade rows. R. I. Lewis (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England) and J. M. Hill. *Journal of Mechanical Engineering Science,* vol. 13, Aug. 1971, p. 266-285. 10 refs.

A qualitative discussion of the geometrical properties of dihedral and sweep in turbomachine blade rows is presented with a discussion of the consequent fluid dynamic effects upon blade to blade and meridional flows. Results of blade to blade calculations for four heavily loaded turbine cascades of infinite span and various angles of sweep are presented. Annulus end wall interference effects on blade to blade flow are briefly discussed with reference to previous work. The principal analytical contribution is a development of actuator disc theory to deal with meridional flows for swept cascades and for blade rows in cylindrical annuli. (Author)

A71-38300 Automatic air traffic control displays. T. H. Harrison. *Interavia,* vol. 26, Aug. 1971, p. 934-936.

The great problems involved in controlling the rapidly expanding air traffic are considered. It is pointed out that the controller's display is the crucial element in an air traffic control system which is capable of coping with the situation. The use of an electronic flight progress strip is discussed. The electronic strip reproduces by telemetry all the essential things a controller wants to know about the flight of any aircraft directly from the pilot's instrument panel, i.e. height, ground speed, track, and ETA. Any changes of the aircraft's flight profile will be immediately shown to the controller. The track shown on the electronic strip as seen by the controller is a replica, in miniature, of the pilot's cartesian coordinates pictorial display. G.R.

A71-38307 Numerical design of transonic airfoils. P. R. Garabedian and D. G. Korn (New York University, New York, N.Y.). In: Numerical solution of partial differential equations - II: SYNSPADE 1970; Proceedings of the Second Symposium, University of Maryland, College Park, Md., May 11-15, 1970. Symposium sponsored by the University of Maryland and the National Science Foundation. Edited by Bert Hubbard. New York, Academic Press, Inc., 1971, p. 253-271. 13 refs. AEC Contract No. AT (30-1)-1480.

Description of an inverse method of computing plane transonic flows past airfoils that are not only free of shocks, but also have adverse pressure gradients so moderate that no separation of the boundary layer should take place. Up-to-date existence and uniqueness theorems combine with the experimental evidence to assure that these flows are physically realistic and will occur in practice. The partial differential equations governing steady two-dimensional flow of an inviscid compressible flow are solved by numerical analysis of characteristic initial value problems for the analytic continuation of the solution into the complex domain. Although the principal aim is to construct smooth transonic flows, the method also generates solutions with limiting lines that can be interpreted as an approximation of weak shocks. F.R.L.

A71-38313 # The application of vacuum brazing as a repair technique for aero-engine components. C. J. Baker (British European Airways Corp., London Airport, Heathrow, Middx., England). *(American Welding Society and Welding Research Council, International Brazing Conference, 2nd, San Francisco, Calif., Apr. 27-29, 1971.) Welding Journal,* vol. 50, Aug. 1971, p. 559-566.

Operational conditions leading to a high rate of deterioration of nozzle guide vanes in gas turbine engines are examined. The nature of the defect in the nozzle guide vanes was primarily one of thermal cracking of the leading and trailing edges. Several alternative methods of repair were considered and, finally, vacuum brazing was attempted. This technique after the solution of certain development problems proved successful. Late in 1969 vacuum brazing was introduced as a production repair technique on nozzle guide vanes. Details of the brazing technique are discussed and economic advantages of the new approach are pointed out. G.R.

A71-38343 Droop nose. Wilfred E. Goff. *Flight International,* vol. 100, Aug. 12, 1971, p. 257-260.

A prominent feature of Concorde at take-off and landing is the pendulous nose of the fuselage drooped to improve visibility from the flight-deck. This droop nose is the forward, unpressurized section of the Concorde nose fuselage. The nose fuselage proper is a pressurized shell, at the forward end of which is the flight deck. The droop nose, which carries the retractable visor, is hinged to the forward end of the pressure-shell. The purpose of the hinged forward portion is to give the pilot, when near the ground, forward vision comparable with that in current subsonic aircraft. After take-off the entire nose, including the visor, is raised to give the aircraft a clean aerodynamic external form. G.R.

A71-38426 The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1970. 496 p. Members, $6.00; nonmembers, $9.00.

The sessions covered problems on EMC standards; susceptibility analysis; future solutions; air traffic control and EMC; shielding; electromagnetic smog; antennas and fields; bonding and grounding; aircraft lightning; EMC in inner and outer space; analysis and modeling; emission analysis; and EMC design for the 70s. F.R.L.

A71-38435 **EMC in air traffic control.** Robert A. Frazier and Earl F. Freeman (IIT Research Institute, Annapolis, Md.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 71-80. 5 refs. Contract No. AF 19(628)-69-C-0073.

One result of the ever increasing use of air travel is its detrimental impact on the effectiveness of air traffic control facilities. One type of facility, the Air Traffic Control Radar Beacon System (ATCRBS) was analysed at the ECAC for the purpose of developing an ATCRBS Performance Prediction Model (PPM). Such a PPM was developed as an automated model with flexibility in predicting ATCRBS intra-system performance for a wide variety of environmental inputs. The primary model outputs are 'Fruit Rate' received by a given victim interrogator and 'Round Reliability' of the interrogator-transponder links. Most of the model outputs have been validated by comparison with measured data. The measured data were obtained from tests at Tyndall AFB and along an air route between Jacksonville, Florida and Savannah, Georgia. A few applications of the model are included to show how environments predicted for the future will operate with the present ATCRBS. The effect of changes in system parameters and proposed fixes as predicted by the model are also reported herein. (Author)

A71-38436 **Application of time sharing techniques to the air traffic control interference problem.** John F. Spina, Richard E. Rabe (USAF, Rome Air Development Center, Griffiss AFB, N.Y.), Jose Perini (Syracuse University, Syracuse, N.Y.), and Lance Greve (USAF, Communication Services, Scott AFB, Ill.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 81-88.

A typical Air Force air traffic control site is described, along with the interference problems that result from collocating transmitting and receiving antennas at such sites, and a solution is outlined that is presently being considered to alleviate these problems. Principles of time-sharing as applied to collocation problems are reviewed, and a discussion is presented on implementing the time-sharing approach for the solution of a particular problem. An antenna multiplexing scheme incorporated in the time-sharing approach is also reviewed. M.V.E.

A71-38445 **Near-field antenna coupling on aerospace vehicles.** M. Donald Siegel (McDonnell Aircraft Co., St. Louis, Mo.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 211-216. 9 refs.

A numerical method for accurately determining antenna coupling over a conducting surface, such as an aircraft, is presented. The surface may have an arbitrary geometry and specified conductivity, permittivity, and permeability. The only separation requirement is such that interaction effects are negligible. To compute the antenna coupling, a function involving the surface current density and the electromagnetic fields on the surface is derived. A complex, vector, integral equation is then derived to find the surface current density. This equation is then reduced to a form suitable for computer analysis, and an iterative procedure to obtain the solution is devised. The validity of the algorithm was tested by calculating the coupling between two L-band, annular slot antennas on an F-4 Phantom II aircraft. The results compare favorably with measured data. (Author)

A71-38450 **Radome lightning protection techniques and their electromagnetic compatibility.** M. P. Amason and G. J. Cassell (Douglas Aircraft Co., Long Beach, Calif.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 286-304. 9 refs. Research sponsored by the Douglas Aircraft Independent Research and Development Program.

The design and development of several radome lightning protection systems and their effects on the electromagnetic characteristics of nearby antennas are presented. The paper describes the results of simulated lightning tests performed on flat panels and radomes, with various types of lightning protection systems installed. Lightning test facilities used at Douglas Aircraft Company and Lightning and Transients Research Institute during the lightning strip developments are discussed. Results of antenna pattern measurements with and without the lightning protection systems installed on radomes are also presented. (Author)

A71-38457 **COSAM (Co-site analysis model).** M. N. Lustgarten (IIT Research Institute, Annapolis, Md.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 394-406. 6 refs. Contract No. AF 19(628)-69-C-0073.

COSAM (Co-site analysis model) is an automated program which is designed to evaluate the electromagnetic compatibility (EMC) of a single site which employs a large number of transmitting and receiving equipments. This paper includes: (1) a brief evaluation of the 'co-site problem,' (2) a description of the engineering features of the model, (3) input data requirements, (4) sample outputs, (5) a discussion of possible model applications, and (6) plans for future expansion. At this time, only single channel uhf (225-400 MHz) amplitude modulated (AM) voice transmitting/receiving systems have been considered. (Author)

A71-38462 **Induced effects of streamer discharges on an integrated antenna and avionics.** G. C. Huang, R. Goldman, and R. B. Schulz (Boeing Co., Commercial Airplane Div., Seattle, Wash.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 442-452. 9 refs. Contract No. AF 33(615)-68-C-1720.

The induced effects of streamer (spark) discharges on an integrated antenna and associated avionics are estimated with respect to rf interference and component damage. It is shown that the integrated antenna system can withstand damage from streamer discharges but that rf interference is unavoidable. Suggestions are offered for improved design. M.V.E.

A71-38464 **EMC design for a complex airborne system.** Allan S. Margulies (Mitre Corp., Bedford, Mass.). In: *The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 463-466. Contract No. AF 19(628)-68-C-0365.

The need for including compatibility as a factor in the design of large-scale airborne systems is discussed, along with the interference problems confronting such systems and the operational requirements

which affect the selection and employment of interference minimization techniques. It is shown that modern airborne systems necessitate an integrated approach to electromagnetic compatibility because their ultimate utility and cost may depend on the extent to which that effort is successful in determining and resolving possible interference situations prior to production. M.V.E.

A71-38466 * Discrete radiation from rotating periodic sources. S. E. Wright (Southampton, University, Southampton, England; George Washington University, Washington, D.C.; NASA, Langley Research Center, Hampton, Va.). *Journal of Sound and Vibration,* vol. 17, Aug. 22, 1971, p. 437-498. 15 refs.

A theory for discrete frequency sound radiation from rotating periodic sources is described. The theory is quite general and can be applied to electromagnetic as well as acoustic radiation. The theory was basically developed for rotor noise and attempts to cover tonal noise generally from the whole family of rotors, including helicopter rotors, propellers, fans and gas turbine compressors. The theory uses the free-field rotating point force concept, and then considers the modifying effect of boundaries such as ducts, and distributive forces such as those experienced on rotor blades. Radiation close to the rotor (near field) and radiation from arbitrary disk-loading asymmetries are considered. (Author)

A71-38467 Shock-cell noise - Aircraft measurements. J. A. Hay (British Aircraft Corp., Ltd., Weybridge, Surrey, England). *(Conference on Current Developments in Sonic Fatigue, University of Southampton, Southampton, England, July 6-9, 1970.) Journal of Sound and Vibration,* vol. 17, Aug. 22, 1971, p. 509-516. 13 refs.

A description is given of flight test measurements designed to determine the cause of severe acoustic loading on the tail planes of early V.C. 10 and B.A.C. 1-11 aircraft. This loading was found to be due to in-flight shock-cell noise. A convergent-divergent nozzle design, together with mirror structural modifications, was found to give the greatest overall alleviation of the problem for these two particular aircraft. (Author)

A71-38496 # Weight center of the spectrum of a received signal and the effective antenna centers of a Doppler velocimeter (O tsentre tiazhesti spektra prinimaemogo signala i effektivnykh tsentrakh antenn Dopplerovskogo izmeritelia skorosti). V. I. Baburin, L. I. Zakhar'ev, and A. A. Lemanskii. *Radiotekhnika,* vol. 26, June 1971, p. 49-54. 5 refs. In Russian.

The beam direction corresponding to the data weight center in the signal spectrum of an airborne Doppler velocimeter is determined together with the point (effective antenna center) at which this beam intersects the antenna aperture. The influence of factors causing asymmetrical illumination of the ground surface is examined. The study is conducted for the case of identical receiving and transmitting antennas on an aircraft in horizontal flight. T.M.

A71-38531 # Preliminary experimental investigation of the simple source theory of jet noise. Terry D. Scharton (Bolt Beranek and Newman, Inc., Canoga Park, Calif.) and William C. Meecham (California, University, Los Angeles, Calif.). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper.* 13 p. 6 refs.

Starting with the simple source theory of jet noise, an approximate relation between the radiated sound power spectrum and the jet pressure spectrum is derived. This relation is compared with one-third octave band sound power levels and jet pressure levels measured during ground runup of a small turbojet engine, and the agreement between theoretical and measured values is encouraging. (Author)

A71-38534 # Practical aerodynamics of aircraft with turboprop engines (Prakticheskaia aerodinamika samoletov s turbovintovymi dvigateliami). A. A. D'iachenko, E. B. Mikirtumov, V. V. Sushko, and V. V. Filippov. Moscow, Voenizdat, 1970. 319 p. 13 refs. In Russian.

A theoretical explanation of the technique of piloting turboprop aircraft is presented for readers with prior experience in flying such aircraft. A study is made of the forces and moments acting on a turboprop aircraft while in flight. The special features of the operation of a turboprop power plant are reviewed. Longitudinal and lateral equilibrium, stability, and controllability are considered. The flight engineering properties and the operation of turboprop aircraft during takeoff, while gaining altitude, during descent and gliding, during landing, during curvilinear maneuvers in a horizontal plane, and during vertical and spatial maneuvers are considered. Flight under complex conditions during takeoff, while cruising, and during landing is investigated. A.B.K.

A71-38546 ARIA for faraway voices. Hank Jones. *Esso Air World,* vol. 23, no. 6, 1971, p. 156-159.

Description of the Apollo Range Instrumentation Aircraft (ARIA), a modification of the Boeing C-135A. Specifically prepared to NASA requirements, sophisticated electronics equipment weighing 30,000 lb is installed in each of the eight ARIA, which fill gaps left by ships and land-based stations in the communications network for space exploration. Four ARIA have been modified with Airborne Lightweight Optical Tracking Systems (ALOTS), which provide optical coverage for missile launches, staging, reentry, and other functions along the Eastern Test Range (ETR). F.R.L.

A71-38647 # Theoretical study of the laminar boundary layer on a circular cone at incidence in a supersonic stream (Etude théorique de la couche limite laminaire sur un cône circulaire en incidence dans un courant supersonique). Bernard Roux. Aix-Marseille, Université, Docteur ès Sciences Mathématiques Thesis, 1971. 236 p. 107 refs. In French.

Study of the phenomena which occur on a circular cone at an angle of incidence, the cone being in a supersonic current, particularly with reference to the three-dimensional type separation which appears in the boundary layer at a sufficiently high incidence. The theoretical method of approach consisted of utilizing Prandtl's classical boundary layer equations which, in the case of a cone, lead to a parabolic system of equations of partial derivatives in relation to two independent variables only. The system was integrated numerically by an implicit finite difference method, following a scheme analogous to that proposed by Crank and Nicholson (1947). The results obtained were, in many cases, for the convective heat flow and the inclination of the limiting current lines (especially to the wall), successfully compared with the experimental results obtained by various authors. F.R.L.

A71-38651 Control of large crane helicopters. Leonard S. Szustak and David S. Jenney (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Journal,* vol. 16, July 1971, p. 11-22. 8 refs.

The size and mission of the next generation of large crane helicopters may require the development of new pilot techniques and a redefinition of current stability and controllability criteria. The primary mission of these large cranes, that of serving as an external cargo carrying platform, dictates the need to understand better and to account for the characteristics of slung loads and to offer more

automatic assistance to the pilot in this complex job. Some specific controllability criteria are proposed here. It is shown too, that some seemingly simple external load handling problems are, in fact, difficult if not insoluble. Results of tests of a canted tail rotor (for better hover efficiency) show that with proper coupling added, controllability does not suffer. Finally, advances in the design of control systems - perhaps even to fly-by-wire - and in Automatic Flight Control Systems (AFCS) to permit load stabilization and precision hovering have been shown to be feasible. (Author)

A71-38652 Stability and control considerations for a tilt-fold-proprotor aircraft. F. E. Tiller, Jr. (Bell Helicopter Co., Fort Worth, Tex.) and Robert Nicholson (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Helicopter Society, Journal,* vol. 16, July 1971, p. 23-33. 10 refs. Contract No. AF 33(615)-69-C-1121.

The flying qualities of tilt-fold-rotor VTOL aircraft are considered in this paper. These include the inherent characteristics of the concept and how they influence handling qualities, and the significant compromises made necessary by conflicting requirements of the different flight modes. The influence that its unique characteristics - i.e., pylon tilt and rotor stop-fold - have on flying qualities is emphasized. The effect of stability and control criteria on design is evaluated with results of analytical studies and wind tunnel test results of static and dynamic models included for background information. (Author)

A71-38653 Optimum rotor thrust to jet thrust for tip jet rotors. Henry R. Velkoff (Ohio State University, Columbus, Ohio). *American Helicopter Society, Journal,* vol. 16, July 1971, p. 51, 52.

A procedure is described for obtaining a simple relationship for the optimum values of the ratio of rotor thrust to jet thrust for tip jet driven rotors. This technique also makes possible a quick determination of the upper bound of performance for such rotors. M.V.E.

A81-38713 * Optimal control-surface locations for flexible aircraft. Timothy L. Johnson, Michael Athans (MIT, Cambridge, Mass.), and Grant B. Skelton (Honeywell Systems and Research Center, St. Paul, Minn.). *IEEE Transactions on Automatic Control,* vol. AC-16, Aug. 1971, p. 320-331. 14 refs. Research supported by the Fannie and John Hertz Foundation; Grants No. NGL-22-009-124; No. AF AFOSR 69-1724.

The basic physical relationships involved in control of a flexible aircraft disturbed by random wind gusts are used in formulating the aerodynamic surface location problem as one in optimal control of a distributed system, using a limited number of point-force controllers. The three phases of this problem - estimation, control, and surface placement - are then solved by means of the matrix minimum principle and the calculus of variations. The variational equations are greatly simplified and the order of the problem considerably reduced by the use of optimal controllers at each stage in the search for optimal surface locations. A computer program has been written which uses these equations in solving the surface location problem for winged aircraft. Results of a trial study based on a fourteenth-order model of the Lockheed C-5A transport aircraft are reported. (Author)

A71-38749 # European A300B airbus. *Aircraft Engineering,* vol. 43, Aug. 1971, p. 4-7, 9-15.

Discussion of the A300B Airbus, of similar configuration to the Hawker Siddeley, Breguet, and Nord HBN and the Sud Aviation/ Dassault Galion, but significantly bigger. Currently the B1, B3, and B7 versions are in an advanced stage of development. The first is the basic version, the second is the long range version, and the third is the 'stretched capacity' variant. Aerodynamic research carried out in France, the UK, Germany, and Holland is reviewed, and structural features are described. F.R.L.

A71-38750 # Optimum number of blades for maximum efficiency of centrifugal blowers. Y. R. Reddy and M. S. Konnur (Jyoti, Ltd., Baroda, India). *Aircraft Engineering,* vol. 43, Aug. 1971, p. 16, 17. 7 refs.

Development of a theoretical equation to determine optimum blade number which agrees well with experimental results. Impeller characteristics are influenced by the extent of shock losses and friction losses. Shock losses can be reduced by proper design of the angles at inlet and exit. Friction losses increase with the number of blades for an impeller but at the expense of better guidance, and this latter factor is the more dominant. Therefore a compromise should be made such that frictional losses in the impeller are minimal, at the same time that there are enough blades to give good guidance to the flowing fluid. F.R.L.

A71-38751 # Transparency applications of polycarbonates. George L. Wiser (Sierracin Corp., Sylmar, Calif.). *Aircraft Engineering,* vol. 43, Aug. 1971, p. 18-20. 7 refs.

Discussion of polycarbonate, which has several key properties that make it attractive to the aircraft designer particularly because of its impact resistance and good strength at elevated temperatures. Optics have been improved both in a 'cleaning up' of raw resin and the extrusion processing, and also through optical flattening by pressure polishing of the surfaces. By this latter means, thicknesses greater than the normal sheet extrusion capacity can be built up from thinner gauges by simply welding them together without the use of adhesives or solvents. F.R.L.

A71-38752 # Decompression of cabins. Marcus Langley. *Aircraft Engineering,* vol. 43, Aug. 1971, p. 23, 24.

Suggestion that the marine bulkhead system be applied to aircraft as a means of diminishing the risks of cabin decompression. A configuration is described which divides the occupied part of the fuselage length into five compartments. Doors are provided in the bulkheads, and these can normally be kept open, only to be closed and sealed if a leak occurs at any point. This will allow the fault to be localized. If an emergency arises, it is only the loss of air or oxygen from the affected compartment which has to be made good. F.R.L.

A71-38864 The effect of aircraft lateral dynamics on aircraft positioning accuracy when using Loran-C. R. V. Gressang (USAF, Eglin AFB, Fla.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-7, July 1971, p. 700-704. 7 refs.

The dynamics of an aircraft following a fixed course line using Loran-C for position fixing is shown to interact with Loran-C receiver dynamics to result in cross-track aircraft positioning errors that are smaller than cross-track Loran receiver errors. In a particular case considered, this error reduction is of the order of 50%. It is pointed out that the positioning error implied by the results obtained is markedly better than would be predicted based on Loran-C receiver accuracy, and corresponds to the additonal filtering inherent in the lateral dynamics of the aircraft following the 20 to 25 n mi approach path. M.M.

A71-38973 Computer control of multiple site track correlation. R. A. Singer and A. J. Kanyuck (Hughes Aircraft Co., Fullerton, Calif.). *Automatica,* vol. 7, July 1971, p. 455-463. 11 refs.

Several new computer techniques for multiple site track correlation are described. Each of these techniques is shown to provide considerable improvement in performance at low computer cost. Six techniques are examined theoretically and, using a simulated scenario, compared in terms of correlation accuracy and computer requirements. The coarse-fine technique is shown to be generally suitable for implementation and to provide correlation accuracies near unity. This technique uses coordinate gates for limiting the number of tracks examined in the correlation process, and scalar sums, composed of measurement vectors and their accuracies, to select among the remaining tracks. M.V.E.

A71-38989 Applications of multivariable control techniques to aircraft gas turbines. A. G. J. MacFarlane, P. D. McMorran, B. A. Dixon, and S. S. Hodge (University of Manchester, Institute of Science and Technology, Manchester, England). In: Multivariable control system design and applications; Institution of Electrical Engineers, United Kingdom Automation Council Control Convention, 4th, Victoria University of Manchester, Owens Park, Manchester, England, September 1-3, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 78), 1971, p. 1-7. 5 refs. Research supported by the Department of Trade and Industry.

Evaluation of some recent studies in multivariable theory involving test-bed trials on a digital control test bed facilily. A modern high-performance twin-pool axial-flow gas turbine with re-heat system and variable-area nozzle was used together with a complete on-line digital control test system. On the basis of the results it is concluded that multivariable frequency-response methods show considerable promise for the design of feedback controllers for aircraft gas turbines. G.R.

A71-39000 On the use of a model-following technique to control aircraft systems. D. McLean (Royal Air Force College, Cranwell, Lincs., England). In: Multivariable control system design and applications; Institution of Electrical Engineers, United Kingdom Automation Council Control Convention, 4th, Victoria University of Manchester, Owens Park, Manchester, England, September 1-3, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 78), 1971, p. 127-134. 10 refs.

The method proposed by Tyler (1964) has been extended by Asseo (1968) whose principal concern was with the necessary conditions for perfect model-following. The method reported by Erzberger (1968) requires that the optimal solution produces a perfect match between the output variables of the system and those of the model. The problem to control optimally the hovering motion of a CH-53 helicopter is discussed in order to demonstrate the efficiency of the Erzberger method. G.R.

A71-39084 # Vortex pollution - Wing-tip vortices: The hazard and the remedy. S. W. Yuan (George Washington University, Washington, D.C.). *Aeronautical Society of India, Journal,* vol. 23, May 1971, p. 67-70.

A device has been developed for controlling wing tip vortices, and its effectiveness has been verified by wind-tunnel testing. Multiple apertures (or a continuous slot) extending along the chordwise direction of the wing tip are used for blowing tangential jets of gas at preselected locations. Rows of vortices are thus produced to counterbalance the undesirable wing-tip vortices. The small amount of gas required can be bled off from the jet engine through a conduit, or it can be generated locally. The system improves lift efficiency and increases the volume of airport landing and takeoff operations by shortening the separation requirements dictated by vortex hazards. T.M.

A71-39086 # Optimisation study of an air heater. R. Balu and K. A. Damodaran (Indian Institute of Technology, Madras, India). *Aeronautical Society of India, Journal,* vol. 23, May 1971, p. 75-80. 5 refs.

High speed wind-tunnel facilities (M less than 4) always require some form of air heating system to avoid liquefaction of air at the test section. For intermittent operation, a pebble-bed type air heater is ideally suited. The procedure of optimizing the design of such a heater is discussed fully in this paper. Only four of the most commonly used pebble materials are considered for this study. The results show that aluminium oxide, when used as pebbles, gives the least length of the pebble bed for a given set of specifications. A cost analysis of the heater shows that the relative cost of the heater is least when aluminium oxide pebbles are used as compared to the other three materials. The procedure outlined here can be adapted for a more exhaustive analysis covering the complete range of pebble materials, shapes, sizes, etc. (Author)

A71-39087 # Reliability controlled maintenance plan for avionics equipment. Ravinder Kumar Bhatnagar (Indian Airlines, Bombay, India). *(Aeronautical Society of India, Annual General Meeting, Hyderabad, India, Mar. 20, 21, 1970.) Aeronautical Society of India, Journal,* vol. 23, May 1971, p. 81-90. 7 refs.

Development of the proposition that since the failure rate of hydraulic and electronic components does not show any tendency to increase at advanced age, the best policy is to leave these components alone as long as they are working satisfactorily. However, it is considered essential that some kind of control be exercised on the system to keep it in check. The parameter used to exercise the control is the failure rate or mean time between failures (MTBF). Using these data, principles of life testing, incorporating acceptance sampling procedures, are applied to accept/reject the hypothesis that the performance of the unit or type has not deteriorated with respect to the set standard. Statistical analysis is used throughout to substantiate the results obtained. F.R.L.

A71-39093 # Performance of segmented stator vanes of airfoil section. T. F. W. Embleton and G. J. Thiessen. *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper.* 23 p.

The possibility of reducing the radiated sound power by staggering the edges of stator vanes in an axial-flow compressor in such a way that the acoustic sources associated with the blades radiate with different phases is studied experimentally. It is shown that in the case where both rotor blades and stator vanes are straight and radial, reduction of the sound radiated by the entire stator ring can be achieved by choosing the relative numbers of rotor and stator vanes appropriately. An alternative method is to change the phase of excitation by changing the shape of the edge of each stator vane. A rotor section and duct for which the flow vectors were measured, and both segmented and straight-edged stator vanes were designed with the correct inlet angles and other parameters, is demonstrated. The results show that increasing the difference between the numbers of rotor and stator vanes decreases the sound radiated at high frequencies. Increasing the complexity of the stator-vane edge from one to two, three or even four segments decreases the sound radiated. In the usual range of rotor rpm, a decrease in the speed of the rotor decreases the sound radiated as far as interference effects are concerned. V.P.

A71-39147 **Vickers Aerospace Fluid Power Conference, 20th, Detroit, Mich., October 26, 27, 1970, Proceedings.** Conference sponsored by the Sperry Rand Corp. Troy, Mich., Sperry Rand Corp., 1970. 221 p.

Representatives of airline and airframe companies from various countries presented technical papers and points of view, and the full transcript of the proceedings is reported with the question and answer portion of the conference a verbatim record of the meeting. The hydraulic systems of the Boeing 747, the DC-10, and the L-1011 are treated in detail. Attention is given to hoses and fittings; hydraulic fluids; advanced flight control systems (power-by-wire, fly-by-wire); contamination and filtration; seals; components; and system performance monitoring. F.R.L.

A71-39148 # **Meeting the challenge of the 747 hydraulic system.** George F. Moore (Trans World Airlines, Inc., Kansas City, Mo.). In: Vickers Aerospace Fluid Power Conference, 20th, Detroit, Mich., October 26, 27, 1970, Proceedings.
Conference sponsored by the Sperry Rand Corp. Troy, Mich., Sperry Rand Corp., 1970, p. 1-10; Discussion, p. II-11 to II-15.

Results, with reference to the hydraulic system of the 747 aircraft, of nearly 11 months of operation for a total of over 17,000 flight hours. No significant chronic problems have been encountered. This achievement is considered to be noteworthy in view of the number of design improvements and state-of-the-art advancements that have been incorporated in the hydraulic power system design without adversely affecting the operational performance of the aircraft. Specific attention is given to these improvements: thin wall high-pressure tubing for lighter weight; use of swaged sleeves and welded joints for greater reliability; use of a new fire-resistant fluid; and maintaining high cleanliness by use of adequate filtration. F.R.L.

A71-39149 # **L-1011 up-date.** A. Nemechek (Lockheed-California Co., Burbank, Calif.). In: Vickers Aerospace Fluid Power Conference, 20th, Detroit, Mich., October 26, 27, 1970, Proceedings.
Conference sponsored by the Sperry Rand Corp. Troy, Mich., Sperry Rand Corp., 1970, p. VII-1 to VII-4.

Discussion of the L-1011 hydraulic system, which has been modified and improved since its inception. A gas turbine is now used as the power source for the all-engine-out situation. Various hydraulic fluids were tried and evaluated, and filter systems have been improved. The use of welded steel tubing has been successful. Maintenance and checkout procedures are reviewed. F.R.L.

A71-39150 # **Advanced flight control systems power-by-wire and fly-by-wire.** Vernon R. Schmitt and Robert C. Lorenzetti (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Vickers Aerospace Fluid Power Conference, 20th, Detroit, Mich., October 26, 27, 1970, Proceedings.
Conference sponsored by the Sperry Rand Corp. Troy, Mich., Sperry Rand Corp., 1970, p. 1-12; Discussion, p. VIII-13 to VIII-16.

Discussion of power-by-wire (PBW) actuators and fly-by-wire (FBW) flight controls. PBW is the transmission of power from the aircraft engine to the control surface actuator by electrical rather than hydraulic means. Instead of generating hydraulic power at the engine accessory pad, electrical power is distributed to integrated actuator packages located at the control surfaces, where the hydraulic power is generated. FBW is an electrical closed-loop feedback control system which makes aircraft motion, rather than surface position, the controlled variable. The mechanical linkages between the control stick and the control surface actuators are replaced by multiple physically dispersed electrical signal wires. Various systems now under study or development, or in actual use are described. F.R.L.

A71-39172 # **Experimental study of the aerodynamic characteristics of flat arrays of adjustable nozzle rings of gas turbine engines (Eksperimental'noe issledovanie aerodinamicheskikh kharakteristik ploskikh reshetok reguliruemykh soplovykh apparatov gazoturbinnogo dvigatelia).** V. M. Epifanov, L. I. Syromiatnikova, and N. I. Troitskii. *Mashinostroenie,* no. 6, 1971, p. 99-102. In Russian.

Determination of the main aerodynamic characteristics of an adjustable nozzle ring array on the basis of the dependence of the profile loss factor on the setting angle in the array. It is shown that with an increase in the setting angle of a blade profile in an adjustable nozzle ring array the profile losses increase nonuniformly, which leads to a nonuniform increase in the losses in the corresponding modes of operation of the turbine stage. A.B.K.

A71-39173 * # **Design and operation of the NASA 91.5-cm airborne telescope.** R. M. Cameron, M. Bader, and R. E. Mobley (NASA, Ames Research Center, Moffett Field, Calif.). *Applied Optics,* vol. 10, Sept. 1971, p. 2011-2015.

Description of a 91.5-cm aperture telescope being built for IR and submillimeter observations at altitudes of 12 to 14 km aboard a StarLifter (Lockheed C-141A) aircraft. The main optics will be totally reflecting, and aerodynamic boundary layer control will permit open-port operation (no material window). The elevation will be adjustable in flight between 35 and 75 deg. Westward flying will permit several hours observation of an object near transit at constant bearing (azimuth) and with little change in elevation. An air bearing support with inertial stabilization and star tracking will give a net line-of-sight stability of better than 2-sec of arc rms in the open-port mode. (Author)

A71-39206 # **Summary results of the Lewisburg fog clearing program.** Vernon G. Plank, Alfred A. Spatola (USAF, Cambridge Research Laboratories, Bedford, Mass.), and James R. Hicks (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, N.H.). *Journal of Applied Meteorology,* vol. 10, Aug. 1971, p. 763-779. 8 refs.

Results are reviewed of fog clearing experiments conducted with helicopters on 10 separate days, with fog layers from 125 to 525 ft in depth, in 35 hover and 18 runway clearing attempts. The hover experiments, successful in virtually all cases, yield clearings that varied from 400 to 2800 ft in length. The largest clearings occurred with the shallowest fog during tests conducted within 1 hr of the natural dissipation time of the fog. The runway-clearing experiments were successful in clearing the full 6000 ft extent of the runway on two occasions, were partially successful on four occasions, and were unsuccessful on 12 occasions. Six helicopter landings were accomplished through artificially created clearings. M.V.E.

A71-39207 # **Simultaneous radar and instrumented aircraft observations in a clear air turbulent layer.** R. A. Kropfli (Johns Hopkins University, Silver Spring, Md.). *Journal of Applied Meteorology,* vol. 10, Aug. 1971, p. 796-802. 12 refs.

In order to determine how wall radar can measure clear air turbulence, powerful, narrow-beam, sensitive radars were used on Wallops Island to indicate turbulent regions, while local turbulence observations were also performed by an appropriately instrumented aircraft sent into these regions. The simultaneously obtained aircraft and radar measurements were used to calculate eddy dissipation rates. These calculated rates agreed to within a factor of 4 with the more dependable estimates of dissipation derived from airborne hot wire anemometer velocity spectra. Turbulence was always found near the underside of an extremely stable and very thin layer within a region of high shear. M.V.E.

A71-39209 **AN/ARC-144 uhf multimode transceiver.** N. R. Avella (RCA, New York, N.Y.) and W. R. Perrigo (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). *Signal*, vol. 26, Sept. 1971, p. 14, 15.

Description of an all solid-state, ultrareliable multimode transceiver suitable for use in new aircraft such as the F-15, AX, B-1, etc. In addition, the transceiver has been designed to be compatible and directly interchangeable in aircraft with existing ARC-27 and ARC-34 installations. AN/ARC-144 incorporates rf front end semiconductor tuning, electronic digital frequency synthesis, and a unique solid state broadband power amplifier that is rated at 10 watt carrier output in the AM mode and 30 watt in the FSK mode. F.R.L.

A71-39264 # **Model studies of aircraft noise propagation.** Richard H. Lyon and Lalit Pande (MIT, Cambridge, Mass.). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper.* 9 p.

Aircraft noise propagation in city streets is studied in anticipation of intertown V/STOL and helicopter applications for short-haul operations. Small scale models are used to cope with the difficulties involved in acoustic problems of this type, noting the necessity of using very high acoustical frequencies. Experiments are carried out at frequencies from 8 to 150 kHz, using sparks and small jets as sound sources, a small microphone as a receiver, and plywood boxes for the buildings. A sample result is shown for the predicted Perceived Noise Level (PNL) of a helicopter flying over a city street. A comparison with open ground PNL results shows that the street noise of an overhead helicopter is about twice as loud as its open ground noise. For other positions along the flight path, the buildings shield the street from the helicopter, reducing the street noise below the open terrain noise. V.Z.

A71-39275 # **Closed-cycle refrigeration for an airborne illuminator.** F. F. Chellis, T. P. Hosmer (Cryogenic Technology, Inc., Waltham, Mass.), and E. Keller (Texas Instruments, Inc., Dallas, Tex.). In: National Academy of Sciences, National Research Council, Cryogenic Engineering Conference, University of Colorado, Boulder, Colo., June 17-19, 1970, Proceedings. Edited by K. D. Timmerhaus. New York, Plenum Press (Advances in Cryogenic Engineering. Volume 16), 1971, p. 214-220.

A refrigeration system is described that offers a reliable source of cooling for airborne systems requiring the cooling of large elements to cryogenic temperatures, at minimum size, weight, and input power. The system was designed to provide continuous cooling for an array of light-emitting elements in an airborne infrared spotlight. The 130-lb cooler which was built for this application employs the Gifford-McMahon (1960) cycle. Design problem areas are discussed, along with the reasons for the main choices made in the heat station design, as well as in the compressor-pump and refrigerator drive selection. M.V.E.

A71-39362 # **On the application of nonstationary analogy for the determination of hypersonic flows past blunt bodies.** M. N. Kogan and V. V. Mikhailov. (*Prikladnaia Matematika i Mekhanika*, vol. 34, Nov.-Dec. 1970, p. 1053-1057.) *PMM - Journal of Applied Mathematics and Mechanics*, vol. 34, no. 6, 1970, p. 992-996. 10 refs. Translation.

Construction of a class of unsteady flows to which direct application of unsteady analogy can be made when calculating hypersonic flow past a blunt body in a region far from the blunt part of the body. The basic idea of the method employed for this purpose is that the entropy corrections are not introduced into the flowfield or the body configuration, but into the head wave configuration as determined by unsteady analogy. The shape of this shock wave is determined from the condition that the fields of the steady and unsteady solutions must totally coincide, while the body configuration corresponds to the trajectory of a particle of an unsteady flow with an entropy equal to the entropy behind a normal shock wave. A.B.K.

A71-39364 # **On the determination of the shape of a supersonic nozzle taking into consideration the variation of aircraft flight conditions.** A. N. Kraiko and A. A. Osipov. (*Prikladnaia Matematika i Mekhanika*, vol. 34, Nov.-Dec. 1970, p. 1067-1075.) *PMM - Journal of Applied Mathematics and Mechanics*, vol. 34, no. 6, 1970, p. 1005-1013. 11 refs. Translation.

Consideration of the problem of designing a rigid (unadjustable) contour for the supersonic part of a nozzle which is optimal in the sense of solving a certain trajectory problem with allowance for changes in the flight conditions and the operating mode of the engine. The flight vehicle in this case is assumed to be a material point of variable mass, while its drag at a given moment is regarded as equal to the corresponding steady value. In addition to obtaining general results, a detailed study is made of two cases where the solution of the problem using the optimality conditions obtained turns out to be comparatively simple. The first case occurs if the Mach number distribution at the nozzle inlet does not vary during the flight time. It is established that in this case the optimal contour belongs to a family of contours corresponding to the solution of a variational problem with fixed conditions. The second case occurs if the flow at the nozzle inlet remains uniform and supersonic during the entire flight time, while the nozzle is plane and 'short.' In this case the generatrix of the optimal nozzle is rectilinear. A.B.K.

A71-39374 **Ice formation at helicopters (Vereisung an Hubschraubern).** Karl Wagner. *Flugrevue/Flugwelt International*, Sept. 1971, p. 31-34. In German.

It is pointed out that the possibility to use the helicopter under all kinds of weather conditions would be a decisive factor for an extended general use of this aircraft. An important problem which would have to be overcome is the formation of ice at the aircraft. The helicopter is particularly exposed to this danger because of its low flight altitudes. Thin ice layers at the rotor blades can cause serious aerodynamic disturbances. The conditions of ice formation are analyzed, taking into account the presence of big drops of undercooled rain and the existence of very fine droplets. The prevention of ice formation by heating the rotor blades by exhaust gases or electrically is discussed. G.R.

A71-39375 **Mil Mi-12 - Soviet large helicopter (Mil Mi-12 - Sowjetischer Grosshubschrauber).** Hans Brenner. *Flugrevue/Flugwelt International*, Sept. 1971, p. 44-47. In German.

The work of the aircraft designer Mil is discussed, giving attention to the heavy lift helicopters Mi-6 and Mi-10. The Mi-12 is the last design of Mil. This helicopter exceeded in its dimensions at its presentation in Le Bourget every other aircraft with the exception of the Lockheed C-5 A Galaxy. It is more than twice as large and four times as heavy as the Boeing Vertol CH-47 Chinook. The Mi-12 can transport a load of more than 30,000 kg. On August 1969 the aircraft reached an altitude of 2250 m with a load of 40,150 kg. The passenger version of the helicopter can carry 250 persons. G.R.

A71-39387 **The case for the convertible rotor.** R. Hafner. *Aeronautical Journal*, vol. 75, Aug. 1971, p. 505-528. 10 refs.

It is pointed out that the demand for transport at the end of the century will increase by the factor five. The development of traffic conditions on the Continent and the UK is discussed, giving attention to the role of air traffic. The three basic systems suitable for mass air transport are CTOL, STOL, and VTOL. The main configurations of

VTOL aircraft include the helicopter, the convertible rotor, and fan lift configurations. Aspects of safety are considered together with noise, air traffic control, airports, and socio-economics. The characteristics of the convertible rotor transport aircraft are described, giving particular attention to its potential performance. The competitive situation regarding the convertible rotor aircraft and other aircraft types is examined. G.R.

A71-39388 International airport planning as influenced by aircraft development. E. Bryan Tutty (International Air Transport Association, Montreal, Canada). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 529-531.

During 50 years of commercial aviation progress, the most significant developments in airport or aviation planning have been directly connected with the safe operation of the aircraft. The most important physical development has been the construction of runways. Any airport possessing runways designed to handle the long-range aircraft of the late 1960s can generally speaking also look forward to accepting with equal safety the aircraft of the 1970s. However, the hangars used have to be larger and higher. Second level loading is discussed together with the handling of cargo. G.R.

A71-39389 A third London airport. P. C. Haines (GPS Sciences, Ltd., Farnborough, Hants., England). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 531-534.

Discussion of interface problems arising in connection with a third London airport. An airport-to-airport interface is considered giving attention to an inhibition of operations at one airport due to operations at the other because of an in-built interaction. Another interface involves the matching between the respective capacities of the airport and the airspace. Other questions are concerned with the economic use of airspace. Procedures in the airspaces of different countries have to be compatible. G.R.

A71-39390 The economics of airport operation as affected by transport aircraft design trends. R. A. Read. *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 535-538.

Improvements in direct operating costs of an aircraft are often more than offset by increased and additional airport charges. This effect has been most glaringly demonstrated in the increases in runway lengths required for takeoff over the past 15 years. Runway utilization is a critical factor in determining cost and charges. Careful alignment of parking bays can increase utilization of given areas of concrete. The suitable handling of baggage is also discussed together with problems caused by aircraft noise. G.R.

A71-39391 Airport restrictions as they affect economic airline operation. P. M. Davey (British European Airways Corp., Ruislip, Middx., England). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 539, 540.

Discussion of three major areas of concern including congestion, noise, and performance. A graph showing the percentage of BEA departures from London that were delayed for air traffic control reasons is presented. In the main the ATC delays were attributable to problems within the French ATC system. All BEA specifications for new aircraft since 1958 have had a requirement for flyover noise. Additional approaches for reducing noise are considered. G.R.

A71-39392 Aircraft noise in the airport environment. O. I. Green (Department of Trade and Industry, London, England). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 541, 542.

Approaches to deal with aircraft noise include the reduction of noise at its source and operational procedures to obtain noise-reduced takeoffs. A third class of noise alleviation techniques involves land use planning. The implications of these measures in terms of economic and international aspects are discussed, and the costs of noise disturbance in terms of reduced efficiency due to loss of sleep and speech interference are considered. G.R.

A71-39393 Facilities planning for international air cargo. John C. Leslie (R. Dixon Speas Associates, Inc.). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 542, 543.

Characteristics of cargo handling requirements are examined. Aircraft movements on the airport are between the runway and the passenger terminal, between the runway and the cargo terminal, and between both terminals and the parking or maintenance areas. Cargo must be moved between aircraft and the cargo terminals. Another category of interface is between airlines at the airport. The cargo interface between the airport and the world outside is also discussed. G.R.

A71-39394 The impact of VTOL aircraft on airport design and development. I. Chichester-Miles and D. R. M. Romer (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). *(Royal Aeronautical Society, Symposium on Airports and Transport Aircraft - Inter-Relations and Interface Problems, London, England, Dec. 9, 1970.) Aeronautical Journal*, vol. 75, Aug. 1971, p. 544-549; Discussion, p. 549, 550.

The place of VTOL in the integration of transport systems is examined. The location of the terminal and its efficiency of operation has a significant effect upon the total cost and time of the whole journey. The accessibility of the terminal is the major factor in speeding up the total journey. One hour isochrones for road transport and high-speed VTOL aircraft are considered. Effects of a combination of central terminal, rapid processing, and high speed VTOL are discussed together with problems of integrating new air traffic in the existing ATC system. G.R.

A71-39395 Objectives and standards for air safety. H. C. Black (Air Registration Board, London, England). *Aeronautical Journal*, vol. 75, Aug. 1971, p. 551-559. 5 refs.

It is tried to forecast accident trends to give guidance on target safety levels for the next decade. It is thought likely that in the future a safety level of one fatal accident per million hours will be achieved by many of the operators. Human factors remain important accident causes, and require close examination when new standards are being written. However, the biggest improvements in this field are likely to come from better piloting aids, and from the wider realization of the importance of management. G.R.

A71-39397 A numerical method for calculating the trailing vortex system behind a swept wing at low speed. D. J. Butter and G. J. Hancock (Queen Mary College, London, England). *Aeronautical Journal*, vol. 75, Aug. 1971, p. 564-568. 8 refs.

The applicability is investigated of a purely numerical approach to the problem of calculating the trailing vortex pattern behind an unstalled swept wing. The evaluation of the approach outlined

indicates that the problem can be treated by a straightforward digital computer procedure. Further possibilities of accuracy improvement are pointed out. M.V.E.

A71-39398 Correlation of total lift data for thin, sharp-edged, low-aspect-ratio delta wings at low speeds. A. J. Alexander (Loughborough University of Technology, Loughborough, Leics., England). *Aeronautical Journal,* vol. 75, Aug. 1971, p. 569, 570. 12 refs.

An empirical equation is derived for the lift of thin sharp-edged delta wings with due allowance for the trailing edge effect in incompressible flow. The scatter in the experimental results casts some doubt on the accuracy of the nonlinear lift term and points to the need for experimental work of greater accuracy than is at present available. M.V.E.

A71-39399 High temperature turbine design considerations. S. N. Suciu (General Electric Co., New York, N.Y.). *(NATO, AGARD, Meeting, 36th, Florence, Italy, Sept. 21-25, 1970.) Aeronautical Journal,* vol. 75, Aug. 1971, p. 577-586. 14 refs.

Review of the technological developments that have made high-temperature turbine cycles in aircraft engines practical. It is shown that the advent of high-temperature turbine engines is the product of a great number of significant developments and not the consequence of any one revolutionary concept or technological breakthrough and that the incorporation of these advances was accomplished only through well-balanced and carefully considered designs closely coupled to extensive laboratory, component, and engine tests. M.V.E.

A71-39411 # Theoretical and real weight of shell fuselages (Peso teorico e peso reale delle fusoliere a guscio). Dario E. Poggio (Torino, Politecnico, Turin, Italy). *Ingegneria,* Jan. 1971, p. 1-12. 16 refs. In Italian.

Investigation of an expression for the real weight of fuselages on the basis of theoretical similarity considerations. Reference is made to the definition of 'theoretical weight' of a structure given by Gabrielli and to an investigation made by the author in the case of aircraft wings and fuselages. With emphasis on the coefficient of the formula of the theoretical weight, defined as 'fuselage weight coefficient,' and on the basis of data from numerous fuselages, the parameters on which the coefficient more obviously depends are derived. The most significant and recent formulas for predicting fuselage weight given by various authors are shown. M.M.

A71-39418 # Effect of wing tip shape on the rolling up of vortex sheets (Effet de la forme des extrémités d'ailes sur l'enroulement des nappes tourbillonnaires). Robert Legendre (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* July-Aug. 1971, p. 227, 228. In French.

Application of the laws of detachment on the whole contour of a wing, discovered during the study of delta wings, to the study of straight or moderately swept back wings. Experimental investigations are reviewed which lead to the practical conclusion that an unfurling at the edge of such wings must be guarded against. Improvement of wing tips does not render useless other arrangements to regulate the characteristics of detachment. F.R.L.

A71-39424 Community noise levels of the DC-10 aircraft. A. L. McPike (Douglas Aircraft Co., Long Beach, Calif.). *Canadian Aeronautics and Space Institute, Royal Aeronautical Society, and American Institute of Aeronautics and Astronautics, Anglo-American Aeronautical Conference, 12th, Calgary, Alberta, Canada, July 7-9, 1971, CASI Paper 72/5.* 7 p. Members, $1.25; nonmembers, $2.00.

The results of recent flyover noise tests show that the McDonnell Douglas DC-10 aircraft powered by General Electric CF6-6D engines is much quieter than the current jet transport aircraft powered by turbojet or low-bypass-ratio turbofan engines. Several major design features incorporated into the engine and the installation of the engine on the aircraft have accomplished the reduction in noise. The DC-10 will meet the noise level requirements established by the Federal Aviation Administration for new transport aircraft and will generate noise levels which are well below the requirements for takeoff and sideline noise. G.R.

A71-39451 Sound absorptive materials for aircraft noise control. Chris Arctander (Boeing Co., Seattle, Wash.). *Sound and Vibration,* vol. 5, Aug. 1971, p. 12-16.

Acoustical and physical treatments demanded of porous surfaces in engine acoustic treatments led to the development of perforated metal sheet, woven glass fiber sheet, sintered fiber metal sheet, sintered woven-screen sheet, and sintered continuous-filament sheet materials for this application. Evaluation procedures for selecting the suitable material in a specific situation are described, together with design procedures for obtaining a configuration that offers the best control of a given noise process. The characteristics of some specific materials used for minimizing equipment, systems, and internal noise are illustrated in graphs and tables. Necessary compromises of many factors involved in the final selection are demonstrated. T.M.

A71-39452 Problems of smoking and exhaust gas emission of turbine propulsion systems (Probleme des Rauchens und der Abgasemission von Turbinentriebwerken). Fritz Eisfeld (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Luftsaugende Antriebe, Braunschweig, West Germany). *DFVLR-Nachrichten,* Aug. 1971, p. 177-180. In German.

The increasing pollution of the air in connection with growing world energy needs is considered. The pollutants include soot particles, hydrocarbons, nitrogen oxides, carbon monoxide, and sulfur oxides. The emission of pollutants by automobiles and aircraft is considered. Investigations for reducing the emission of pollutants from aircraft by designing new engines were conducted. Local air deficiency and a fast rise in temperature in the aircraft turbine are responsible for the formation of carbon particles. The progress made regarding the reduction of various pollutants in the new engines is shown. General approaches are discussed for designing combustion chambers which will optimize conditions regarding the emission of harmful pollutants. G.R.

A71-39483 * Extension of a perturbation-expansion method to strong-interaction boundary-layer problems, with application to vorticity interaction. E. Dale Martin (NASA, Ames Research Center, Moffett Field, Calif.). *Zeitschrift für angewandte Mathematik und Physik,* vol. 22, July 25, 1971, p. 664-680. 12 refs.

An asymptotic expansion method previously developed by Martin (1967) for singular perturbation problems is modified and extended to treatment of strong interaction effects in a class of boundary layer problems. The modified method is applied to the study of the effect of free flow rotation on the boundary layer for a simplified hypersonic flow about a blunt body. The main modifications are parameter magnifications used in several different ways to eliminate the difficulties caused by strong vorticity interaction. In a logical progression, several different methods are developed, of which the final method yields Hayes' (1956) theory as the first term of an expansion solution. M.V.E.

A71-39497 Lamé's equation and its use in elliptic cone problems. R. S. Taylor and F. M. Arscott (Surrey, University,

Guildford, Surrey, England). *Institute of Mathematics and Its Applications, Journal,* vol. 7, June 1971, p. 331-336. 11 refs.

A new method is presented for solving Lamé's equation, which appears to have possibilities for application in a variety of problems where the basic geometry involves elliptic cones or an infinite sector, such a sector being a limiting case of an elliptic cone. The work on Lamé's equation is described, and a brief indication of its applications is given. M.V.E.

A71-39498 A new approach to the delta wing problem. R. S. Taylor (Surrey, University, Guildford, Surrey, England). *Institute of Mathematics and Its Applications, Journal,* vol. 7, June 1971, p. 337-347. 11 refs.

The 'delta-wing problem' involves a solution of Laplace's equation near the apex of an infinite sector, subject to certain boundary conditions; it is known that the solution involves r to the nu power, where r is the distance from the apex and nu is a parameter depending on the angle of the sector. The core of the problem is the determination of nu. This paper gives a new approach, based on the use of elliptic conal coordinates, and the solution of the resulting Lamé equation by a new perturbation technique. (Author)

A71-39505 The response of a turbulent boundary layer to a step change in surface roughness. I - Smooth to rough. R. A. Antonia and R. E. Luxton (Sydney, University, Sydney, Australia). *Journal of Fluid Mechanics,* vol. 48, Aug. 27, 1971, p. 721-761. 43 refs. Research supported by the Australian Research Grants Committee, the Australian Institute of Nuclear Science and Engineering, and the Commonwealth Scientific and Industrial Research Organization.

Discussion of wind tunnel experiments in which the response of a turbulent boundary layer to smooth-to-rough changes in surface conditions was studied using a smooth floor 8 ft long followed by a rough floor of similar length. The form drag method was used to determine the wall shear stress from pressure difference profiles near the tunnel wall step. Self-preservation of the mean velocity field is analyzed from plots of mean velocity defect profiles. A method for plotting mean profiles is set forth. Turbulent intensity data are analyzed in detail and the mixing length, the eddy viscosity distributions, the breakdown of inner layer similarity, and length scales on the rough wall are discussed. The measurements in the self-preserving boundary layer on the rough wall suggest that the turbulence intensity in the outer layer tends to follow the same self-preserving form as exhibited by the corresponding distributions on a smooth wall. V.Z.

A71-39543 Equations of an aircraft's form. Malcolm Sabin (British Aircraft Corp., Ltd., Weybridge, Surrey, England). *New Scientist and Science Journal,* vol. 51, Aug. 19, 1971, p. 410-412.

Three techniques have been used in determining the form of an aircraft. The first is a graphical approach borrowed from the shipbuilding industry. Lofting, as it is called, involves drawing out full-size a set of horizontal and vertical plane sections through the required surface. The main advantage of this approach is its directness. The second method is a development of the idea of representing a surface by plane sections through it. The plane sections are represented by algebraic curves. The third method uses equations in which the position of a general point of the surface is expressed as a vector function of two scalar parameters. G.R.

A71-39568 Three-dimensional nonlinear flow over finite symmetrical wings of arbitrary planform. H. Nørstrud (Lockheed-Georgia Co., Marietta, Ga.). *(U.S. National Congress of Applied Mechanics, 6th, Harvard University, Cambridge, Mass., June 15-19, 1970.) Acta Mechanica,* vol. 11, no. 3-4, 1971, p. 299-312. 20 refs.

An integral equation method is applied to the solution of the transonic small disturbance equation for finite wings in subsonic flows. The spanwise influence of the nonlinear compressibility sources is expressed in terms of Bessel and related functions. Additional nonlinear compressibility effects are considered two-dimensional. Numerical results for high aspect ratio wings approach correctly the corresponding planar values. Results obtained for slender pointed small aspect ratio wings are transformed to the solution of the equivalent body of revolution and are then favorable compared with the solution given by the method of local linearization. (Author)

A71-39569 A similarity law for flow with relaxation (Ein Ähnlichkeitsgesetz für Strömungen mit Relaxation). J. Zierep (Karlsruhe, Universität, Karlsruhe, West Germany). *Acta Mechanica,* vol. 11, no. 3-4, 1971, p. 313-318. 9 refs. In German.

Small perturbations of a stationary parallel flow with relaxation are considered. Starting point is the well-known partial differential equation for these phenomena, together with the boundary condition for the flow around slender wings. Four parameters characterize the problem: the Damköhler number, the frozen and the equilibrium Mach number, and the body thickness. An affinity transformation leads to the Prandtl-Glauert laws. However, two additional conditions for the first three of the parameters appear whose meaning and consequences are discussed. (Author)

A71-39608 # The performance of imaging sensors aloft. Paul Pryor (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). *Astronautics and Aeronautics,* vol. 9, Sept. 1971, p. 42-51. 46 refs.

The resolving power, contrast rendition, dynamic range, SNR, sensitivity, geometric fidelity, reliability, and data usefulness are explained as measures of the performance of remote image-forming sensors on satellites and aircraft. These measures are considered for different types of sensors in terms of effects brought about by altitude, temperature extremes and gradients, ambient pressure, humidity, radiation, electric and electromagnetic interference, and vehicle motion. Various methods of compensating for vehicle motion are described, and guidelines are given for matching sensor characteristics with vehicle constraints and data requirements. T.M.

A71-39766 # Speech intelligibility in the presence of time-varying aircraft noise. Carl E. Williams (U.S. Naval Aerospace Medical Center, Pensacola, Fla.), Karl S. Pearsons (Bolt Beranek and Newman, Inc., Canoga Park, Calif.), and Michael H. L. Hecker (Stanford Research Institute, Menlo Park, Calif.). *Acoustical Society of America, Journal,* vol. 50, Aug. 1971, pt. 1, p. 426-434. 16 refs. FAA-supported research.

This study concerns the question of whether or not the relation between intelligibility test scores and the Articulation Index (AI) established for steady-state noise can be used to predict speech intelligibility in the presence of time-varying aircraft noise. For various aircraft flyovers, intelligibility scores and several noise measures were obtained as functions of time. In addition, intelligibility scores and measures of AI were obtained for steady-state simulated aircraft noise. The relation between speech intelligibility and AI for time-varying noise was different from the relation obtained for steady-state noise. The various noise measures were almost equally effective in predicting speech intelligibility in the presence of time-varying aircraft noise. There is an appreciable disruption of contextual speech when the peak level of a flyover exceeds 88 PNdB, a speech-interference level of 68 dB, or an A-weighted sound-pressure level of 76 dB. (Author)

A71-39788 # Experimental investigation of turbulent boundary layers with suction (Eksperimental'noe issledovanie tur-

bulentnogo pogranichnogo sloia s otsosom). M. Ia. Arie and L. F. Kozlov (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR). *Gidromekhanika,* no. 17, 1971, p. 40-44. In Russian.

An investigation in a wind tunnel of rectangular (500 x 340 mm) cross section is described. The influence of uniformly distributed suction on the velocity profiles and the characteristics of a turbulent boundary layer is demonstrated. A formula for evaluating the ratio of local surface-friction coefficients on a flat plate with and without suction is derived on the basis of a comparison of the characteristics of a turbulent boundary layer on an impermeable plate and a plate with suction. V.P.

A71-39795 # **Plane turbulent semibounded jet on a porous surface (Ploskaia turbulentnaia poluogranichennaia struia na poristoi poverkhnosti).** A. M. Mkhitarian and A. P. Girol' (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Gidromekhanika,* no. 17, 1971, p. 82-88. 10 refs. In Russian.

An approximate method is discussed for calculating the boundary layer of an isothermal turbulent jet ejected from a narrow slot into a slipstream and expanding along a curvilinear porous surface. A semiempirical theory is applied to obtain in a closed form the expressions for the tangential friction stresses near the surface. Expressions are also derived for the flow velocity in the skin and stream regions of the boundary layer. The parameters of submerged and semibounded jets expanding over a porous surface can be calculated by this method. V.Z.

A71-39825 **Jaguar one-man band.** J. J. Cockburn (British Aircraft Corp., Ltd., London, England). *Flight International,* vol. 100, Aug. 26, 1971, p. 336-338.

The navigation and weapon-aiming system of the RAF Jaguar aircraft is described together with the main operational tasks of the pilot. Alignment of the inertial platform and preparation of the system for a sortie are discussed, and attention is given to types of information available from the projected map display, the horizontal situation indicator, and the head-up display. Planned and target-of-opportunity modes of attack are explained in terms of weapons aiming, aircraft approach, and weapons release functions. T.M.

STAR ENTRIES

N71-31611# Civil Aeronautics Board, Washington, D.C. Costs and Statistics Div.
AIRCRAFT OPERATING COST AND PERFORMANCE REPORT. VOLUME 4: FOR CALENDAR YEARS 1968 AND 1969
Aug. 1970 135 p refs
Avail: SOD $2.25

Unit cost and performance data are presented for transport aircraft operated by the Nation's certificated route air carriers during the 12 months ended December 31, 1968 and the 12 months ended December 31, 1969. Unit operating cost and performance data for turbine aircraft operated by the U.S. supplemental air carriers during the 12 months ended December 31, 1969 are also presented. Author

N71-31619# National Bureau of Standards, Washington, D.C.
DEVELOPMENT, TESTING, AND EVALUATION OF VISUAL LANDING AIDS Consolidated Progress Report, 1 Oct.–31 Dec. 1970
1 May 1971 11 p refs
(NBS-10-577) Avail: NTIS

The development, testing, and performance evaluation of visibility meters, airfield lighting and marking, and carrier lighting are reported. Field testing and evaluation of a backscatter visibility meter (shipboard), development of fog detectors, a review of natural horizon sky luminance observations, and transmissometers are included as well as the improvement and field testing of a cable fault locator, airfield lighting maintenance manual reviews, frangible *coupling impact tests, static load tests of semiflush lights,* photometric measurements of visual approach indicator and lamp lenses, electrical tests of isolating transformers, and the fabrication of a portable runway photometer. J.M.

N71-31623# Federal Aviation Administration, Washington, D.C. Systems Maintenance Service.
SYSTEMS MAINTENANCE PROGRAM EVALUATION CONDUCTED IN THE CENTRAL REGION Summary Report, 10–28 Aug. 1970
Nov. 1970 58 p refs
Avail: NTIS

The results of a comprehensive evaluation of the conduct of programs and activities directly related to or significantly affecting, the maintenance of commissioned airway facilities in the Central Region are set forth. The on-site data collection phase took place during the period August 10 - August 28, 1970. Program information was obtained by direct observation, by interviews, by on-site study of region, area, and sector prepared reports, records, and correspondence, and by postvisit analysis of other documents. The on-site phase encompassed visits of three areas, including Kansas City and ten AF Sectors. It included inspection of 47 facilities. Interviews were held with more than 200 employees including technicians, supervisors, and management officials at all levels of the AF organization. Discussions were held with area managers and the regional director as well as with air traffic controllers, flight inspectors, and other key officials in AT, FS, BU, PT, and other organizations. Author

N71-31624# Department of Transportation, Washington, D.C.
INVESTIGATION OF CHARTER AIRCRAFT SERVICES, VOLUME 1
5 Feb. 1971 82 p refs
(PB-197636) Avail: NTIS CSCL 01B

An-indepth investigation of charter operations utilizing large airplanes was conducted to determine the true condition of air charter operations. The investigation included activities peripheral to the commercial operation of large airplanes and any and all other factors affecting the safety of this segment of the aviation industry. It is agreed that the regulated air carriers and commercial operators are not fulfilling the total demands of the marketplace. However, the limited time allocated to the project precluded the full development of information relating to the magnitude of the requirement for air charter operations. E.M.C.

N71-31651# *Sylvania Electronic Systems-West, Mountain View,* Calif.
AN INTRUSION DETECTOR FOR PARKED AIRCRAFT
R. F. Bell *In* Kentucky Univ. Proc. of 1970 Carnahan Conf. on Electron. Crime Countermeas. Apr. 1970 p 239–246

Avail: NTIS

The technique and equipment developed to detect an individual touching an aircraft are described. The sensing technique is the change of electrical capacitance caused by the human touch. The system described differs from previous capacitive systems in that digital processing is used. This allows the detector to compensate more effectively for environmental changes and eliminate false alarms due to rain, wind, and snow. Also, the equipment may be operated by unskilled personnel since no adjustments are required. The basic detection technique may also be used in other security applications. Author

N71-31663# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
FREE-FLIGHT STATIC STABILITY MEASUREMENTS OF CONES IN HYPERSONIC FLOW
K. R. Enkenhus, S. Culotta, and P. Krogmann Jan. 1970 78 p refs
(VKI-TN-66) Avail: NTIS

Free-flight tests of 15 deg and 9 deg half-angle cones have been carried out in the VKI longshot free piston hypersonic tunnel at 15 and 23 M. The motion of the models was recorded by exposing successive images onto one photographic plate by use of a multiple spark light source. The lift and drag coefficients were calculated from the analysis of the trajectory using an IBM 1130 computer. The force coefficients agreed well with values obtained from force balance measurements $M = 20.3$ in a helium blowdown wind tunnel, but differed somewhat from Newtonian predictions. Author (ESRO)

N71-31683# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
CONCEPTS IN FAIL-SAFE DESIGN OF AIRCRAFT STRUCTURES
David Broek Mar. 1971 22 p refs
(Contract F33615-71-C-1067)
(AD-723317; DMIC-Memo-252) Avail: NTIS CSCL 1/3

In order to obtain an appraisal of the state of the art of fail-safe design, the author made an inventory of fail-safe design

methods applied by various aerospace companies and of research work relevant to the engineering approach of fatigue-crack propagation and residual strength. This memorandum is based on information from discussions with personnel of several companies and research laboratories, with the main emphasis on plane stress and transitional fracture behavior. The memorandum presents a brief description of the general approach to the fail-safe problem, an analysis of several of the existing methods that use this approach, including their shortcomings, and a summary of the data required for a good fail-safe design. A specific approach proposed for the presentation in MIL-HDBK-5 of data pertinent to the fail-safe design concept is evaluated in terms of its applicability to that concept. Author (GRA)

N71-31688# Brussels Univ. (Belgium). Inst. of Applied Mechanics.

ANALYSIS OF AN AIR CUSHION WITH PERIPHERAL JET HOVERING OVER WATER [LE MECANISME DU COUSSIN D'AIR A JET PERIPHERIQUE AU POINT FIXE SUR L'EAU]

A. Jaumotte, A. Kiedrzynski, P. Spehl, and P. Waterkeyn 1971 41 p refs In FRENCH

(NT-27-1971) Avail: NTIS

Observations made on both the experimental air cushion vehicle of Brussels University and a two dimensional mock-up have led to a model of peripheral jets. A theory is developed for nonviscous jets from which all parameters of the jet including form can be determined from independent variables. The theory is compared with experimental results. From the model secondary effects due to viscosity are discussed. ESRO

N71-31694# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

TRAJECTORY READOUT BY PROGRESSIVE ECLIPSING OF A PHOTO-ELECTRIC SCREEN TO OBTAIN AERODYNAMIC FORCE DATA FROM FREE-FLIGHT WIND TUNNEL MODELS

P. L. Clemens May 1971 30 p refs

(VKI-TN-72) Avail: NTIS

A newly designed photoelectric system has been used to measure aerodynamic forces on models in a longshot wind tunnel. The system makes use of a periodically interrupted light beam which is progressively eclipsed by the free-flight model. Electronic readout is provided. In early testing, the drag coefficient for a sharp conical model of 9 deg semiangle has been measured at zero attack angle and at a Mach number of 15 and a Reynolds number of 21 x 1,000,000 per m. Measurements by this method are compared with those from a previously used shadowgraph technique. The latter produce values of drag coefficient either higher (12.9%) or lower (11.1%) depending upon which of the two data reduction methods is applied. The value of C sub D given by the photoelectric system agrees, within 6.29%, with that given by Talbot's method. Author (ESRO)

N71-31695# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Instrumentierung und Anthropotechnik.

PARAVISUAL INDICATOR FOR ELECTRONIC DISPLAYS [PARAVISUELLE ANZEIGE FUER ELECTRONISCHE DISPLAYS]

Josef Thomas Mar. 1971 34 p refs In GERMAN; ENGLISH summary

(DLR-FB-71-27) Avail: NTIS; DFVLR Porz: 10 DM

The development of electronic aircraft displays facilitates new implementation methods for paravisual indication which could be more efficient than those used in the past. A method was developed for the electronic display of a checkerboard pattern moving in two axes on the screen of a cathode ray tube. The technique of digital symbol generation is described and some possible applications for this paravisual indication in aircraft are shown. Author (ESRO)

N71-31698# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

EXPLORATORY INVESTIGATION OF JET ENGINE SILENCING WITH PLUG NOZZLE CONFIGURATIONS

Terry D. Scharton, Benjamin J. Pinkel, and Suyed Tomooka 16 Apr. 1971 22 p refs

(Contract DOT-FA-SS-71-6)

(AD-722851; BBN-2089) Avail: NTIS CSCL 21/5

The objective in the present exploratory investigation was to determine experimentally whether significant silencing could be obtained with noise suppressors that could be conveniently incorporated within the plug nozzle configuration. The 1/3-octave band sound power radiated by the plug nozzle incorporating various suppressor concepts was compared with that of the conventional converging-diverging nozzle and with that of the conventional multi-tube nozzle noise suppressor. Comparisons were also made of the measured thrust of the various nozzles and of the directivity of the radiated sound. Shadow-graph pictures of the flow from some of the nozzles were obtained. The tests were made mainly at a ratio of nozzle total pressure to ambient pressure of 3 which is representative of the pressure ratios during take-off in high performance turbojet engines (jet Mach number approximately 1.4). Author (GRA)

N71-31706# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

BLADE PROFILE CALCULATION THROUGH A GRAPHIC VISUALIZATION CONSOLE [CALCUL DE PROFILS D'AUBES DE COMPRESSEUR A L'AIDE D'UNE CONSOLE DE VISUALISATION GRAPHIQUE]

Ginette Mortier and Claude Lecomte 1971 23 p In FRENCH; ENGLISH summary

(ONERA-NT-176) Avail: NTIS

A variant of the hodograph method is briefly presented, applied on the calculation of the compressible flow on a compressor blade cascade in Chaplygin fluid. This method leaves two arbitrary complex parameters; these are adjusted in order to obtain a hodograph, and thence a satisfactory profile and velocity distribution. This is done with the help of a visualization computer console permitting first to display the results as curves (hodograph, profile), and then to enter new values of the parameters before restarting the calculation. Author (ESRO)

N71-31723# Dynasciences Corp., Blue Bell, Pa. Scientific Systems Div.

HELICOPTER PAYLOAD CAPABILITY INDICATOR Final Report, May 1968 – Nov. 1969

E. Kisielowski and E. Fraundorf Aberdeen Proving Ground, Md. Army Land Warfare Lab. Mar. 1971 64 p refs

(Contract DAAD05-68-C-0366)

(AD-723436; LWL-CR-02M69) Avail: NTIS CSCL 14/2

A feasibility study was made of a helicopter payload meter concept. A simple, manually operated device was developed and tested, which gives an indication of payload capability in terms of gas generator speed for the prevailing atmospheric conditions where vertical take-offs and landings are required from a confined area. Tests were conducted by the U.S. Army Aviation Test Board, and the device was found to have military potential. Author (GRA)

N71-31727# Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.

STRUCTURAL ANALYSIS OF THE LASER CAMERA

MODULE AND ITS INSTALLATION FOR THE LASER AIRBORNE PHOTOGRAPHIC SCANNING SYSTEM (LAPSS) ON THE RA-5C AIRCRAFT ***Final Report***
Carl H. Acker 12 Feb. 1971 76 p refs
(AD-723820; NADC-AM-7031) Avail: NTIS CSCL 14/5

The report presents a structural analysis of the Laser Camera Module and its installation for the LAPSS (Laser Airborne Photographic Scanning System) on the RA-5C Aircraft. This analysis serves as substantiation for the structural integrity of the module and its installation for all normal flight and carrier operational conditions for the RA-5C Aircraft. Author (GRA)

N71-31744# Aviation Electric, Ltd., Montreal (Quebec).
CLOSURE TECHNIQUE FOR LARGE BEARINGS ON AIRCRAFT WHEELS Final Report, Aug. 1967 -Jun. 1969
Wright-Patterson AFB, Ohio ASD Mar. 1971 59 p
(Contract F33657-67-C-1527)
(AD-723679; AETR-13857; ASD-TR-70-52) Avail: NTIS CSCL 13/9

Aircraft wheels incorporating large bearings (10 inches diameter and larger) have been subject to problems relating to grease retention. The project included inspecting a number of F-4C aircraft wheels during overhaul at MacDill Air Force Base. Tests of various designs of seals were then conducted at Aviation Electric Limited to determine if a satisfactory method of sealing such bearings could be developed. As a result of the investigation, it was concluded that the failure of F-4C wheel bearings was due to loss of grease. Tests indicated that several orders of magnitude improvement in bearing seals could be realized. One design is directly interchangeable with existing seals and two designs require some wheel modification; however, these designs could be incorporated in new wheels with very little difficulty. Author (GRA)

N71-31763# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
THE AERODYNAMIC CHARACTERISTICS OF A VEHICLE TRAVELING IN A TUNNEL OF FINITE LENGTH Final Report, Oct. 1969 – Oct. 1970
S. William Gouse, Jr. and Ezzatt Wali Oct. 1970 93 p
(Contract DOT-FR-0007)
(PB-197871; CMU-59095-1) Avail: NTIS CSCL 20D

The dependence of the drag coefficient of a vehicle, moving coaxially with uniform linear velocity through a solid wall tube of finite length, on the ratio of the relative velocity of the induced fluid pushed ahead of the vehicle to the absolute velocity of the vehicle was investigated. An apparatus was built with a vertical acrylic test tube, 25 ft. high and 1.732 in. inside diameter. The tube was provided with water flow of different negative and positive pressure gradients. Drop tests were conducted using models with smooth surface, in the form of cylinders with a streamlined nose and conical tail. The mode of variation of the drag coefficient with the velocity ratio at model Reynolds number of 100,000 was experimentally established for the test parameters. Author (GRA)

N71-31766# Massachusetts Inst. of Tech., Cambridge.
SUMMARY OF RESEARCH AT MIT ON TECHNOLOGY FOR HIGH SPEED GROUND TRANSPORT Progress Report, 16 Nov. 1967 – 15 Sep. 1969
William W. Seifert 31 Aug. 1970 85 p refs
(Contract DOT-C-85-65)
(PB-198015; FRA-RT-71-71) Avail: NTIS CSCL 13F

Contents: Systems analysis and vehicle control; Vehicle suspension systems; Propulsion; Vehicle and tube aerodynamics; Some guideway considerations. GRA

N71-31771# Army Foreign Science and Technology Center, Charlottesville, Va.
HELICOPTERS IN THE NATIONAL ECONOMY
V. I. Biryulin et al 12 Mar. 1971 205 p Transl. into ENGLISH of the book "Vertolety V Narodhom Khozyaistre" Moscow, Transport Press, 1969 p 1 – 176
(AD-723594; FSTC-HT-23-1137-70) Avail: NTIS CSCL 1/3

This book summarizes the experiences of the use of helicopters in the national economy. Flying-technical and economic characteristics of helicopters are studied from the standpoint of their use in various branches of the national economy of the USSR. Problems of the operation of helicopters without heliports under various geographic and climatic conditions are discussed. The requirements placed on helicopters designed for various purposes and the prospects for the improvement of helicopters are discussed. This book is designed for flying and engineering-technical personnel, workers of enterprises and organizations, ministries and departments where helicopters are used. GRA

N71-31772# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AVIATION VERSUS SUBMARINES
I. M. Sotnikov et al 1 Mar. 1971 232 p refs Transl. into ENGLISH of the book "Aviats. Protiv Podvodnykh Lodok" Moscow, Izd-Vo Min. Oborony SSSR, 1970 206 p
(AD-723558; FTD-MT-24-02-71) Avail: NTIS CSCL 15/1

The contemporary state and the means of developing antisubmarine aircraft, helicopters and airships of capitalist governments, and also the aviation means of detecting and destroying submarines, or organizing conflicts with submarines, the methods of operational utilization and tactical application of aircraft in antisubmarine operations are reviewed. Author (GRA)

N71-31775# Frost Engineering Development Corp., Englewood, Colo.
INVESTIGATION OF MATERIALS FOR SEAT CUSHION AND PARACHUTE SUPPORT SPACER DEVELOPMENT Technical Report, Jan. 1968 – Sep. 1970
Ernest L. Stech and G. Kenneth Russell Wright-Patterson AFB, Ohio ASD Mar. 1971 61 p ref
(Contract F33657-67-C-1520)
(AD-723302; ASD-TR-70-56) Avail: NTIS CSCL 11/9

The report describes cushion material research and development which culminated in a special foam that offers a significant breakthrough in its ability to provide increased long-duration seating comfort simultaneously with reduction in the probability of spinal injury attributable to amplification of the vertical accelerations produced in upward ejections and crash landings.

Discovery of the new polyurethane material, designated as Frost XP-3, foam, is reported along with a summary of its properties and a method of approximating them by impregnation of a commercially available reticulated foam with polymeric materials. Author (GRA)

N71-31779# Air Pollution Control District, Los Angeles, Calif.
STUDY OF JET AIRCRAFT EMISSIONS AND AIR QUALITY IN THE VICINITY OF THE LOS ANGELES INTERNATIONAL AIRPORT
Apr. 1971 190 p
(Contract CPA-22-69-137)
(PB-198699; APTD-0662) Avail: NTIS CSCL 13B

The results of an investigation of the impact of jet aircraft operations on the air environment in the vicinity of a major air terminal are presented. The study, made at Los Angeles International Airport during the period of June 30, 1969, through November 18, 1970, had the following objectives: to determine total pollutant

emissions from aircraft and ground operations at a major airport; to conduct exhaust measurements on the Pratt and Whitney JT4A and JT9D engines to complete the available exhaust emission data for gas turbine engines; to measure atmospheric concentrations of pollutants at ground level within and around a major airport; and, to determine the carbon monoxide exposure in an aircraft cabin during all ground operations. GRA

N71-31781# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
SYNOPTIC AEROLOGICAL CONDITIONS FOR THE OCCURRENCE OF CLEAR AIR TURBULENCE [DIE SYNOPTISCH-AEROLOGISCHEN BEDINGUNGEN FUER DAS AUFTRETEN VON CLEAR-AIR-TURBULENZ]
F. Weber Bonn Bundeswehramt Aug. 1970 113 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMWg-FBWT-70-9) Avail: NTIS; Bundeswehramt, Bonn: 25 DM

Bibliography on practical clear air turbulence (CAT) is reported. This is followed by a representation of the results of CAT measurements based on board registrations and observations made by the Deutsche Lufthansa over the North Atlantic and during some other special flights on jet stream conditions. Vertical acceleration and bumpiness has been related to certain meteorological situations and different atmospherical parameters. It follows an illustration of the special synoptical-aerological conditions on which severe or moderate CAT can be expected by means of a demonstration of typical cases and a discussion of statistical studies on the frequency of the occurrence of bumpiness and on the expansion of the zones of turbulence. Author (ESRO)

N71-31782# Tracked Hovercraft, Ltd., London (England).
A COST COMPARISON OF THREE TRACKED AIR CUSHION VEHICLE CONFIGURATIONS Final Report
Jul. 1970 370 p refs
(Contract DOT-FR-9-0032)
(PB-197501; FRA-RT-71-68) Avail: NTIS HC $6.00/MF $0.95 CSCL 13F

A comparison is made of vehicle systems, using box, inverted-tee and channel cross section tracks. Each system is adapted to meet a common specification, which required 100 passenger, electrically powered, vehicles operating at 250 mph on an elevated guideway. The comparison is divided into sections: guideway assessment, vehicle design and performance, total system performance, and an essay on the concept of single-sided linear induction motors. Vehicle power requirements are based on a simple form of peripheral jet air-cushion suspension system which can be expected to be improved upon. Even with this assumption it is shown that the box track system would have the lowest total annual cost to an operator, due to the substantially lower costs of the box guideway. Author (GRA)

N71-31788# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Hauptabteilung Wissenschaft und Technik.
ON A NUMERICAL SOLUTION OF THE INTEGRAL EQUATION OF DUCTED PROPELLERS WITH A TIP CLEARANCE [ZUR NUMERISCHEN LOESUNG DER INTEGRALGLEICHUNG FUER MANTELSCHRAUBEN MIT SPALT]
Brigitte Overlach (Karlsruhe Univ.) 1971 39 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-15) Avail: NTIS; DFVLR Porz: 11.60 DM

The vortex distribution on the duct of a ducted propeller results from a singular Fredholm integral equation of the first kind. If there is a small tip clearance, the right hand side of the integral equation behaves nearly like a logarithmic singularity so that the solution almost has a jump at the propeller location. A numerical method is presented, which is based on a coordinate transformation smoothing the discontinuous behavior of the solution. Furthermore, the result is compared with other methods by use of numerical examples. Author (ESRO)

N71-31789# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Regelsysteme.
QUALIFICATION OF A HFB-320 HANSA AND A PIAGGIO P 149 D FOR INFLIGHT SIMULATION FOR THE APPROACH OF A COMBAT AIRCRAFT WITH HIGH WING LOADING [EIGNUNG EINER HFB-320 HANSA UND EINER PIAGGIO P 149 D ALS FLIEGENDER SIMULATOR FUER DEN LANDEANFLUG EINES KAMPFFLUGZEUGES HOHER FLAECHENBELASTUNG]
Bernd Uhrmeister 1971 83 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-06) Avail: NTIS; DFVLR Porz: 27 DM

The qualification of a HFB-320 Hansa and a Piaggio P 149 D as an inflight simulator for the approach of a heavy combat aircraft are compared. The principle of the modification being the response feedback technique. The validity of the simulation with actuators both lagging and being free from lag, was investigated by means of periods of time. A discussion follows about the simulator's sensitivity against lagging thrust and lagging actuators as well as errors in the derivatives of the basic aircraft. Simulated landing approaches were performed in a fixed base simulator to gain insight into the pattern of motion and steering progress and required control deflections of the inflight simulator. Author (ESRO)

N71-31791# National Aerospace Lab., Amsterdam (Netherlands).
THE APPLICABILITY OF FIRST AND SECOND ORDER THEORY FOR THE DETERMINATION OF SUBCRITICAL PRESSURE DISTRIBUTIONS ON NON-LIFTING AEROFOILS
H. I. Baurdoux and G. J. Schipholt Jun. 1969 21 p refs Sponsored by the Min. of Defence of the Neth.
(NLR-TR-69028-U) Avail: NTIS

Pressure distributions are calculated for a number of two dimensional nonlifting symmetrical quasi-elliptical airfoils with the uniformly valid first order theory and Gretler's second order theory. The results have been compared with exact solutions for incompressible and compressible subsonic flow. For nonelliptical nose shapes the results of the approximate theories may differ considerably from exact results. Author (ESRO)

N71-31793# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
EFFECTS OF SST TAKEOFF PROCEDURES ON NOISE EXPOSURE, AND REVIEW OF EPNL VARIATIONS WITH DISTANCE
Apr. 1971 57 p refs
(Contract DOT-FA-SS-71-8)
(AD-722366; BBN-2090) Avail: NTIS CSCL 20/1

The report summarizes the results of a study of noise exposure from supersonic transport (SST) operations and the estimation of changes in SST noise levels with distance, from currently available data. The report is presented in two parts. Part I describes a study of the effects of SST takeoff operational procedures on aircraft noise exposure for a simplified airport situation. Factors considered include aircraft mix, takeoff climb profiles and aircraft noise levels. Part II discusses methods of estimating variations of effective perceived noise level (EPNL) with slant distance for SST aircraft. Emphasis is placed on estimating these noise levels at large distances between the aircraft and the observer. Author (GRA)

N71-31805# Los Angeles Maintainability Association, Van Nuys, Calif.

MAINTAINABILITY SEMINAR

1 May 1971 119 p refs Conf. held at Inglewood, Calif., 1 May 1971

(AD-723227) Avail: NTIS CSCL 14/4

The lectures are centered around the entire spectrum of maintainability engineering which includes planning, requirements, allocation, design liaison, predictions, demonstration procedures, data analysis, collection, and corrective action procedures. The series are centered around a single seat Attack/Fighter aircraft. Author (GRA)

N71-31812# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.

THE TEST SECTION OF THE WIND TUNNEL FOR JET PROPULSION RESEARCH OF THE DFVLR AT TRAUEN [DIE MESSTRECKE DES WINDKANALS FUER ANTRIEBSFORSCHUNG DER DFVLR IN TRAUEN]

Reiner Lindemann and Egbert Riester Apr. 1971 45 p refs In GERMAN; ENGLISH summary

(DLR-MITT-71-08) Avail: NTIS; DFVLR Porz: 11,50 DM

After completion of the wind tunnel for jet propulsion research, its performance, and application possibilities are investigated. The facility is described and the range of its simulation capability is shown. The accuracy of the flow distribution in the test section is investigated along the tunnel axis and in several cross sections. The necessary adjustment data of the tunnel components, especially of those of the diffuser arrangement, are determined. With these data it is possible to consider the combination of the tunnel with the hot water ejector performance. Author (ESRO)

N71-31813# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PROPELLER TESTS IN THE LARGE SONIC WIND TUNNEL OF MODANE-AVRIEUX [ESSAIS D'HELICES DANS LA GRANDE SOUFFLERIE SONIQUE DE MODANE-AVRIEUX]

Alain Masson 1970 37 p refs In FRENCH; ENGLISH summary

(ONERA-NT-161) Avail: NTIS

The installation designed by ONERA for investigations on full-scale or large-scale models of conventional aircraft or convertiplane propellers in the large sonic wind tunnel at the Modane – Avrieux Test Center is described. Some examples of tests carried out and typical results obtained illustrate the use capability of the equipment, which is also suitable for helicopter rotor tests. Author (ESRO)

N71-31814# Grandes Souffleries de Modane-Avrieux (France).

OPERATION OF THE MODANE-AVRIEUX AEROTHERMODYNAMIC TEST CENTER [EXPLOITATION DU CENTRE D'ESSAIS AEROTHERMODYNAMIQUES DE MODANE-AVRIEUX]

Marcel Pierre and Guy Fasso Paris ONERA 1971 33 p In FRENCH; ENGLISH summary

(ONERA-NT-181) Avail: NTIS

The technical features of the facilities are briefly reported: four wind tunnels, the velocity of which range from 10 m/sec up to Mach 6 (eventually Mach 12), and auxiliary installations. The operational conditions of these test facilities are described: relations with customers, internal organization, technical development. The suitability of the Modane wind tunnels to the present aerospace needs is considered by a survey of the various test categories asked for: aerodynamics, propulsion, operational tests. The improvements foreseen for these facilities are indicated. Finally, the need for new industrial wind tunnels is examined. Author (ESRO)

N71-31815# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

AIRCRAFT, FIXED AND ROTARY WING Final Report

19 Mar. 1971 40 p refs

(AD-723411; MTP-7-3-021) Avail: NTIS CSCL 1/3

The procedure defines methods of evaluating performance of rotary and fixed wing aircraft in all phases of employment from ground handling to flight operations. Author (GRA)

N71-31882# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

TURBULENCE MODEL AT LOW ALTITUDES AND FLIGHT IN A TURBULENT ATMOSPHERE [TURBULENZMODELL IN BODENNAEHE UND FLUG IN TURBULENTER ATMOSPHAEHRE]

Dec. 1970 163 p refs In GERMAN; ENGLISH summary Presented at the Meeting of the DGLR Sci. Comm. on Flight Performance and Trajectories and Flight Characteristics, Darmstadt, West Ger., 12 – 13 Nov. 1970

(DLR-MITT-70-12) Avail: NTIS; ZLDI Munich: 34 DM

CONTENTS:

1. THE STRUCTURE OF ATMOSPHERIC TURBULENCE NEAR EARTH'S SURFACE W. Klug (Tech. Hochschule, Darmstadt) p. 7 – 20 refs

2. A MEASUREMENT SET-UP FOR DETERMINING ATMOSPHERIC TURBULENCE I. Schmidt (Luftwaffenamt) p 21 – 28

3. SYNOPTIC AEROLOGICAL CONDITIONS FOR THE OCCURRENCE OF CLEAR AIR TURBULENCE F. Weber (DFVLR, Oberpfaffenhofen) p 29 – 54 refs

4. DIGITAL SIMULATION OF RANDOM PERTURBATION VARIABLES (Tech. Hochschule, Darmstadt) p 55 – 86

5. THE SIGNIFICANCE OF TURBULENCE MODELS FOR THE CALCULATION OF THE STANDARD DEVIATION OF BALLISTIC MISSILES B. Weissenbach (Messerschmitt-Boelkow-Blohm, Ottobrunn) p 87 – 97

6. ON THE QUESTION OF PILOT INJURY DURING LOW ALTITUDE FLIGHT P. Schulz (Ver. Flugtech. Werke-Fokker, Bremen) p 99 – 117 refs

7. A SIMPLE CRITERION FOR REDUCTION OF MULTIPLE GUST LOADS WITH ACCELERATION CONTROL P. Hamel (Messerschmitt-Boelkow-Blohm, Ottobrun) and U. Graeberds (Messerschmitt-Boelkow-Blohm, Ottobrun) p 119 – 135 refs

8. COMPARISON OF THE INFLUENCE OF HORIZONTAL AND VERTICAL GUST INTERFERENCES ON AIRCRAFT LONGITUDINAL MOTION G. Schaenzer (Bodenseewerk Geraetetech.) p 137 – 141 refs

9. SIMULATION OF ATMOSPHERIC TURBULENCE, IN PARTICULAR ITS INFLUENCE ON AIRCRAFT YAWING MOTION W. Schattenmann (DFVLR, Oberpfaffenhofen) p 143 – 159 refs

N71-31885# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

SYNOPTIC AEROLOGICAL CONDITIONS FOR THE OCCURRENCE OF CLEAR AIR TURBULENCE [DIE SYNOPTISCH-AEROLOGISCHEN BEDINGUNGEN FUER. DAS AUFTRETEN VON CLEAR-AIR-TURBULENZ]

F. Weber *In* DGLR Turbulence Model at Low Altitudes and Flight in a Turbulent Atmosphere Dec. 1970 p 29 – 54 refs In GERMAN

Avail: NTIS; ZLDI Munich: 34 DM

The results of Lufthansa North Atlantic and European continent

jet stream clear air turbulence (CAT) observations are given. Vertical acceleration was related to certain meteorological situations and different atmospheric parameters. Special synoptic aerological conditions during which moderate or severe CAT can be expected are discussed. ESRO

N71-31889# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

A SIMPLE CRITERION FOR REDUCTION OF MULTIPLE GUST LOADS WITH ACCELERATION CONTROL [EIN EINFACHES KRITERIUM ZUR VERMINDERUNG DER BOEENLASTVIELFACHEN MITTELS BESCHLEUNIGUNGSREGELUNG]

P. Hamel and U. Graeber *In* DGLR Turbulence Model at Low Altitudes and Flight in a Turbulent Atmosphere Dec. 1970 p 119–135 refs In GERMAN

Avail: NTIS; ZLDI Munich: 34 DM

The possibility of an acceleration control for the reduction of multiple loads produced by air turbulence is investigated. It is found that the method of tune lift control results in the most optimal gust load reduction. ESRO

N71-31890# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

COMPARISON OF THE INFLUENCE OF HORIZONTAL AND VERTICAL GUST INTERFERENCE ON AIRCRAFT LONGITUDINAL MOTION [VERGLEICH DER EINFLUESSE HORIZONTALER UND VERTIKALER BOEENSTOERUNGEN AUF DIE FLUGZEUGLAENGSBEWEGUNG]

G. Schaenzer *In* DGLR Turbulence Model at Low Altitudes and Flight in a Turbulent Atmosphere Dec. 1970 p 137–141 refs In GERMAN

Avail: NTIS; ZLDI Munich: 34 DM

In determining the influence of gust loads on a noncontrolled longitudinal aircraft motion, it is shown to be necessary to take into account horizontal and vertical gust components, their frequencies and power spectra. ESRO

N71-31891# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.

SIMULATION OF ATMOSPHERIC TURBULENCE, IN PARTICULAR ITS INFLUENCE ON AIRCRAFT YAWING MOTION [SIMULATION DER ATMOSPHAERISCHEN TURBULENZ, INSBESONDERE DEREN EINFLUSS AUF DIE FLUGZEUGSEITENBEWEGUNG]

W. Schattenmann *In* DGLR Turbulence Model at Low Altitudes and Flight in a Turbulent Atmosphere Dec. 1970 p 143–159 refs In GERMAN

Avail: NTIS; ZLDI Munich: 34 DM

An atmospheric turbulence model according to Military Specification F 8785 A (USAF) is analyzed. It is shown that the dominant aircraft yaw motion is determined by the lateral gust velocity component and asymmetric vertical gust velocity component. ESRO

N71-31893# Smith (Wilbur) and Associates, Columbia, S.C.

SOUTH CAROLINA STATEWIDE AVIATION AND AIRPORTS PLAN

Nov. 1970 290 p refs Prepared for South Carolina State Planning and Grants Div., Columbia

(PB-197728; SC-40-0014-0260) Avail: NTIS CSCL 01E

The report outlines a statewide system of public use airports to accommodate the needs for air carriers and general aviation in South Carolina to the year 1980. A short-term plan to meet the demands to 1975 outlines immediate needs for upgrading 39 airports and removing general aviation from Charleston Municipal Air Force Base. The long term plan to 1980 would add several general aviation airports, relocate the North Myrtle Beach Airport and propose a regional airport in the Pee Dee area. Long range plans beyond 1985 recommend the addition of VSTOL airports as required. Emphasis was placed on the need for an integrated intermodal transportation system compatible with new types of aircraft, new modes of transportation and the ever changing location of industry. The future utilization of McIntire as a general aviation airport for Richland County and possible back-up air carrier facility for the Columbia Metropolitan Airport is discussed. Also such a facility could be considered, along with other east coast locations for accommodating international flights, after 1990. Author (GRA)

N71-31894# ARO, Inc., Arnold Air Force Station, Tenn.

AN INVESTIGATION OF SEVERAL SLOTTED WIND TUNNEL WALL CONFIGURATIONS WITH A HIGH DISC LOADING V/STOL MODEL Final Report, 1 Jul. 1966–30 Jun. 1970

T. W. Binion, Jr. AEDC May 1971 66 p refs

(Contract F40600-71-C-0002)

(AD-723294; AEDC-TR-71-77) Avail: NTIS CSCL 14/2

The investigation reported herein is the experimental portion of a unified theoretical and experimental search for a slotted wind tunnel wall configuration with minimal interference for conventional and V/STOL models. It is shown that theory and experiment are in excellent agreement for the classical case provided an appropriate expression is used to relate the wall geometry to the boundary condition. Classical data correction equations are not appropriate for the V/STOL case, however. An additional term, not predicted by theory, is needed to account for changes in the jet wake. Geometric parameters which influence the wall interference quantities are indicated. Wall configurations are shown which will produce interference-free force data to a jet-to-free-stream velocity ratio of 4.5. Author (GRA)

N71-31900# Battelle Memorial Inst., Columbus, Ohio.

THE FEDERAL R AND D PLAN FOR AIR POLLUTION CONTROL BY COMBUSTION-PROCESS MODIFICATION Final Report

11 Jan. 1971 352 p refs

(Contract CPA-22-69-147)

(PB-198066; APTD-0643) Avail: NTIS HC $6.00/MF $0.95 CSCL 13B

Results are reported of a study conducted for the Air Pollution Control Office to (1) identify gaps in combustion technology and (2) recommend a 5-year plan with priorities for effectively allocating resources for APCO supported combustion R and D directed toward meeting projected needs for air pollution control of energy conversion system by combustion modification. Combustion applications considered as elements of the plan include: central station power generation; industrial processing; industrial steam generation, commercial and residential heating; gas turbines and external combustion engines; and reciprocating internal combustion engines. A 5-year plan of combustion R and D is presented, with R and D opportunities identified and ranked in five priority levels. GRA

N71-31929# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Heterogene Stroemungen.

DEVELOPMENT OF A HEAT FLOWMETER FOR TEMPERATURES FROM 100 TO 300 C AND HEAT FLUXES FROM 1000 TO 10,000 kcal/sq m h AND ITS CALIBRATION [DIE ENTWICKLUNG EINES WAERMESTROMMESSERS FUER TEMPERATUREN VON 100 BIS 300 C BEI

WAERMESTROEMEN VON 1000 BIS 10000 kcal/m2 h UND SEINE EICHUNG]

Fritz Eisfeld, Klaus Pientka, Klaus-Juergen Schultz, and Wolf Splettstoesser Jan. 1971 33 p refs In GERMAN; ENGLISH summary

(DLR-MITT-71-07) Avail: NTIS; DFVLR Porz: 9.50 DM

The development and construction of a heat flowmeter for temperatures up to 300 C and a heat flux density up to 10,000 kcal/sq m.h are described. The design of an adequate calibration device as well as the performance of the calibration are presented, and the experience resulting from the first tests with the heat flowmeter, is communicated. The heat flow meter is to be applied to heat dissipation measurements of the insulation of an energy transportation system for hot exhaust gases of VTOL projects. Author (ESRO)

N71-31932# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AERODYNAMICS

D. M. Pritsker et al 23 Feb. 1971 283 p refs Transl. into ENGLISH of the book "Aerodinamika" Moscow, Izd. Mashinostr., 1968 p 1–310

(AD-723542; FTD-HC-23-640-70) Avail: NTIS CSCL 20/4

The text presents the fundamentals of the aerodynamics of modern aircraft. Laws governing the motion of the gas (air) and bodies in a gas flow are discussed; methods of applying these laws to a study of the aerodynamic characteristics of a wing, a propeller and the entire aircraft over a wide range of velocities are also discussed considering viscosity and compressibility of the flow. Also discussed are similarity laws for air flows, coordinate systems and aerodynamic coefficients expressing forces of interaction between the flow and the body, and the moments of these forces; formation of the boundary layer and control of it; aerodynamic heating of bodies and fundamentals of the aerodynamics of rarefied gases. GRA

N71-31933# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN INVESTIGATION OF THE APPLICABILITY OF LINEAR OPTIMAL CONTROL THEORY TO AIRCRAFT CONTROL SYSTEM DESIGN

Ancel R. Sherrard (M.S. Thesis) Mar. 1971 134 p refs

(AD-722652; GGC/EE/71-22) Avail: NTIS CSCL 1/3

Using steady-state linear regulator theory a longitudinal feedback control system is found for a hypothetical high-performance aircraft that operates through a wide range of Mach number and dynamic pressure. The aircraft stability derivatives vary statistically and the aircraft measurement sensors are affected by body bending responses. Linear approximations of the optimal feedback law gains are programmed as functions of Mach number and dynamic pressure, and the normal-acceleration elevator-step-response of the closed-loop aircraft is simulated. The simulated step responses are compared to a normal acceleration step response criterion envelope that is specified in the 1970 Joint Automatic Control Conference (JACC) Design Challenge. Author (GRA)

N71-31934# Boeing Co., Wichita, Kans.

PIVOTING WING RIDE SMOOTHING/FLUTTER SAS ANALYSIS Summary Report

Walter J. Wattman and James L. Townsend 3 May 1971 71 p refs

(AD-723321; D3-8597) Avail: NTIS CSCL 1/3

Rigid body studies conducted by Battelle and NASA-Langley have indicated that free floating pivoting wings can significantly reduce turbulence induced vertical accelerations. However, NASA-Langley has shown that a flexible pivoting wing can have an unacceptably low flutter speed. Presented in this document are the results of an analytical follow-on study conducted to determine the feasibility of increasing the flutter speed with an active or passive flutter stability augmentation system (SAS) while retaining significant ride smoothing capability. Author (GRA)

N71-31940# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

SAFETY Final Report

1 Mar. 1971 35 p refs.

(AD-723033; MTP-7-3-506) Avail: NTIS CSCL 1/3

Procedures are described for identifying safety hazards associated with aircraft armament, airframe, ejection seat, electrical systems, and mechanical systems. Checklists are furnished. Author (GRA)

N71-31951# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

FLIGHT MECHANICAL SIMULATION, GROUND BASED OR IN-FLIGHT ? [FLUGMECHANISCHE SIMULATION, AM BODEN ODER IN DER LUFT ?]

May 1971 253 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Symp., Duesseldorf, 4 Dec. 1970

(DLR-MITT-70-29) Avail: NTIS; ZLDI Munich: 53.15 DM

CONTENTS:

1. APPLICABILITY OF FLIGHT SIMULATORS WITHOUT VISUAL OR MOTION CUES FOR THE PILOT R. Schweinfurth (Ver. Flugtech. Werke-Fokker, Bremen) p 9–39 refs

2. THE INFLUENCE OF MOTION CUES ON PILOT ERRORS IN SIMULATED ILS APPROACHES F. Erdmann (DFVLR, Brunswick) and R. Dierke (DFVLR, Brunswick) p 41–48 refs

3. EFFICIENCY OF A FLIGHT SIMULATOR FOR SPECIAL MISSIONS H. M. Franke (Industrieanlagen-Betriebges.) and P. Sepp (Industrieanlagen-Betriebges.) p 49–69 refs

4. FLIGHT MECHANICAL TAKEOFF AND LANDING INVESTIGATIONS OF A VTOL AIRCRAFT WHEN USING DIFFERENT CONTROL SYSTEMS IN HOVERING FLIGHT H. Kolar (Messerschmitt-Boelkow-Blohm) and G. Schneider (Messerschmitt-Boelkow-Bloum) p 71–112 refs

5. FLIGHT MECHANICAL SIMULATION FROM THE USER'S POINT OF VIEW H. Friedrich (Dornier-Werke, Friedrichshafen) p 113–128

6. EVALUATION OF IN-FLIGHT SIMULATION USING A HELICOPTER OF VARIABLE STABILITY AND CONTROL WITH REGARD TO ITS USE AS AN AUXILIARY IN AIRCRAFT DEVELOPMENT H. Schmidtlein (Ver. Flugtech. Werke-Fokker, Bremen) p 129–168 refs

7. CONTRIBUTION TO THE SIMULATION MARGIN AND PARAMETER SENSITIVITY OF IN-FLIGHT SIMULATORS B. Uhrmeister (DFVLR, Oberpfaffenhofen) p 169–210 refs

8. THE IN-FLIGHT SIMULATOR HFB 320 HANSA: STATE-OF-THE-ART AND PLANNING A. Pietrass (DFVLR, Oberpfaffenhofen) p 211–235 refs

9. V/STOL TECHNIQUE AS AN APPLICATION FIELD OF IN-FLIGHT SIMULATION K. Janik (Messerschmitt-Boelkow-Blohm) p 237–253 refs

N71-31952# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

APPLICABILITY OF FLIGHT SIMULATORS WITHOUT VISUAL OR MOTION CUES FOR THE PILOT [VERWENDBARKEIT VON FLUGSIMULATOREN OHNE

SICHT- UND BEWEGUNGSEINDRUECKE DES PILOTEN]
R. Schweinfurth *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 9-39 refs In GERMAN

Avail: NTIS; ZLDI Munich: 53,15 DM

The pilot's role in cockpit simulation, the requirements of the simulator, and the validity of the factors influencing the simulation, are treated. The applicability of the fixed seat simulator in investigations of handling quality is demonstrated by comparisons of simulation and flight test. ESRO

N71-31953# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
THE INFLUENCE OF MOTION CUES ON PILOT ERRORS IN SIMULATED ILS APPROACHES [DER EINFLUSS VON BEWEGUNGSEINDRUECKEN AUF FUEHRUNGSFEHLER BEI SIMULIERTEN ILS-ANFLUEGEN]
F. Erdmann and R. Dierke *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 41-48 refs In GERMAN

Avail: NTIS; ZLDI Munich: 53,15 DM

The flight simulator at DFVLR-Braunschweig is briefly described (digital simulation, gust modes, motion simulation with three-axis system). A short description is given of the test results of using this simulator for ILS-approaches (Instrument Landing Systems) with and without motion. ESRO

N71-31954# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany). Hauptabteilung Wehrtechnische Studien.
EFFICIENCY OF A FLIGHT SIMULATOR FOR SPECIAL MISSIONS [UEBER DIE WIRKSAMKEIT EINES FLUGSIMULATORS FUER SPEZIELLE MISSIONEN]
H. M. Franke and P. Sepp *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 49-69 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 53,15 DM

The necessity of simulation during the early phase of design for the determination of the proper mission and the parameters that describe the vehicle is pointed out. A comparison of different simulation techniques (all digital simulation, fixed base simulation, and in-flight simulation) is made with respect to their relevance, flexibility, and cost. The installations of a universal simulation facility are described. A flight simulator is presented where special attention is given to sight simulation. Finally an example of a complex simulation problem is introduced. Author (ESRO)

N71-31955# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge-Entwicklung.
FLIGHT MECHANICAL TAKEOFF AND LANDING INVESTIGATIONS OF A VTOL AIRCRAFT WHEN USING DIFFERENT CONTROL SYSTEMS IN HOVERING FLIGHT [FLUGMECHANISCHE START- UND LANDEUNTERSUCHUNGEN EINES VTOL-FLUGZEUGES BEI VERWENDUNG VERSCHIEDENER STEUERSYSTEME IM SCHWEBEFLUG]
H. Kolar and G. Schneider *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 71-112 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 53,15 DM

Uses and quality of various control systems (attitude and speed control) during takeoff and landing of VTOL aircraft are determined. A yardstick for these two types of control was prepared based upon pilots' assessments and the measured data which were statistically analyzed. Various external conditions such as visibility and gusts, including a variation in the thrust-weight ratio were also treated in the investigation. Author (ESRO)

N71-31956# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
FLIGHT MECHANICAL SIMULATION FROM THE USER'S POINT OF VIEW [FLUGMECHANISCHE SIMULATION AUS DER SICHT DES BENUTZERS]
H. Friedrich *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 113-128 In GERMAN

Avail: NTIS; ZLDI Munich: 53,15 DM

Taking two examples, a project study of a STOL transport aircraft and the Dornier 31 development, the experiences of using a simulator with fixed cockpit are discussed. The simulation of the Do-31 on a simulator allowing 6 degrees of cockpit freedom at NASA Ames Research Center, is described. The possible new developments, resulting from the practical work, are discussed. ESRO

N71-31957# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
EVALUATION OF IN-FLIGHT SIMULATION USING A HELICOPTER OF VARIABLE STABILITY AND CONTROL WITH REGARD TO ITS USE AS AN AUXILIARY IN AIRCRAFT DEVELOPMENT [AUSWERTUNG VON FREIFLUGSIMULATIONEN MIT EINEM HUBSCHRAUBER VARIABLER STABILITAET UND STEUERBARKEIT IM HINBLICK AUF SEINE EIGNUNG ALS HILFSMITTEL BEI DER FLUGZEUGENTWICKLUNG]
H. Schmidtlein *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 129-168 refs In GERMAN

Avail: NTIS; ZLDI Munich: 53,15 DM

A helicopter Bell 47-G was used to simulate the flight characteristics of a VFW/Fokker V/STOL flying platform to see whether its properties are well enough transmitted to the pilot, and also to study the pilot's reaction in case of vertical takeoff control system breakdown, and to optimize the maneuverability of the vertical takeoff aircraft by nonlinear positioning. ESRO

N71-31958# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
CONTRIBUTION TO THE SIMULATION MARGIN AND PARAMETER SENSITIVITY OF IN-FLIGHT SIMULATORS [BEIT RAEGE ZUR SIMULATIONSBREITE UND PARAMETEREMPFINDLICHKEIT VON FLIEGENDEN SIMULATOREN]
B. Uhrmeister *In* DGLR Flight Mech. Simulation, Ground Based or In-Flight May 1971 p 169-210 refs In GERMAN

Avail: NTIS; ZLDI Munich: 53,15 DM

A formula for calculating the simulation margin and the parameter sensitivity of in-flight simulation is derived from the root locus analysis of a control system. The relation between the flight characteristics of the original aircraft and its model and the simulation margin are discussed. ESRO

N71-31959# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
THE IN-FLIGHT SIMULATOR HFB 320 HANSA: STATE-OF-THE-ART AND PLANNING [DER FLIEGENDE SIMULATOR HFB 320 HANSA: STAND UND PLANUNG]
A. Pietrass *In* DGLR Flight Mech. Simulation, Ground Based or In-Flight May 1971 p 211-235 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 53,15 DM

The auxiliary equipment necessary for the in-flight simulator has been combined in several subsystems, connected via specific

interfaces. Subsystems are electrical regulating system, command system of the simulated pilot with load simulation, display system of the simulated pilot, onboard computer and measuring equipment. These subsystems will be ready in 1971. ESRO

N71-31960# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Drehfluegler.
V/STOL TECHNIQUE AS AN APPLICATION FIELD OF IN-FLIGHT SIMULATION [V/STOL-TECHNIK ALS ANWENDUNGSGEBIET FUER DIE SIMULATION IM FLUG]
K. Janik *In* DGLR Flight Mech. Simulation, Ground Based or In-flight May 1971 p 237–253 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 53,15 DM

It is shown that the problems of mission-oriented handling qualities of future V/STOL aircraft can best be solved by means of in-flight simulation. THE MBB-BO 105 light helicopter with hingeless rotor is described as being particularly suited for the simulation. Author (ESRO)

N71-32025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A GENERAL FATIGUE PREDICTION METHOD BASED ON NEUBER NOTCH STRESSES AND STRAINS Final Report
John M. Potter Feb. 1971 35 p refs
(AD-723631; AFFDL-TR-70-161) Avail: NTIS CSCL 20/11

A new combination of the Neuber parameter and stress-strain data is proposed and investigated for a completely general graphic analysis of cycle-by-cycle notch stress level. The proposed analysis is applied to two common aircraft structural materials, 2024-T4 and 7075-T6. Life to failure predictions based on the graphically derived notch stress levels compare very favorably with constant stress amplitude notched coupon results. Author (GRA)

N71-32059# North American Rockwell Corp., Columbus, Ohio.
INTERNAL AERODYNAMICS MANUAL, VOLUME 1
Jun. 1970 426 p refs
(Contract NOw-66-0460-d)
(AD-723823; NR68H-434-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 21/5

The Internal Aerodynamics Handbook has been developed in order to provide a convenient, accurate and reliable internal aerodynamics design manual which enables rapid determination of the internal airflow effects on airplane performance. It also enables the computation of internal airflow systems performance by developed theoretical and empirical methods. The scope of the design manual relates specifically to internal aerodynamics for the complete aircraft speed range up to and including Mach 3.5. In addition to the detailed data and methods presentation, an extensive bibliography is provided. Author (GRA)

N71-32060# North American Rockwell Corp., Columbus, Ohio.
INTERNAL AERONAUTICAL MANUAL, VOLUME 2
Jun. 1970 516 p refs
(Contract NOw-66-0460-d)
(AD-723824; NR68H-434-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 21/5

The Internal Aerodynamics Handbook has been developed in order to provide a convenient, accurate and reliable internal aerodynamics design manual which enables rapid determination of the internal airflow effects on airplane performance. It also enables the computation of internal airflow systems performance by developed theoretical and empirical methods. The scope of the design manual relates specifically to internal aerodynamics for the complete aircraft speed range up to and including Mach 3.5. Author (GRA)

N71-32061# North American Rockwell Corp., Columbus, Ohio.
INTERNAL DYNAMICS MANUAL, APPENDIX
Jun. 1970 597 p refs
(Contract NOw-66-0460-d)
(AD-723841; NR68H-434-App) Avail: NTIS HC $6.00/MF $0.95 CSCL 21/5

The report is organized into six sections and consists of tabulations that will facilitate theoretical thermodynamic calculations. These sections of the Appendix are: basic thermodynamic relationships, normal shock wave parameters, two-dimensional shock wave parameters, three-dimensional shock wave analysis, corrected weight flow parameters, and parameters for thrust calculation. Author (GRA)

N71-32065# Center for Naval Analyses, Arlington, Va. Inst. of Naval Studies.
A SIMULATION AND QUEUING MODEL FOR THE STUDY OF EN ROUTE AIR TRAFFIC SYSTEMS
Leon M. Kaatz Feb. 1971 49 p refs *Its* Res. Contrib. No. 169
(AD-721726) Avail: NTIS CSCL 17/7

Air traffic congestion at airports and along major jet routes are the primary sources of concern with the airspace system. This paper describes 2 related mathematical models to study these problems. The first model is a simulation of en route traffic. It defines a quantity called the congestion index and relates this to the level of air traffic and the level of investment in the airspace system. The second model is a queuing model used to study congestion and average flight delays at points of jet route intersections. The models consider only high altitude IFR flights but allow for parameterization of plane speeds, separation criteria, available jet routes, and airport operations capacity. The models do not look at holding and takeoff patterns around an airport. Author (GRA)

N71-32074# Defense Documentation Center, Alexandria, Va.
FUEL AND PROPELLANT TANKS, VOLUME 1 Report Bibliography, Sep.–Oct. 1970
May 1971 78 p refs
(AD-723920; DDC-TAS-71-15-1-Vol-1) Avail: NTIS CSCL 13/4

Unclassified annotated references are compiled from the Defense Documentation Centers holding on tanks. The topics and subjects covered vary from anti-icing, anti-bacterial additives, to the vibrational, and structural effects of space environmental conditions and travel. Author (GRA)

N71-32077# National Aviation Facilities Experimental Center, Atlantic City, N.J.
CRASH RESISTANT FUEL SYSTEMS DEMONSTRATIONS AND EVALUATION Final Report, 1966–1970
Hugo P. Scheuerman Aug. 1971 31 p refs
(FAA-NA-71-34; FAA-RD-71-27) Avail: NTIS

A crash-resistant bladder fuel tank system incorporating crash actuated valves and crash-resistant bladder material was impact tested in full-scale wing assemblies. The tests were conducted under realistic crash load conditions simulating survivable accidents at approximately 25 mph to 75 mph. Weight and volume changes incurred by the crashworthy features installed are outlined. Author

N71-32078# Dow Chemical Co., Midland, Mich.
CHEMICAL AND PHYSICAL STUDY OF FUELS GELLED WITH HYDROCARBON RESINS Final Report, 22 Jun. 1970–2 Feb. 1971
R. E. Erickson and R. M. Krajewski Jul. 1971 104 p

(Contract DOT-FA70NA-496)
(FAA-NA-71-17; FAA-RD-71-34) Avail: NTIS

A gelled fuel was modified to achieve low viscosity at low shear while maintaining significant resistance to fire while in the misting condition. The modified gelled fuel has been rheologically profiled using a variety of rheometers. Test data on flowability, rheological characteristics, and simulated crash fire misting hazard are included in the report. Author

N71-32080# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.

AEROMEDICAL TRANSPORTATION AND GENERAL AVIATION

Harry L. Gibbons and Carl Fromhagen Apr. 1971 11 p refs
(FAA-AM-71-18) Avail: NTIS

Fixed-wing secondary ambulance service is growing at a rapid rate without the benefit of studies such as those pertaining to helicopter primary ambulance service. Problems associated with this growth relate to equipment, crew training, and knowledge of the physiology of flight. Legislative and/or education efforts are needed to assure optimum general aviation patient transportation. Author

N71-32084# National Aviation Facilities Experimental Center, Atlantic City, N.J.

EVALUATION OF FLIGHT PLAN, POSITION INFORMATION DISPLAY FOR OCEANIC CONTROL Final Report, May 1970–Jan. 1971

Anthony J. Spingola, W. Robert McCosker, and Richard L. Sulzer Jul. 1971 50 p refs
(FAA-NA-71-21; FAA-RD-71-38) Avail: NTIS

Tests were conducted using flight data paralleling that entering oceanic sectors to evaluate the concept and measure the accuracy of using computer generated flight plan position information as presented on pictorial and tabular displays for oceanic air traffic control. Actual flight progress strip data were tabulated to show the relations among flight plans, estimated times of arrival updated en route, and actual times of arrival over fixes. Experienced oceanic controller teams were trained in the use of an interactive graphic display system. Results of the analysis of flight progress strips indicated that the standard deviation of differences between pilot estimated times at reporting fixes and actual time taken at 515 data points was 3.2 minutes. Author

N71-32085# National Aviation Facilities Experimental Center, Atlantic City, N.J.

A 1585 MHz GLIDE SLOPE SYSTEM Final Report, Sep. 1967–Nov. 1970

John E. Townsend Aug. 1971 31 p
(FAA-NA-71-15; FAA-RD-71-50) Avail: NTIS

Test and evaluation of a glide slope system operating in the 1585 MHz frequency range were conducted. The system uses a directional waveguide antenna that forms beams in space that are independent of ground reflections. Based on the data obtained from the tests performed, it was determined that a glide slope operating in the 1585 MHz frequency range is feasible, but certain improvements are necessary to the present system to make it operational. Author

N71-32086# Federal Aviation Administration, Washington, D.C.

SECOND FEDERAL AIRCRAFT NOISE ABATEMENT PLAN, FY 1970–1971

Jan. 1971 65 p refs
Avail: SOD $0.65; NTIS

The causes of aircraft noise and programs to reduce the disturbances caused by aircraft noise are discussed. Subjects presented are: (1) milestones in noise abatement, (2) aircraft noise and the urban environment, (3) sonic boom phenomenon, and (4) research and development programs, government and non-government supported, for noise abatement. Author

N71-32087*# National Aviation Facilities Experimental Center, Atlantic City, N.J.

SMALL SCALE IMPACT TESTS OF CRASH SAFE TURBINE FUELS Final Report, 1964–1970

Ralph A. Russell, Jr. Aug. 1971 48 p refs
(FAA-NA-71-12; FAA-RD-71-49) Avail: NTIS

A variety of regular and modified hydrocarbon-turbine fuels, one nonhydrocarbon fuel, and reticulated polyurethane foam filled with neat fuel was subjected to small-scale impact tests to determine burning, misting, and splatter characteristics of the fuels. The results of this study conclude that it is entirely feasible to retard the ignitibility, combustibility, and flow characteristics of current hydrocarbon fuels by increasing their apparent viscosity. The study showed that non-Newtonian gelled fuels performed better than other modified fuel candidates and better than the reticulated polyurethane foams filled with neat fuel. Author

N71-32144*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INFLIGHT THRUST MEASURING SYSTEM FOR UNDERWING NACELLES INSTALLED ON A MODIFIED F-106 AIRCRAFT

Harold W. Groth, Nick E. Samanich, and Philip Z. Blumenthal Washington Aug. 1971 33 p refs
(NASA-TM-X-2356; E-5557) Avail: NTIS CSCL 21E

An F-106 aircraft was modified for use as a flight test bed to evaluate powerplant system performance using two underwing nacelles containing afterburning J85-13 engines. A calibration program was conducted to determine the random error of the thrust measuring system in evaluating flight performance of exhaust nozzles. The random error in the determination of a nacelle tare drag was nearly Gaussian and provided a repeatability of + or − 1.0 percent in the calculation of nozzle performance for 68 percent of the data. Author

N71-32156*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF PREDICTED AND EXPERIMENTAL WALL TEMPERATURES FOR A CYLINDRICAL EJECTOR EXHAUST NOZZLE OPERATED WITH A TURBOJET GAS GENERATOR

Arthur Lieberman Washington Aug. 1971 57 p refs
(NASA-TN-D-6465; E-6300) Avail: NTIS CSCL 21E

The shroud wall temperatures during operation with and without an afterburner are predicted analytically by using a wall heat balance of hot gas radiation, coolant convection, internal and external radiation, and external free convection. The Hatch–Papell film-cooling correlation predicts an adiabatic wall temperature which is used as the driving temperature for the coolant heat transfer. Ejectors with nozzle area ratios from 1.65 to 2.75 and ejector length to primary diameter ratios from 1.63 to 1.95 were tested. Tests were conducted at nozzle pressure ratios ranging from 2.0 to 6.3, primary total temperatures from 861 to 1939 K (1550 to 3490 R), and corrected secondary weight-flow ratios from 0.027 to 0.088. The predictions yielded reasonably good results throughout the range of conditions tested. Author

N71-32185*# Techtran Corp., Glen Burnie, Md.

PROGRESS IN AERODYNAMICS AND AIRCRAFT DESIGN IN THE UKRAINE IN 1920–1930 [DOSLIDZHENNYA Z

TEORIY LITAKOBUDUVANNYA V UKRAINI V 1920–1930 RR]

Stephan G. Prociuk Washington NASA Aug. 1971 32 p refs Transl. into ENGLISH from Visti Ukr. Inzh., v.20, no. 4, 1969 p 72–87

(Contract NASw-2037)

(NASA-TT-F-12878) Avail: NTIS CSCL 01A

A review of developments in Ukrainian science and technology during the 1920's and early 1930's is presented, emphasizing progress in the fields of aeronautics and aircraft construction and design. The involvement of many Ukrainian scientists in the work of the Central Aerohydrodynamic Institute in Moscow is discussed. The point is also made that number of major contributors were Ukrainians and not Russians. The development of aviation schools, particularly those in Kharkow and Kiev, and construction factories is also summarized. Author

N71-32211*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 1.60 TO 2.16 OF A BLUNT-NOSE MISSILE MODEL HAVING A TRIANGULAR CROSS SECTION AND FIXED TRIFORM FINS

William J. Monta Washington Aug. 1971 27 p

(NASA-TM-X-2340; L-7179) Avail: NTIS CSCL 01A

A wind tunnel investigation has been conducted to determine the aerodynamic characteristics of a triform finned missile configuration having a body of triangular cross section and a flat-faced nose. The investigation included the effects of nose corner radius, fin span, and fin asymmetry for providing rolling moment. The tests were conducted at Mach numbers of 1.60, 1.75, and 2.16, for a unit Reynolds number of 8.2 × 1 million per meter (2.5 × 1 million per foot). The angle of attack was varied from about −6 deg to 20 deg for a series of model roll orientations between 0 deg and 180 deg. Author

N71-32303*# LTV Aerospace Corp., Dallas, Tex. Vought Missiles and Space Div.

GEOMETRIC, AERODYNAMIC, AND KINEMATIC CHARACTERISTICS OF TWO TWIN KEEL PARAWINGS DURING DEPLOYMENT

Paul M. Kenner, Frederic T. Churchill, and Ralph B. Holt Washington NASA Aug. 1971 69 p refs

(Contract NAS1-6957)

(NASA-CR-1788) Avail: NTIS CSCL 01B

The results are presented of an analysis of flight test data on two intermediate size (5000 lb payload) twin keel parawings. Kinematic data on various points on each canopy were determined along with establishing forces for two stages of inflation. Transient aerodynamics produced pressure differentials as high as five times the dynamic pressure of the free stream. Local structural failures are attributed to impulsive arresting of spanwise expansion and abrupt reversals in curvature during chordwise expansion. Author

N71-32305# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INERTED FUEL TANK OXYGEN CONCENTRATION REQUIREMENTS Interim Report, Jan.–Mar. 1971

Samuel V. Zinn, Jr. Aug. 1971 21 p refs

(FAA-NA-71-26; FAA-RD-71-42) Avail: NTIS

A literature search was conducted to investigate the extent of experimental work and studies that were performed for determining and evaluating safety parameters of jet fuels in aircraft tanks when using nitrogen as a inerting agent. The search revealed that extensive laboratory studies have been made during the past 30 years and that safety zones can be predicted over a wide range of conditions and environments. As a conclusion from this search, it is considered that an oxygen content up to 9 percent in the effluent obtained by nitrogen inerting will produce an incombustible environment. Author

N71-32307*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LIFT INDUCED ON A SWEPT WING BY A TWO-DIMENSIONAL PARTIAL-SPAN DEFLECTED JET AT MACH NUMBERS FROM 0.20 TO 1.30

Blake W. Corson, Jr., Francis J. Capone, and Lawrence E. Putnam Washington Aug. 1971 66 p refs

(NASA-TM-X-2309; L-7707) Avail: NTIS CSCL 01A

An exploratory investigation was conducted in the 16-foot transonic tunnel at Mach numbers from 0.20 to 1.30 to determine the induced lift characteristics of a body and swept-wing configuration having a partial-span two-dimensional propulsive nozzle with exhaust exit in the notch of the swept-wing trailing edge. The effects on wing-body characteristics of deflecting the propulsive jet in the flap mode at nominal exhaust-nozzle deflection angles from 0 to 30 deg were studied. The Reynolds number based on wing mean geometric chord varied from 1.35 million to 3.86 million. Author

N71-32330# Naval Research Lab., Washington, D.C.

SIMULATION OF AADC SYSTEM OPERATION WITH AN E-2-B PROGRAM WORKLOAD Interim Report

William R. Smith 22 Apr. 1971 56 p refs

(AD-723521; NRL-7259) Avail: NTIS CSCL 9/2

Modeling and simulation of the proposed Naval Advanced Avionic Digital Computer (AADC) has been undertaken in order to study system performance and arrive at optimum hardware configurations. Author (GRA)

N71-32349*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NEW DIRECTIONS IN MATERIALS RESEARCH DICTATED BY STRINGENT FUTURE REQUIREMENTS

S. S. Manson 1971 80 p refs Presented at Intern. Conf. on the Mech. Behavior of Materials, Kyoto, 15–20 Aug. 1971

(NASA-TM-X-67885) Avail: NTIS CSCL 11D

The stringent materials requirements associated with advanced projects such as automotive thermal reactors, jet engines, space shuttle and space nuclear power systems are outlined. Specific results are cited for metal and polymer matrix materials, dispersion strengthening, directional solidification, powder metallurgy, and materials of novel composition. Cryogenic fatigue and fracture, as well as high temperature creep and fatigue are also discussed, with the emphasis placed on new facilities and new analytical techniques that are being developed to treat these problems. Author

N71-32369*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

FULL-SCALE WIND TUNNEL TESTS OF A LOW-WING, SINGLE-ENGINE, LIGHT PLANE WITH POSITIVE AND NEGATIVE PROPELLER THRUST AND UP AND DOWN FLAP DEFLECTION

Edward Seckel and James J. Morris Washington NASA Aug. 1971 152 p ref

(Contract NAS1-9443)

(NASA-CR-1783; Rept-922) Avail: NTIS CSCL 01B

Full scale wind tunnel data for a low-wing single-engine light airplane, with up and down flap deflections and a range of negative through positive propeller thrust, are presented. The data

are analyzed to determine the effects of flap deflection, propeller thrust and angle-of-attack on the aerodynamic characteristics of the airplane. Longitudinal and lateral directional static stability, control, and trim characteristics are considered in some detail. Author

N71-32370*# Northrop Corp., Hawthorne, Calif.
MODEL TESTS OF CONCEPTS TO REDUCE HOT GAS INGESTION IN VTOL LIFT ENGINES
Gordon R. Hall Washington NASA Jul. 1971 157 p refs
(Contract NAS3-10498)
(NASA-CR-1863) Avail: NTIS CSCL 01B

An investigation was performed to determine the relative effectiveness of various exhaust gas ingestion suppression concepts for application to VTOL aircraft. The test model used in the investigation was a small-scale simulated VTOL lift engine pod containing two engines. Ingestion control concepts included: (1) shielding devices integral with the engine pod which act to deflect the reflected upwash gases away from the inlets; (2) concepts designed to alter the issuing exhaust jets (such as exhaust vectoring and jet suppression nozzles); and (3) ground plane platforms which alter the impingement process of the exhaust jets on the ground so that the potential upwash is laterally removed from the engine proximity. Effectiveness of the various ingestion control concepts was based on comprehensive measurements of the inlet thermal environment as well as upon the effect the concept had in altering the structure of the near flow field. The majority of concepts evaluated were found to be effective in producing major reductions in exhaust gas ingestion at low wind conditions. However, none were found to be totally effective in eliminating hot gas ingestion at all wind conditions tested, particularly with the model exposed to crosswinds. Author

N71-32385*# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.
FEASIBILITY STUDY OF A BIDIRECTIONAL JET FLAP DEVICE FOR APPLICATION TO HELICOPTER ROTOR BLADES, PHASE 1 *Final Report, 6 Jun. 1967 – 3 Oct. 1969*
R. E. Rose, J. M. Hammer and A. P. Kizilos Jul. 1971 157 p refs
(Contract NAS2-4389)
(NASA-CR-114359; Rept-12081-FR1) Avail: NTIS CSCL 01B

A bidirectional jet flap device called the Variable Deflection Thruster (VDT) has been investigated for possible application to helicopter rotors. The study is part of a long-range program to develop blown control techniques for stabilizing the higher harmonic modes of helicopter rotors. A three-sectioned, two-dimensional VDT-blade model was designed with individually controlled VDT jet flaps in each section. Steady-state wind tunnel tests were conducted with various combinations of VDT-blade section blowing and with the VDT-blade center section only. Dynamic tests were conducted with the VDT jet oscillating at various frequencies. Fair agreement was obtained between theory and experimental results. The results show that the VDT is an effective lift-producing device with simultaneous drag reduction. The VDT-blade lift can be sensed from the differential pressure at midchord. This pressure signal can be amplified using fluidic circuitry and used to automatically control the VDT-blade lift. The dynamic results indicate that the ratio of dynamic lift to steady-state lift increases with increased VDT jet oscillation frequency for a constant oscillation angle. It is indicated that the dynamic response of the VDT device is less than 8 msec (corresponding to a phase angle of approximately 0.5 radian) for a jet oscillation frequency of 10 Hz. Author

N71-32447# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.
GENERAL AVIATION STRUCTURES DIRECTLY RESPONSIBLE FOR TRAUMA IN CRASH DECELERATIONS
John J. Swearingen Jan. 1971 217 p
(FAA-AM-71-3) Avail: NTIS

An analytical study of general aviation accident injuries is presented. Needs for improvement of both the crash design of the interior of the cockpit and the structural integrity of the cockpit itself are clearly illustrated. The author concludes, after many detailed analyses, that many present-day general aviation aircraft *with their rigid instrument panels studded with heavy instruments*, protruding knobs and sharp edges, along with a lack of slow-return padding and very inadequate restraint equipment, are producing fatal or very serious injuries during low cabin crash decelerations. Again based on the author's calculations, it is not uncommon for light aircraft cabins to start to disintegrate and/or collapse on the occupants if the crash forces exceed 9 or 10 g. And yet, some manufacturers have produced aircraft for aerial application that have cockpits that can withstand up to 40 g. Engineering design changes can sharply reduce the death and injury rate in general aviation accidents. Author

N71-32452*# Translation Consultants, Ltd., Arlington, Va.
AEROELASTIC STABILITY OF PLANE SANDWICH-TYPE STRUCTURES PLACED IN A CURRENT OF SUPERSONIC GAS [STABILITATEA AEROELEASTICA A STRUCTURILOR PLANE DE TIP SANDVIS, PLASATE INTR-UN CURENT DE GAZ SUPERSONIC]
L. Librescu et al Washington NASA Aug. 1971 30 p refs Transl. into ENGLISH from Stud. Cercert. Mec. Apl. (Romania), v. 30, no. 1, 1971 p 171 – 196
(Contract NASw-2038)
(NASA-TT-F-13778) Avail: NTIS CSCL 01B

Particular attention is devoted to the problem of the aeroelastic stability of infinite sandwich panels. The influence of the parameter which expresses the flexibility of the transverse shear of the structure and the parameter connected with the axial loads on the critical magnitudes (flutter and divergence) is investigated. The conclusions reached in other recent works regarding the lack of agreement between a series of results in this field obtained in exact and approximate fashion are examined and justified. Author

N71-32453*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
THEORETICAL INVESTIGATION OF THE AERODYNAMIC INTERFERENCE INDUCED BY CRUISE AND LIFT FANS ON TRANSPORT-TYPE AIRCRAFT
M. R. Mendenhall, M. F. E. Dillenius, and S. B. Spangler Washington NASA Aug. 1971 92 p refs
(Contract NAS2-5247)
(NASA-CR-1730) Avail: NTIS CSCL 01B

Potential flow theory was applied to two configurations characteristic of transport-type aircraft: a wing-pylon-high bypass ratio turbofan arrangement and a lifting fan adjacent to a wing. For the wing-pylon, a nonplanar, vortex lattice, lifting surface method was developed. For the turbofan engine and lift fan, a ring vortex model was used, with exhaust wake curvature handled by the addition of a sink and doublet distribution along the wake centerline. Comparisons with force and pressure distribution data for wing alone, wing-pylon, wing-pylon-engine, and wing-lifting jet configurations are presented to illustrate the nature of the interference effects and to assess the accuracy of the methods. Author

N71-32454+ National Transportation Safety Board, Washington, D.C.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US *GENERAL AVIATION CALENDAR YEAR 1969*
28 Apr. 1971 151 p
(NTSB-ARG-71-1) Avail: NTIS

The Annual Review of Aircraft Accident Data is a statistical

compilation published by the National Transportation Safety Board. The publication contains statistical information compiled from reports of 4,767 General Aviation accidents that occurred during the calendar year 1969. Included in the total number of accidents are 45 collisions between aircraft. By coding each aircraft involved in the collisions, an additional 45 records are produced, bringing the total accidents to 4,812. This figure relfects the true number of pilots and aircraft involved in the accidents. Author

N71-32455*# Translation Consultants, Ltd., Arlington, Va.
MEASUREMENT OF PERFORMANCES: FLIGHT TESTING METHODS APPLIED TO THE CONCORDE [MESURE DES PERFORMANCES METHODES D'ESSAIS EN VOL APPLIQUEES A CONCORDE]
J. Tourraille et al Washington NASA Aug. 1971 46 p Transl. into ENGLISH from report presented at 38th Meeting of AGARD Flight Mechanics Group, Toulouse, 10-14 May, 1971 43 p
(Contract NASw-2038)
(NASA-TT-F-13728) Avail: NTIS CSCL 01B

A *summary of the testing methods used for performance* measurement of the Concorde aircraft is presented. Subjects discussed are: (1) trajectory plotting for determination of takeoff and landing trajectories, (2) calibration of the anemobarometric installation, (3) determination of operational performances by stabilizations and continuous method by accelerometry, and (4) calibration of the incidence and sideslip sensors. Author

N71-32456# National Bureau of Standards, Washington, D.C.
SIMULATION OF AIR TRAFFIC CONTROL RADAR BEACON CODE ASSIGNMENT PLANS Final Report
R. D. Elbourn and Judith F. Gilsinn Mar. 1971 76 p Sponsored by FAA and DOT
(NBS-TN-568) Avail: SOD $0.70

In the Air Traffic Control Radar Beacon System transponders in the aircraft use one of 4096 identity codes when replying to interrogation from the Secondary Surveillance Radar. Two types of plans for assigning identity codes to aircraft were tested by simulating in a digital computer a peak day's IFR traffic in the USA. In one type each Air Route Traffic Control Center assigns codes independently of all the others, while in the other type a single master center makes all the code assignments for the USA. Four other types of plans are discussed, and an assignment plan of mixed type is proposed for further study. The strategy of simulation and the use of the SIMSCRIPT language are discussed in an appendix. Author

N71-32460# National Transportation Safety Board, Washington, D.C.
NORTHEAST AIRLINES, INCORPORATED, McDONNELL DOUGLAS DC-9-31, N982NE, MARTHA'S VINEYARD, MASSACHUSETTS, 22 JUNE 1971
4 Aug. 1971 6 p
(SB-71-64) Avail: NTIS

An incident involving a Northeast Airlines DC-9 aircraft at Martha's Vineyard, Massachusetts on June 22, 1971 is reported. While on final approach to the airport, the aircraft struck the surface of the water and received minor damage. The aircraft flew to Boston, Massachusetts and made an airport landing without further incident. Author

N71-32466*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIAL IN-FLOW TURBINE PERFORMANCE WITH EXIT DIFFUSERS DESIGNED FOR LINEAR STATIC PRESSURE VARIATION
William J. Nusbaum and Milton G. Kofskey Washington Aug. 1971 22 p refs
(NASA-TM-X-2357; E-6276) Avail: NTIS CSCL 21E

Two alternative turbine exit diffusers were designed with an area ratio identical to that of the original but with a significantly different axial static-pressure variation. These two diffusers had the same flow area variation; they differed only in the contours of the inner and outer walls. Each diffuser was tested as part of the turbine with cold argon at design Reynolds number. Overall total-to-total efficiency for operation at the design point with either of the two alternative diffusers was about 0.906 as compared to 0.894 for operation with the original. The diffuser loss was reduced from 0.019 to 0.007 in terms of overall total efficiency. Author

N71-32473*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IDENTIFICATION OF SYSTEM PARAMETERS FROM INPUT-OUTPUT DATA WITH APPLICATION TO AIR VEHICLES
Dallas G. Denery (Ph.D. Thesis – Stanford Univ.) Washington Aug. 1971 146 p refs
(NASA-TN-D-6468; A-3901) Avail: NTIS CSCL 12A

A new algorithm is developed for estimating system parameters from input-output data. If the noise or uncertainty in the system is small, the algorithm does not require a prior estimate of the unknown parameters and if the noise has a zero mean, the final parameter estimates will not be biased. A method for reducing the computations required to obtain the parameter estimates is also presented. A general canonical realization is developed for multi-input, multioutput, constant-coefficient, linear equations. If the unknown system is modeled in its canonical form, the unknown parameters are uniquely identifiable. An analogy is established between a parameter estimation procedure developed by Shinbrot and the concept of linear observers developed by Luenberger. It is shown that observers of lower order can be designed quite easily using an extension of Shinbrot's method. Author

N71-32484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF OPERATING VARIABLES ON POLLUTANT EMISSIONS FROM AIRCRAFT TURBINE ENGINE COMBUSTORS
Jack Grobman [1971] 41 p refs Proposed for presentation at 1971 Gen. Motors Lab. Symp., Warren, Mich., 27-28 Sep. 1971
(NASA-TM-X-67887) Avail: NTIS CSCL 21E

Combustor research aimed at reducing exhaust emissions from jet aircraft engines is reviewed. Experimental results of tests performed on both conventional and experimental combustors over a range of inlet total pressure, inlet total temperature, reference velocity, and fuel-air ratio are presented to demonstrate the effect of operating variables on pollutant emissions. Combustor design techniques to reduce emissions are discussed. Improving fuel atomization by using an air-assist fuel nozzle has been shown to significantly reduce hydrocarbon and carbon monoxide emissions during idle. A short-length annular swirl-can combustor has demonstrated a significant reduction in nitric oxide emissions compared to a conventional combustor operating at similar conditions. The use of diffuser wall bleed to provide variable control of combustor airflow distribution may enable the achievement of reduced emissions without compromising combustor performance. Author

N71-32488*# General Applied Science Labs., Inc., Westbury, N.Y.
EXPERIMENTAL DETERMINATION OF ACOUSTIC AND STRUCTURAL BEHAVIOR OF WALL PANEL-CAVITY CONFIGURATIONS EXPOSED TO SONIC BOOMS
W. Peschke, E. Sanlorenzo, and M. Abele [1970] 133 p refs
(Contract NAS1-9594)
(NASA-CR-111925; GASL-TR-754) Avail: NTIS CSCL 20K

The structural response and acoustic transmission characteristics of a 6.25 ft × 10.42 ft, 1/4-inch thick glass pane and two 8 ft × 12 ft standard wood frame construction wall panels acted upon by a sonic boom N-wave were investigated. The use of a variable-volume cavity in conjunction with the test panels provided data concerning the acoustic properties of the cavity and, for a limited range of cavity volumes, the influence of the cavity on the behavior of the glass pane. The results indicate that the initial glass pane acceleration and cavity pressure amplitude are essentially independent of the N-wave duration. Although the initial acceleration of the pane is practically constant as the cavity volume increases, the initial pressure is directly proportional to the variation in stiffness ratio. The duration which induces maximum dynamic and acoustic effects in the glass pane and cavity is approximately 60 ms., and the dominant modes excited in the glass pane are the (1,1), (2,1), (3,1), and (4,1) corresponding to frequencies of 7, 10, 14, and 40 Hz. Author

N71-32491# *National Transportation Safety Board, Washington, D.C.*

A MIDAIR COLLISION INVOLVING A HUGHES AIR WEST DC-9-31, N9345, AND A MARINE CORPS McDONNELL F-4B (PHANTOM) BUREAU NO. 151458 4NM NNE OF DUARTE, CALIFORNIA, 6 JUNE 1971

26 Jul. 1971 13 p

(SB-71-62) Avail: NTIS

A report of the midair collision between a DC-9 commercial aircraft and a Marine Corps F-4B aircraft near Durate, California on June 6, 1971 is presented. The collision occured in daylight at an altitude of 15,150 feet above mean sea level. The radar observer in the military aircraft was the sole survivor. Author

N71-32500# National Transportation Safety Board, Washington, D.C.

ALLEGHENY AIRLINES, INCORPORATED ALLISON PROP JET CONVAIR 440, N5832, NEW HAVEN, CONNECTICUT, 7 JUNE 1971

3 Aug. 1971 13 p

(SB-71-65) Avail: NTIS

The results of the aircraft accident investigation following the crash of a Convair 440 at New Haven, Connecticut on June 7, 1971 are presented. The aircraft crashed short of the runway while on instrument approach to the New Haven airport. An intense fire which occurred immediately after impact was directly responsible for the death of 28 persons aboard the aircraft. Author

N71-32527*# *National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.*

NASA BALLOON AIRCRAFT RANGING DATA AND VOICE EXPERIMENT

Sheldon Wishna Jul. 1971 32 p

(NASA-TM-X-65649; X-752-71-212) Avail: NTIS CSCL 17B

The ranging, data, and voice communication system, planned for using Satellite in air traffic control, to be studied during the balloon-aircraft test program are discussed. System concepts, signal format, power requirements, equipment and the test program are presented. F.O.S.

N71-32563*# General Electric Co., Scnenectady, N.Y. Research and Development Center.

THE CALCULATION OF OPTIMAL LININGS FOR JET ENGINE INLET DUCTS, PART 2

J. P. D. Wilkinson Washington NASA Aug. 1971 31 p refs

(Contract NASw-1922)

(NASA-CR-1832) Avail: NTIS CSCL 20D

A numerical method is presented for calculating the optimal lining impedance for the inlet duct of a jet engine. The calculation is based on the condition that the total radiated power from the duct shall be a minimum. Several situations are considered: first, the case of an axially symmetric duct in a stationary acoustic medium; second, that of a body of arbitrary geometry in a stationary medium; and finally, the case of an axially symmetric duct in the presence of spinning modes and axial air flow. In each case, the method may yield the optimal lining impedances for a given discrete frequency, flow velocity, and duct geometry. To demonstrate the application of the method, a number of cases are investigated. First, a cylindrical duct closed at one end with a vibrating piston is used to make comparisons with predictions obtained analytically by Rice. Then a more complex problem of a bell-mouth compressor is investigated. A discussion of the results obtained is presented, together with a critique of the potential difficulties of the method as applied to complex duct configurations. Author

N71-32574# RAND Corp., Santa Monica, Calif.

A MODEL FOR EVALUATING VSTOL VERSUS CTOL COMBAT AIRCRAFT SYSTEMS

Seymour Horowitz (FAA) and Robert Shishko Mar. 1971 29 p refs

(P-4587) Avail: NTIS

A cost-effectiveness study of the use of vertical or short takeoff and landing (VSTOL) aircraft for combat missions is described. A comparison is made with conventional (CTOL) aircraft as tactical fighters in a future NATO environment. The conditions under which VSTOL and CTOL aircraft considered as competitive systems are carefully described. A model yielding the probability of completing n successive missions is used as a measure of combat effectiveness. A cost model was constructed to reflect the resource impact of the same variables or alternatives that affect the measure of effectivness. The integrated format is a necessary condition for the selection of least-cost designs capable of providing a given level of mission performance. A graphical summary of such a format is provided. Author

N71-32620# National Research Council of Canada, Ottowa (Ontario).

DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin, 1 Jan.–31 Mar. 1971

Mar. 1971 101 p refs

(DME/NAE-1971(1)) Avail: NTIS

CONTENTS:

1. FREE PISTON ENGINE HISTORICAL BACKGROUND AND RECENT STUDIES J. J. Samolewicz p 1–18 refs

2. HUMAN FACTORS ENGINEERING L. Buck p 19–26 refs

3. SOME PRELIMINARY ASSESSMENTS OF COMPRESSIBLE TURBULENT BOUNDARY LAYER STUDIES AT MACH 4 AND AT HIGH REYNOLDS NUMBERS, INCLUDING FLOWS IN RELAXING AND ADVERSE PRESSURE GRADIENTS D. J. Peake, J. M. Romeskie (McGill Univ., Montreal), and G. Brakmann (McGill Univ., Montreal) p 27–99 refs

N71-32621# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

FREE PISTON ENGINE HISTORICAL BACKGROUND AND RECENT STUDIES

J. J. Samolewicz *In its* Div. of Mech. Eng. and The Natl. Aeron. Estab. Mar. 1971 p 1 18 refs

Avail: NTIS

The free piston engine principle and its application history

are briefly outlined for the two main forms: a self-contained free piston engine compressor and a gasifier in a compound free piston turbine engine. In the latter form it has found limited application in stationary power stations, and to a lesser extent, in marine propulsion. It is shown that the free piston engine can be developed in a wide power range as a reliable machine. It has failed, however, to prove itself as an engine of superior economy. Author

N71-32689# Committee on Foreign Affairs (U.S. House).
AIRCRAFT HIJACKING
Washington GPO 1970 203 p refs Hearings on resolutions concerning aircraft hijacking and related matters before Comm. on Foreign Affairs, 91st Congr., 2d Sess., 17, 22, 23, and 30 Sep. 1970
Avail: Comm. on Foreign Affairs

Problems involved with aircraft hijacking are discussed including property losses to aircarriers, personal safety, and effects on governments and international relations. Various resolutions concerning hijacking which were introduced to the Congress are included. Hijacking statistics on worldwide and U.S.-registered aircraft are appended. J.M.

N71-32694# Joint Publications Research Service, Washington, D.C.
RADIO CONTROL
L. S. Gutkin, ed. et al 10 Aug. 1971 269 p refs Transl. into ENGLISH from the book 'Radioupravleniye; no. 5' Moscow, 1970 324 p
(JPRS-53789) Avail: NTIS

Radio control of the motions of aerospace vehicles of various types and purposes (missiles, spacecraft, aircraft) is examined. Chief attention is focused on the principles and methods of radio control. Methods of analysis and synthesis of the corresponding systems, closed control loops, and correction control systems are described and the requirements on the makeup of radio engineering installations and systems and their characteristics are formulated. The basic radio engineering tools, which determine the quality of radio control, their principles of operation, characteristics, and potentials are discussed. Author

N71-32699*# Techtran Corp., Glen Burnie, Md.
THE CONTROL SYSTEM OF THE Tu-154 [TU-154: SISTEMA UPRAVLENNYA]
F. Voloshin Washington NASA Aug. 1971 8 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (USSR), no. 5, 1971 p 18–19
(Contract NASw-2037)
(NASA-TT-F-13789) Avail: NTIS CSCL 01B

Due to a number of design peculiarities of the Tu-154 aircraft, it was necessary to develop a better booster system for controlling rudders and ailerons. A network of three independent hydrobooster systems was designed for the Tu-154 which increase the stability of the aircraft, made piloting easier, and nearly eliminates the danger of complete control system failure. Author

N71-32719*# National Aeronautics and Space Administration, Washington, D.C.
FLIGHT DYNAMICS IN MOVING AIR
Yu. P. Dobrolenskiy Jul. 1971 284 p refs Transl. into ENGLISH of the book "Dinamika Poleta v Nespoloynoy Atmosfere" Moscow, Mashinostroyeniye Press, 1969
(NASA-TT-F-600) Avail: NTIS CSCL 01A

The characteristics of flight dynamics, the result of air motion with respect to the ground are presented. Particular attention is given to the influence of turbulent air motion on airplane flight. An analytical evaluation of the action of a discrete rectangular wind gust is provided simultaneously in many of the cases considered. The results of the analytical investigation of the motion of an airplane in turbulent air are compared with data obtained from in-flight experiments. Information on the kinematics of turbulent air motion is systematized, and methods used to describe this motion analytically are reviewed. A method for obtaining equations for the longitudinal and lateral motions of the airplane with the wind taken into consideration is described in detail. Transfer functions for parameters characterizing the movement of the center of gravity, as well as the angular motions of the airplane acted on by gusts, are derived. These transfer functions are then used to evaluate steady-state motion of the airplane acted on by discrete rectangular gusts. Author

N71-32792*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATION OF SUPERSONIC FLOWS AT LARGE DISTANCES FROM SLENDER LIFTING BODIES
Michael Schorling Washington Aug. 1971 48 p refs
(NASA-TN-D-6446; L-7728) Avail: NTIS CSCL 01A

The exact gasdynamical equations are solved far from the axis of a slender body flying at an angle of incidence. The boundary conditions are obtained from slender-body theory. The solution allows one to make a prediction of the strength of the sonic boom as well as the position of the shock waves. Author

N71-32797*# Rochester Applied Science Associates, Inc., N.Y.
THE EFFECTS OF NONUNIFORM SWASH-PLATE STIFFNESS ON COUPLED BLADE-CONTROL SYSTEM DYNAMICS AND STABILITY. PART 2: COMPUTER PROGRAM LISTING
Vincent J. Piarulli Washington NASA Aug. 1971 71 p
(Contract NAS1-9496)
(NASA-CR-1818; Rept-70-07-Pt-1) Avail: NTIS CSCL 01C

A computer program was developed for investigating the effects of an anisotropically mounted flexible swash-plate, including blade out-of-track, on the vibratory and mechanical stability characteristics of helicopter rotor systems. The analysis which the program implements is based on a combined Laplace transform and associated matrix approach. The analysis and application of the program is presented. The program yields eigenvalues which indicate frequency and rate of growth or decay of a natural mode of the complex system. Blade modal response and swash-plate motion corresponding to a given eigenvalue are predicted. Author

N71-32798*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF RUNWAY GROOVING ON AIRCRAFT TIRE SPIN-UP BEHAVIOR
John Locke McCarty Washington Aug. 1971 21 p
(NASA-TM-X-2345; L-7642) Avail: NTIS CSCL 01C

An experimental study was conducted to compare the spin-up behavior of an aircraft tire during touchdown on grooved surfaces with the corresponding behavior on similar ungrooved surfaces. The study involved the impact of 49 × 17, type 7 aircraft tires at several inflation pressures upon dry grooved and ungrooved concrete and asphalt surfaces at ground speeds up to approximately 110 knots. The results indicate that grooving a runway generally reduces wheel spin-up time but does not appreciably affect the maximum wheel spin-up drag loads, at least for the ground speeds of these tests. Tire-tread damage in the form of chevron cutting was observed on the grooved surfaces under some test conditions and appeared to be dependent upon ground speed, tire inflation pressure, and the runway surface material. Author

N71-32804# Rocketdyne, Canoga Park, Calif.
APPLICATION OF A RESONANT COMBUSTOR TO ARMY AIRCRAFT ENGINE STARTING Final Technical Report, 1 Sep. 1969 – 30 Sep. 1970
R. L. Binsley Feb. 1971 89 p refs
(Contract DAAJ02-70-C-0001)
(AD-724125; USAAVLABS-TR-71-3) Avail: NTIS CSCL 21/5

The report describes the results of a 13-month study of the feasibility of starting Army aircraft by means of starting systems utilizing a resonant combustor as the basic power source. Starting of both main engines and auxiliary power units (APU) was considered. Alternative starting techniques were assessed and compared with present techniques. The engine and APU starting starting techniques that best utilize the unique advantages of the resonant combustor were prepared to allow assessment of the characteristics and application problems of these systems. Author (GRA)

N71-32805*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND-TUNNEL INVESTIGATION OF A LARGE 35 DEGREE SWEPT-WING JET TRANSPORT MODEL WITH AN EXTERNAL-FLOWJET-AUGMENTED DOUBLE-SLOTTED FLAP
Kiyoshi Aoyagi and Leo P. Hall Washington Aug. 1971 73 p refs
(NASA-TN-D-6482; A-3523) Avail: NTIS CSCL 01A

The model had a low-mounted wing of aspect ratio 7.82 and four pod-mounted jet engines under the wing. The lift of the flap system was augmented by impingement of the exhaust of the jet engines on the main flap and a small auxiliary flap. The auxiliary flap may be used for direct-lift control. Results were obtained for several main and auxiliary flap deflections at gross thrust coefficients of 0 to 2.0. Three-component longitudinal data are presented with the operation of four and two engines. Limited longitudinal and lateral data are presented for the operation of three engines. Author

N71-32811# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
VIBRATION LEVELS EXPERIENCED IN TAKE-OFF ON A LARGE FLEXIBLE AIRCRAFT
H. Hall London Aeron. Res. Council 1971 30 p refs Supersedes RAE-TR-68193; ARC-32600
(ARC-CP-1149; RAE-TR-68193; ARC-32600) Copyright. Avail: NTIS; HMSO: 40p; BIS: $1.60

On the basis of some American theoretical predictions and flight experience it was suggested by Zbrozek that there was a possibility of unacceptably large responses at the cockpit of the Concorde aircraft during takeoff. In order to provide experimental evidence against which a general theoretical model of takeoff response could be checked, six takeoff runs are made with a VC 10, and the cockpit accelerations are measured. ESRO

N71-32818# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
XV-11A FLIGHT TEST PROGRAM
L. J. Mertaugh, S. C. Roberts, and N. S. Kiran Feb. 1971 116 p
(Contract DA-44-177-AMC-266(T))
(AD-724124; AASE-69-7; USAAVLABS-TR-70-37) Avail: NTIS CSCL 1/3

The report presents the results of a test program that was conducted to evaluate the performance and stability and control characteristics of the XV-11A aircraft. The aircraft is a research vehicle designed to perform basic aerodynamic flight research in the areas of high-lift boundary layer control, propeller thrust augmentation, low drag geometry, and STOL aircraft handling qualities. The aircraft incorporates a number of unique design features including glass fiber reinforced plastic construction; a distributed-suction, high-lift boundary layer control system; a variable-camber wing; and a shrouded propeller. The test data show that the aircraft has sufficient performance and stability and control for conducting low-speed aerodynamic research. Handling qualities research would be limited by the high longitudinal and directional control force gradients. Although low stall speeds are demonstrated, the increment in lift due to the boundary layer control system is less than anticipated. Aircraft performance is somewhat limited by propeller deficiencies due to high blade loading. Author (GRA)

N71-32850# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
SYSTEMS AND EQUIPMENT OF CONVENTIONAL AIRCRAFT FOR APPROACH AND LANDING [VERFAHREN UND AUSRUESTUNG KONVENTIONELLER FLUGZEUGE FUER ANFLUG UND LANDUNG]
Manfred Fricke and Horst Busacker Aug. 1970 118 p refs In GERMAN
(Rept-52) Avail: NTIS

Based on the subdivision of the landing sequence (begin approach, intermediary approach, end approach, and landing) the presently accepted operational steps in all weather landing for civil aviation are explained. The available navigation and landing systems are analyzed in regard to their functional principles, and accuracy. ESRO

N71-32854# National Transportation Safety Board, Washington, D.C.
AN ANALYSIS OF AIRCRAFT ACCIDENT DATA: U. S. GENERAL AVIATION, 1969
29 Mar. 1971 21 p
Avail: NTIS

The growth of general aviation during the year 1969 and an analysis of aircraft accidents are presented. Subjects discussed are: (1) accident analysis, (2) collisions between aircraft, (3) accident analysis by cause and related factors, (4) growth indices, and (5) injuries to flying personnel. Author

N71-32861# Decca Navigator Co., Ltd., London (England). Technical Publications Dept.
DECCA NAVIGATOR MARK 19: OPERATING INSTRUCTIONS
Apr. 1971 23 p
Avail: NTIS

The operating instructions for the Decca Navigator Mark 19 navigation system are presented. Subjects discussed are: (1) systems description, (2) controls and indicator lights, (3) flight log pictorial display, (4) preflight checks, and (5) inflight checks. Author

N71-32862# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 2: BASIC NOTATION AND NOMENCLATURE
H. R. Hopkin London Aeron. Res. Council 1970 52 p Supersedes RAE-TR-66200-Pt-2; N68-13059; ARC-28970
(ARC-R/M-3562-Pt-2; RAE-TR-66200; ARC-28970) Copyright. Avail: NTIS; HMSO: £1.10; BIS: $4.05

A scheme of notation and nomenclature applicable to the

dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamic data respectively are dealt with. Author (ESRO)

N71-32868# National Physical Lab., Teddington (England). Aerodynamics Div.

PRESSURES NEAR THE CENTRE-LINE OF LEEWARD SURFACES ON DELTA WINGS AND CONICAL BODIES AT HIGH SUPERSONIC SPEEDS

M. J. Larcombe London Aeron. Res. Council 1971 26 p refs Supersedes NPL-AERO-1319; ARC-32172

(ARC-CP-1153; NPL-AERO-1319; ARC-32172) Copyright. Avail: NTIS; HMSO: 40p; BIS: $1.60

The manner in which the flow fields over the leeward surfaces of delta wings and conical bodies can be calculated for conditions when the bow shock wave is detached from the leading edges is dealt with. The significant features and the parameters controlling the flow process are determined. As a first step towards the calculation of the complete flow field on leeward surfaces an accurate semiempirical method is developed for predicting pressures near the center-line of wings and bodies for Mach numbers greater than 2.5. Author (ESRO)

N71-32875# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 3: AIRCRAFT DYNAMICS

H. R. Hopkin London Aeron. Res. Council 1970 62 p Supersedes RAE-TR-66200-Pt-3; N68-13058; ARC-28971

(ARC-R/M-3562-Pt-3; RAE-TR-66200-Pt-3; ARC-28971) Copyright. Avail: NTIS; HMSO: £1.65; BIS: $6.30

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamics data respectively, are dealt with. Author (ESRO)

N71-32885# Cranfield Inst. of Technology (England). Electrical and Control Engineering Dept.

SYNTHESIS OF THE AIRCRAFT NAVIGATIONAL ACROSS-TRACK ERROR

R. N. Lord and D. A. Overton Mar. 1971 32 p refs

(Rept-E/C-2) Avail: NTIS

Aircraft across-track errors are synthesised by means of a mathematical model using statistical parameters. A convolution program is described in which the sensitivity of the overall error to variation in accuracy of navigational fix and heading can be determined. Numerical examples relating to present and future North Atlantic navaids are presented for both subsonic and supersonic aircraft, particular attention being paid to the Gaussian/negative exponential error distribution controversy. Results show that the importance of a good fixing aid diminishes as airspeed increases when the heading becomes of prime importance. The value of synthesis as a design tool for ATC as against the uncertainties of observational methods is demonstrated. Future extensions of synthesis to along-track and inhomogeneous traffic samples are discussed. Author

N71-32890# Army Construction Engineering Research Lab. Champaign, Ill.

AIRFIELD PAVEMENT SYSTEMS Final Report

E. Lile Murphree, Jr., Ronald W. Woodhead, and Robert H. Wortman Apr. 1971 24 p refs Presented at the Am. Society of Civil Eng. Natl. Meeting on Transportation, Boston, 13 17 Jul. 1970

(AD-724132; CERL-TM-P-1) Avail: NTIS CSCL 1/5

The current airfield pavement design procedures were introduced nearly thirty years ago. At that time, structural support problems had a dominant effect on design procedures. When other requirements were considered in the design process, they were treated in an ad-hoc manner as difficulties arose. With the arrival of the jumbo jets, the importance of the pavement to the air transport system is apparent. The aerospace industry predicts 5 times the passenger miles and 10 to 20 times the cargo tonnage by 1985 as today. Airplanes are expected to be twice the size and weight of those currently flying. The demands of these large, heavy, high performance aircraft will be more rigorous than those of today and a new and comprehensive look at the pavements role is needed. The systems approach holds the key to an integrated plan for design, construction, operation, and maintenance of airfield pavements. Author (GRA)

N71-32892# Decca Navigator Co., Ltd., London (England). Technical Publications Dept.

DECCA NAVIGATOR MARK 19: BACKGROUND NOTES

Apr. 1970 23 p

Avail: NTIS

A description is given of the functions and development of the Decca Navigation Mark 19 receiver. The system was mainly developed to: (1) drive decometers or other numerical readouts in addition to, or instead of, the flight log, and to (2) form a solid state replacement for the Mark 8A receiver unit, capable of being installed without altering the cabling or the racking of an existing Mark 8A installation. E.H.W.

N71-32917# Decca Navigator Co., Ltd., London (England). Technical Publications Dept.

DECCA NAVIGATOR MARK 25: OPERATING INSTRUCTIONS

May 1970 18 p

Avail: NTIS

Operating instructions for the Decca Navigator Mark 25 navigation system are presented. Subjects discussed are: (1) general system description, (2) pictorial display charts, (3) confidence checks and malfunction warnings, (4) preflight instructions, and (5) inflight operations. Author

N71-32927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.

PERFORMANCE AND ACOUSTIC TESTING OF A VARIABLE CAMBER PROPELLER Technical Report, Mar.–Jul. 1970

Donald P. McErlean and Donald E. Edwards Feb. 1971 99 p refs

(AD-724145; AFAPL-TR-70-80) Avail: NTIS CSCL 1/3

The report presents the test results obtained from a series of performance and acoustic near-field measurements on a propeller fitted with a variable camber feature. The subject propeller effects a change in camber by deflecting a flap positioned along the 72% chordal line of each blade. The tests were conducted on a 10,000 horsepower electric whirl rig. The tests represent the only test data available on this unique propeller configuration which is considered to have good potential for V/STOL applications. Author (GRA)

N71-32931# Army Electronics Command, Fort Monmouth, N.J.

COLLISION GEOMETRY FORMULAE AND APPLICATION TO COLLISION WARNING TECHNIQUES

Anthony Musillo Mar. 1971 39 p

(AD-723977; ECOM-3406) Avail: NTIS CSCL 1/2

The paper discusses two dimensional collision geometry in which straight and nonaccelerated flight paths are assumed. A derivation of the time dependence of the range (R), relative velocity (dR/dt), and relative acceleration (2nd dR/dt) will be presented and the quantities expressed as a function of R. The time to collision (tau) will be discussed, also. These quantities are applied to realistic collision geometries based on present Army aircraft operations. Also, a discussion of relative velocity versus range curves with reference to tau min (where tau = dR/(dR/dt)) and constant range warning lines is given. These parameters are incorporated in present state-of-the-art techniques such as the Doppler and range increment techniques. The former technique attempts to detect any change in the Doppler frequency when tau = tau min (in this case, 15 seconds). A change in the Doppler frequency indicates a noncollision course. The range increment technique measures differences in ranges over small constant time intervals and uses these range changes to obtain tau. A sample error measurement analysis in one of the low range rate change situations gives an indication of the magnitude of the range error measurement. Author (GRA)

N71-32934# Oceanics, Inc., Plainview, N.Y.

TEST SECTION SIZE INFLUENCE ON MODEL HELICOPTER ROTOR PERFORMANCE Final Technical Report

August F. Lehman and Jeffrey A. Besold Mar. 1971 74 p refs

(Contract DAAJ02-68-C-0108)

(AD-724191; Rept-70-76; USAAVLABS-TR-71-6) Avail: NTIS CSCL 14/2

The study indicates that the successful testing of model helicopter rotors in tunnels when in the hover and transitional flight regimes requires not only Reynolds number scaling, where the Reynolds number is recognized as controlling the rotors maximum section lift coefficient, but also a scaling of a characteristic defined here as the wake energy dissipation pattern. The dissipation of the energy from the rotor into the surrounding fluid is a function of the viscosity of the test fluid; thus, operation of a reduced scale model in the same fluid as that in which the full-scale vehicle operates makes appropriate scaling of this wake characteristic difficult if Reynolds number scaling is to be maintained. These conflicting factors have led to the requirements of relatively large models and correspondingly large transitional flight modes are of interest. The use of water as the test fluid for scale model studies permits an easier maintaining of Reynolds number scaling while having the scale model produce a wake energy dissipation pattern similar to that of the full-scale vehicle because of the advantages water possesses over air in terms of kinematic anf dynamic viscosities. Author (GRA)

N71-32935# Bell Helicopter Co., Fort Worth, Tex.

FLIGHT EVALUATION OF ELASTOMERIC BEARINGS IN AN AH-1 HELICOPTER MAIN ROTOR

C. H. Fagan Mar. 1971 62 p refs

(Contract DAAJ02-70-C-0020)

(AD-724192; BHC-TR-299-099-485; USAAVLABS-TR-71-16) Avail: NTIS CSCL 13/9

Presented in this report are the results of a flight test program conducted to evaluate elastomeric bearings in the main rotor of an AH-1G helicopter. An experimental main rotor was fabricated and tested using only elastomeric bearings in both the flapping and pitch change axes. With this rotor, the flapping bearings carry the rotor drive and lift loads and allow the flapping motions. Two pitch change bearings were used in each grip to carry the blade bending and shear loads and transfer the blade centrifugal force to the rotor yoke. These bearings also accommodate the blade collective and cyclic pitch change motions. Torsional, radial, and axial load deflection curves are given for the flapping and pitch change bearings. In addition, the results from a limited endurance test program are included for the pitch change bearing. The purpose of the endurance tests was to assure that bearing metal parts would not fail prior to elastomer shredding. Thus, visual inspection of the elastomeric bearings was considered sufficient for safety-of-flight during the test program. The test results have shown the feasibility of elastomeric bearings for helicopter main rotor applications. Author (GRA)

N71-32943*# National Materials Advisory Board, Washington, D.C.

ACCELERATING UTILIZATION OF NEW MATERIAL

May 1971 107 p refs Sponsored in part by NASA

(Contract DA-49-083-OSA-3131)

(NASA-CR-121375; NMAB-283) Avail: NTIS CSCL 11D

Because of concern regarding the slow rate of introducing new materials into national programs, the National Materials Advisory Board sought to identify the factors that promote or inhibit their use. The advantages to be derived from new materials are documented. Case histories of past material introductions are discussed. Using these histories as a foundation, the factors that constrain or which promote progress in introducing new materials into hardware are identified. The constraints and promoters are organized into four categories; technical, economic, contractual, and management and organization. Recommendations are included. Author

N71-32953# Gillette Research Inst., Inc., Rockville, Md.

EVALUATION OF THE ADHESIVE BONDING PROCESSES USED IN HELICOPTER MANUFACTURE. PART 2: THE CHARACTERIZATION OF ADHERENT SURFACES

Willard C. Hamilton and George A. Lyerly Mar. 1971 66 p refs

(Contract DAA21-70-C-0434)

(AD-724663; PA-TR-4185-Pt-2) Avail: NTIS CSCL 13/8

Surfaces of titanium 6-aluminum, 4-vanadium alloy, commercial pure titanium grade 3, 2024 T-3 and 6061 T-6 aluminum alloys bare, and 2024 T-3 aluminum alloy clad were examined at selected stages in the prebonding treatment of these metals. Variations in the film morphology were observed directly in a scanning electron microscope, and, after removal, in a transmission electron microscope. Film thickness measurements were made with transmission and reflectance interference microscopes. Chemical compositions of these films were determined by photoelectron spectroscopy, electron diffraction, and nondispersive X-ray fluorescence analysis. Contact angles and surface potential measurements were also used to characterize these metal surfaces. The results obtained suggest that bonding differences with the variously treated titanium alloys were caused by variations in the crystalline structure of the titanium dioxide, whereas bonding differences with the aluminum alloys were caused by variations in surface hydration, film thickness, and surface morphology. Author (GRA)

N71-32975# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 4: AERODYNAMIC DATA FOR DYNAMICS

H. R. Hopkin London Aeron. Res. Council 1970 45 p Supersedes RAE-TR-66200-Pt-4; N68-13895; ARC-28972

(ARC-R/M-3562-Pt-4; RAE-TR-66200-Pt-4; ARC-28972) Copyright. Avail: NTIS; HMSO: £1.00; BIS: $3.60

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. Basic notation and nomenclature, aircraft dynamics, and associated aerodynamic data respectively are dealt with. Author (ESRO)

N71-32981# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
THE PAPER-PILOT: A DIGITAL COMPUTER PROGRAM TO PREDICT PILOT RATING FOR THE HOVER TASK
James D. Dillow Mar. 1971 99 p refs
(AD-724144; AFFDL-TR-70-40) Avail: NTIS CSCL 1/3

A mathematical model for predicting the pilot rating of the flying qualities of a VTOL aircraft in the precision hover mode is described. The model includes the following elements: the longitudinal equations of motion for the VTOL aircraft in hover; a stochastic gust model which describes disturbances to the aircraft; a fixed form pilot model which has four free parameters; and a cost functional which is made up of measures of aircraft performance and pilot workload. The four free pilot parameters of the pilot model are selected to minimize the cost functional. These parameters are adjusted to ensure a 20% stability margin in pilot gains and then used to compute a paper pilot rating of the flying qualities of the VTOL aircraft in the precision hover mode. The mathematical equations and digital computer program used to exercise the model are described. The paper pilot rating was computed for 79 aircraft configuration/gust intensity combinations. The aircraft configurations considered include cases with control lag, stability augmentation system lag, and limited pitch rate authority in the stability augmentation system. The paper pilot ratings are compared to actual pilot ratings obtained in fixed base simulation. The difference between the actual pilot ratings and the paper pilot rating has a mean of .14 and a standard deviation of .63 out of a 10 point rating scale. Author (GRA)

N71-32991# ARO, Inc., Arnold Air Force Station, Tenn.
ANALYTICAL MODEL OF AN EXHAUST GAS COOLING SYSTEM EMPLOYING LIQUID INJECTION Final Report
J. M. Pelton and C. E. Willbanks AEDC Jun. 1971 57 p refs
(Contract F40600-71-C-0002)
(AD-724687; AEDC-TR-71-60) Avail: NTIS CSCL 13/1

An analysis was undertaken to better understand the phenomena occurring in spray coolers and to develop a mathematical model for comparison with experimental data from an operating unit. The physical characteristics of an operational exhaust gas spray cooler and the instrumentation systems are described. A mathematical model of a spray cooler was developed by assuming kinetic and thermodynamic equilibrium and one-dimensional flow. A mathematical model of a hypothetical, optimum cooler is included in order to have a basis for defining cooler efficiency. The equations were programmed for numerical solution on a digital computer, and several trial case runs are presented. Experimental measurements are compared with the efficiencies predicted by the mathematical models. Author (GRA)

N71-32992# Dynamic Science, Phoenix, Ariz. AvSER Facility.
CRASHWORTHY FUEL SYSTEM DESIGN CRITERIA AND ANALYSES Final Report
Neva B. Johnson Fort Eustis, Va. US Army Air Mobility Res. and Develop. Lab. Mar. 1971 131 p refs
(Contract DAAJ02-69-C-0030)
(AD-723988; AV-SER-1500-70-49; USAAVLABS-TR-71-8) Avail: NTIS CSCL 1/3

Comprehensive design criteria for crashworthy aircraft fuel systems were developed from the design philosophies of the U. S. Army and several aircraft manufacturers, as well as from Dynamic Sciences experience in the development and testing of crashworthy fuel systems. Eight aircraft fuel systems currently in the U. S. Army inventory were analyzed, and unsatisfactory areas in regard to crashworthiness were determined. Most of these areas were common to the majority of the aircraft studied. Recommendations for improving the crash resistance of these hazardous areas were proposed. Author (GRA)

N71-33002*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
COMPUTER PROGRAMS FOR CALCULATION OF AERODYNAMIC INTERFERENCE BETWEEN LIFTING SURFACES AND LIFT AND CRUISE FANS
M. F. E. Dillenius, M. R. Mendenhall, and S. B. Spangler Apr. 1971 172 p refs
(Contract NAS2-5247)
(NASA-CR-114332; NEAR-TR-29) Avail: NTIS CSCL 01A

A user's manual is presented for a series of three computer programs developed to predict aerodynamic interference in transport-type aircraft. The cases considered are interference between a high-bypass ratio turbofan engine and a wing-pylon-tail configuration, and interference between a fuselage-mounted lift fan and a wing-tail configuration. The methods are applicable to all speeds up to the critical speed of the configuration. The first program calculates the singularity distributions representing the flow model of a high-bypass ratio turbofan engine and computes the velocity field induced by the singularities. The second program computes the singularity distributions representing the wake of a lift fan exhausting in a crossflow. The path of the jet is predicted and the velocity field induced by the jet is computed. The third program is a vortex lattice lifting surface method which can accommodate a wing with a single pylon per panel and a horizontal tail surface. This program can accept externally induced velocities such as those obtained from the turbofan engine program or the lift-fan program. Author

N71-33005# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
AIRCRAFT ANTI-ICING/DE-ICING Final Report
24 Mar. 1971 16 p
(AD-724082; MTP-7-3-528) Avail: NTIS CSCL 1/3

The document provides procedures for evaluating the capability of anti-icing/de-icing equipment on aircraft to perform satisfactorily while the aircraft is operated at all expected speeds, altitudes and weather conditions. Author (GRA)

N71-33006# Air Weather Service, Scott AFB, Ill.
LIGHTNING HAZARD TO AIRCRAFT
Herbert S. Appleman Apr. 1971 13 p refs revised
(AD-724092; AWS-TR-179-Rev) Avail: NTIS CSCL 1/3

The report presents the latest available information on lightning hazards to jet aircraft. Included are the temperature and altitude range where most strokes are encountered, a brief discussion of the type of damage likely to be incurred, and a somewhat more detailed look into the possibility of fuel-tank explosions due to lightning and electrostatic discharges. It appears that, while the possibility of such explosions is small, aircraft using JP-4 fuel are generally more vulnerable to this hazard than those using gasoline or kerosine. It is concluded from this and other hazards associated with JP-4 that jet passenger aircraft, at least, should use kerosene fuels where possible. Author (GRA)

N71-33007# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS NEW ORLEANS, LOUISIANA
David J. Lambiotte and Robert B. Brownie Apr. 1971 81 p ref
(AD-724286; NCEL-TN-1166) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, New Orleans, Louisiana are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland

cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N71-33015# Boeing Co., Philadelphia, Pa. Vertol Div.
STOL HIGH LIFT DESIGN STUDY. VOLUME 3: BIBLIOGRAPHY Final Report, Jan. – Dec. 1970
Fred May and Colin A. Widdison Wright-Patterson AFB, Ohio AFFDL Apr. 1971 338 p refs
(Contract F33615-70-C-1277)
(AD-724186; D210-10201-2; AFFDL-TR-71-26-Vol-2) Avail: NTIS CSCL 1/3

The volume consists of a bibliography that resulted from a literature search for aerodynamic information related to seven lift/propulsion concepts suitable for STOL aircraft. The bibliography contains references to approximately 900 reports classified by concept and by technological area. Author (GRA)

N71-33016# Boeing Co., Philadelphia, Pa. Vertol Div.
STOL HIGH LIFT DESIGN STUDY. VOLUME 1: STATE OF THE ART REVIEW OF STOL AERODYNAMIC TECHNOLOGY Final Report, Jan. – Dec. 1970
Fred May and Colin A. Widdison Wright-Patterson AFB, Ohio AFFDL Apr. 1971 208 p refs
(Contract F33615-70-C-1277)
(AD-724185; D210-1020-1; AFFDL19TR-71-26-Vol-1) Avail: NTIS CSCL 1/3

The state of the art of STOL aerodynamic technology for selected lift/propulsion concepts was surveyed to identify the available test data and prediction methods in the literature. The report consists of two volumes. In Volume I important areas of technology and information necessary for the evaluation of STOL aircraft aerodynamics are listed the aerodynamic test data and prediction methodology relevant to the deflected slipstream and externally blown flap concepts are assessed, with emphasis on the latter an empirical method for the prediction of the longitudinal aerodynamic characteristics of externally blown flap configurations is presented and high-lift technology for five lift/propulsion concepts is assessed in application to a medium-sized STOL transport. Author (GRA)

N71-33025# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FRENCH PROTOTYPE OF A TIME-FREQUENCY COLLISION AVOIDANCE SYSTEM [PROTOTYPE FRANCAIS D'UNS SYSTEME ANTICOLLISION A TEMPS FREQUENCE]
Jean Besson 1971 29 p refs In FRENCH; ENGLISH summary
Presented at 10th Intern. Congr. on Aeron, Paris, 1-3 Jun. 1971
(ONERA-TP-938) Avail: NTIS

A simplified collision avoidance system, based on atomic clocks was developed and tested in France by the Crouzet Cy and O.N.E.R.A. The system was designed to automatically detect all aircraft danger, evaluate collision risk, determine avoidance maneuver, and indicates avoidance maneuver by the pilot. Flight tests show good results with the system. Transl. by E.H.W.

N71-33027# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 1: GENERAL
H. R. Hopkin London Aeron. Res. Council 1970 75 p refs
Supersedes RAE-TR-66200-Pt-1; N68-13135; ARC-28969
(ARC-R/M-3562-Pt-1; RAE-TR-66200-Pt-1; ARC-28969)
Copyright. Avail: NTIS; HMSO: £1.60; BIS: $5.85

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. The main objectives are described and a considerable amount of historical background is summarized. Symbols, references, and most of the tables for the whole report are listed and an index is provided. All illustrations are appended. Author (ESRO)

N71-33028# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 5: APPENDICES
H. R. Hopkin London Aeron. Res. Council 1970 63 p
Supersedes RAE-TR-66200-Pt-5; N68-13891; ARC-27973
(ARC-R/M-3562-Pt-5; RAE-TR-66200-Pt-5; ARC-27973)
Copyright. Avail: NTIS; HMSO: £1.40; BIS: $5.40

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both aircraft and missiles is proposed. The proposals are intended to supersede prior attempts to revise and extend the existing standard reference in this field. A great deal of reference information is included in the twelve appendices. Author (ESRO)

N71-33037# Saab Aircraft Co., Linkoping (Sweden).
AN EXACT METHOD OF TWO-DIMENSIONAL AIRFOIL DESIGN
Bert Arlinger Oct. 1970 37 p refs
(SAAB-TN-67) Avail: NTIS

An inverse method of airfoil design has been developed for the calculation of an airfoil starting from a velocity distribution prescribed as a function of the distance along the airfoil surface. The method is based on conformal transformation of a profile onto a circle. In order to obtain a closed airfoil the prescribed velocity distribution must be corrected so that certain conditions are satisfied. This correction is made on a prescribed limited part of the airfoil contour, for instance along the lower side in order not to change a designed velocity distribution along the upper side. No approximations are made in the method, implying that only numerical inaccuracies may be present. It is programmed for running on a time-sharing computer system. To illustrate the calculation procedure and the capabilities of the method a few airfoils are designed. The efficiency of the method when designing an airfoil with prescribed lift, upper side velocity distribution, and maximum thickness is demonstrated. Author (ESRO)

N71-33076# Honeywell, Inc., St. Paul, Minn. Research Dept.
IFR STEEP ANGLE APPROACH: EFFECTS OF SYSTEM NOISE AIRCRAFT CONTROL AUGMENTATION VARIABLES Final Report, Jan. 1969 – Jun. 1970
James D. Wolf and Mike F. Barrett Jul. 1970 322 p refs
(Contract N00014-68-C-0191)
(AD-724336; JANAIR-700810; Rept-12571-FR2)

The objective of this study was to investigate, by means of real-time man-in-the-loop simulation techniques, piloting performance as influenced by approach-signal degradation and aircraft control-augmentation variables during IFR steep-angle approaches and landings with vertical-lift aircraft. Simulation evaluations also included aircraft-type, display-format, approach-angle, and display-quickening variables to increase the generality of study results. Variable-velocity simulations of Bell UH-1 and Ryan XV-5 aircraft were utilized as test vehicles. Interpreted within the constraints imposed by the simulations, study results indicated that increased filtering of measurement noise is beneficial during approach but may have a degrading effect during hovering flight. Generally, both flight-path error and pilot control activity increased

with increased measurement noise. With one exception data trends also indicated improved performance with aircraft outer-loop control augmentation. Author (GRA)

N71-33079# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS CHASE FIELD, TEXAS
D. J. Lambiotte and R. B. Brownie Apr. 1971 99 p ref
(AD-724676; NCEL-TN-1168) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, Chase Field, Texas are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N71-33080# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
PHOTOGRAPHIC COVERAGE Final Report
3 May 1971 9 p
(AD-724081; MTP-7-3-519) Avail: NTIS CSCL 14/5

Guidance is furnished for the integration of photographic methods and techniques into the service test of aircraft and aircraft related weapons and ancillary equipment. Author (GRA)

N71-33093# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, LIBBY ARMY AIRFIELD, FORT HUACHUCA, ARIZONA
P. J. Vedros Apr. 1971 24 p
(AD-724069; AEWES-MISC-PAPER-S-71-11) Avail: NTIS CSCL 1/5

The purpose of this report is to present the results of an investigation performed at Libby Army Airfield (LAAF) in September 1970. The inspection was limited to visual observations, and no tests were conducted on the existing runways and taxiways. A layout of the airfield is shown. Author (GRA)

N71-33100# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeubau.
STRENGTH OF ADHESIVE BONDS OF CARBON FIBER REINFORCED COMPOSITES [FESTIGKEITSVERHALTEN VON KLEBVERBINDUNGEN AUS KOHLENSTOFFASERVERSTAERKTEN KUNSTSTOFFEN (KFK)]
Walter Althof Apr. 1971 36 p ref In GERMAN; ENGLISH summary
(DLR-FB-71-31) Avail: NTIS

Structural components of carbon fiber reinforced composites are adhesive bonded to each other as well as to aluminum, steel, and titanium. The strength properties of these joints were investigated, using aircraft structural adhesives only. The test results showed relations between joint strength, adhesive ductility, and interlaminar strength of the composite. Author (ESRO)

N71-33116# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
A FIRST ORDER THEORY FOR PREDICTING THE STABILITY OF CABLE TOWED AND TETHERED BODIES WHERE THE CABLE HAS A GENERAL CURVATURE AND TENSION VARIATION
James D. Delaurier Dec. 1970 124 p refs
(VKI-TN-68) Avail: NTIS

The dynamics of cable-body systems are investigated and an analysis for finding the stability of towed and tethered bodies in a fluid stream is developed. The cable-body system is treated analytically by considering it to be essentially a cable problem, where the body provides end and auxiliary conditions. The mathematical description of the first order motion of a cable with a general shape and tension variation is a sequence of nonhomogeneous boundary value problems in linear partial differential wave equations, with linear ordinary differential end and auxiliary conditions. Further, the equations uncouple to five a "lateral" problem and a "longitudinal" problem, as in first order aircraft dynamics. The solution of either problem takes the form of a transcendental characteristic equation for the stability roots. These roots are extracted by using an electronic computer and a roots locus plot. In order to provide a check on the theoretical analysis, a series of tests were performed on a cable-body system tethered in the VKI open throat, low speed wind tunnel. Author (ESRO)

N71-33124# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
POSITION FIXING NAVIGATION EQUIPMENT Final Report
19 Apr. 1971 28 p
(AD-724079; MTP-6-3-207) Avail: NTIS CSCL 17/7

The document defines procedures for evaluating the suitability of navigational equipment for use in Army aircraft, surface and waterborne vehicles. Author (GRA)

N71-33140*# Lockheed-Georgia Co., Marietta.
MATHEMATICAL MODEL FOR TWO-DIMENSIONAL MULTICOMPONENT AIRFOILS IN VISCOUS FLOW
W. A. Stevens, S. H. Goradia, and J. A. Braden Washington NASA Jul. 1971 186 p refs
(Contract NAS1-9143)
(NASA-CR-1843; ER-10896) Avail: CFSTI CSCL 04D

A computer program is described which evaluates the aerodynamic characteristics of multiple-component airfoils in subsonic, viscous flows. The number of components is limited to four elements of arbitrary arrangement. The calculated aerodynamic characteristics include pressure distributions, lift, pitching-moment, and skin friction drag up to incipient separation on any element. Within the evaluation procedures, a slot-flow analysis technique is included and both ordinary and confluent boundary layers are represented. Correlation of the program output with experimental results is provided. Author

N71-33162# Royal Aircraft Establishment, Farnborough (England).
CATALOGUE OF ENEMY AIRCRAFT REPORTS, 1939–1946
D. I. Raitt comp. Mar. 1969 126 p refs
(RAE-LIB-BIB-312) Avail: NTIS

Bibliography on Japanese, German, and Italian military aircraft and components during the Second World War is listed. ESRO

N71-33169*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF RANGE DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 2 Final Report
C. C. Koch, K. R. Bilwakesh, and V. L. Doyle Aug. 1971 125 p
(Contract NAS3-11157)
(NASA-CR-72964; GE-R71-AEG-133-Vol-2) Avail: NTIS CSCL

20D

Tabulations are presented of the computer output of the data reduction programs. Overall performance data are listed for all undistorted and distorted inlet flow tests; blade element data are listed for both undistorted and radial distortion tests; and, vector diagram data are listed for tests with circumferential inlet flow distortion. Author

N71-33173# National Aerospace Lab., Tokyo (Japan).
SOME EFFECTS OF SYSTEMATICALLY VARIED LOCATION OF A CONCENTRATED MASS ON TRANSONIC FLUTTER CHARACTERISTICS OF SWEPTBACK THIN CANTILEVER WINGS
Eiichi Nakai, Toshiyuki Morita, and Toshiro Takagi 1971 36 p refs In JAPANESE; ENGLISH summary
(NAL-TR-226) Avail: NTIS

An experimental investigation of some effects of systematically varied, (i. e., spanwise, longitudinal, and vertical) location of one engine-pod shaped, concentrated mass on transonic flutter characteristics of thin cantilever wings (having a sweptback angle of 20 deg in quater-chord line, and panel aspect ratio and taper ratio of 4.0 and 0.4, respectively) has been conducted in a transonic blowdown wind tunnel for flutter testing at Mach numbers between 0.759 and 0.964. The experimental results are presented in comparing the boundaries of the flutter-density and the experimental flutter-velocity coefficients of the respective wing-pod configuration tested as a function of Mach number, and also are compared with the calculated results by the matrix iteration method which employs two-dimensional incompressible unsteady flow theory as required oscillatory aerodynamic forces. The boundaries of the flutter-density and the experimental flutter-velocity coefficients are characterized by the minimum values at certain interim Mach numbers tested. Author

N71-33180# Defense Documentation Center, Alexandria, Va.
PARACHUTE TECHNOLOGY, VOLUME 1 Bibliography Report, Mar. 1954 – Sep. 1970
May 1971 181 p refs
(AD-724500; DDC-TAS-70-87-1) Avail: NTIS CSCL 1/3

The references in this bibliography are sorted into seven sections. Section I pertains to the testing or the results of testing of parachutes as a whole configuration; Section II to the theoretical and empirical studies of parachute aerodynamics; Section III to the materials involved in parachute systems; Section IV to the release mechanisms; Section V to parachute jumping and packs; Section VI to air drop operations; and Section VII to miscellaneous references. Author (GRA)

N71-33201*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF RANGE AND DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 1 Final Report
C. C. Koch, K. R. Bilwakesh, and V. L. Doyle Aug. 1971 205 p refs
(Contract NAS3-11157)
(NASA-CR-72806; GE-R71-AEG-133-Vol-1) Avail: NTIS CSCL 20D

The performance and the results of testing a single-stage 1400 ft/sec tip speed transonic compressor are discussed. Tests were conducted with undistorted inlet flow and with both radial and circumferential inlet flow distortions. With undistorted inlet flow, the stage demonstrated a peak adiabatic efficiency at 100% design speed of 0.852 at a total-pressure ratio of 1.624 and an inlet corrected weight flow of 217.2 lb/sec. Stall margin of over 20% was obtained at the above operating condition. Radial and circumferential inlet flow distortions caused substantial reductions in unstalled weight flow range and efficiency. A description of test apparatus and procedure, presentation and analysis of the experimental results, and graphical presentations of the data are presented. Author

N71-33211*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
COMPARISONS OF IN FLIGHT F-111A INLET PERFORMANCE FOR ON AND OFF SCHEDULED INLET GEOMETRY AT MACH NUMBERS OF 0.68 TO 2.18
Richard A. Martin and Donald L. Hughes Washington Sep. 1971 47 p refs
(NASA-TN-D-6490; H-654) Avail: NTIS CSCL 01B

Total and static pressure data from the left inlet of a prototype F-111A airplane were recorded over a large portion of the operating range during automatically scheduled and manually controlled off-schedule positioning of the two-cone compression spike. These data were used to derive inlet performance parameters which indicated that a relatively wide range in performance may be expected during normal operation. The data showed that the preset controller schedule produced nearly optimum performance degradation occurred during off-schedule operation. Compressor stalls due to small inlet geometry changes were found to be most likely to occur at high supersonic Mach numbers, and more range in second-cone angle was available before a compressor stall occurred with a blunt-lip cowl than with a sharp-lip cowl. Trends of total pressure recovery and distortion in flight data were similar to trends in both full-scale and 1/6-scale model data. Author

N71-33219# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
A NOTE ON THE SPANWISE INTEGRATION OF THE KERNAL FUNCTION IN SUBSONIC LIFTING SURFACE THEORY
Ian Coote Nov. 1969 6 p refs *Its* Aero. Tech. Note 6093
Avail: NTIS

The kernal function procedure was used in the development of a computer program to determine the lift distribution on wings in subsonic flow. It was found that the width of the region used to isolate the pole in the spanwise integration had a marked effect on the results obtained. An investigation was carried out to find the best width for a range of wing planforms. Author

N71-33220# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
A FORTRAN PROGRAMME FOR DETERMINING THE SUBSONIC LIFT DISTRIBUTION ON A WING, USING LIFTING SURFACE THEORY
Ian Coote Nov. 1969 15 p refs *Its* Aero. Tech. Note 6902
Avail: NTIS

A FORTRAN computer program is presented for calculating lifting force distributions on symmetrical and cambered wings in subsonic flow. The lifting surface theory and numerical integration used in the program are outlined as well as the aerodynamic coefficients and symbols. J.M.

N71-33224# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS CUBI POINT, PHILIPPINES
Hisao Tomita and Robert B. Brownie Apr. 1971 65 p
(AD-724675; NCEL-TN-1167) Avail: NTIS CSCL 1/5

The results of a condition survey of the airfield pavements at the U. S. Naval Air Station, Cubi Point, Philippines are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included

photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N71-33239*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DEPLOYMENT LOADS DATA FROM A FREE FLIGHT INVESTIGATION OF ALL-FLEXIBLE PARAWINGS AT SMALL SCALE

Delwin R. Croom Washington Aug. 1971 441 p refs

(NASA-TM-X-2307; L-7732) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A free-flight investigation to determine the deployment characteristics of all-flexible parawings was made. Both single-keel and twin-keel parawings having wing areas of 37.16 sq cm with a five-stage reefing system were tested by use of a bomb-type instrumented test vehicle. The system was launched from either a C-130 or a B-66 carrier aircraft and a programer parachuste was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight path prior to deployment of the parawing system. The free-flight deployment loads data obtained in the form of time histories of individual suspension-line loads, reefing-line loads, and total loads are presented. Author

N71-33244*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DYNAMICS OF HIGH DRAG PROBE SHAPES AT TRANSONIC SPEEDS

Robert I. Sammonds Washington Sep. 1971 55 p refs

(NASA-TN-D-6489; A-3613) Avail: NTIS CSCL 01B

The transonic aerodynamics of spherically blunted 55 deg and 60 deg half-angle cones were studied in ballistic-range tests. Both shapes were dynamically unstable at small pitch amplitudes over a small Mach number range near 1.0. The dynamic instability was reduced by moving the center of gravity forward and was eliminated entirely by providing a full-diameter spherical segment afterbody that was made concentric with the center of gravity. Both models and variations thereof were statically stable in all tests. Author

N71-33246*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTIMIZATION OF ENGINES FOR COMMERCIAL AIR TRANSPORTS DESIGNED FOR CRUISE SPEEDS RANGING FROM MACH 0.90 TO MACH 0.98

John B. Whitlow, Jr. and Gerald A. Kraft Aug. 1971 71 p refs

(NASA-TM-X-67906; E-6515) Avail: NTIS CSCL 21E

A parametric study was made of a group of separate-flow-exhaust turbofan engines for advanced technology airplanes designed to carry 300 passengers over a transcontinental range. Cruise lift-drag ratios compatible with the supercritical wing were assumed. Combined jet and fan machinery perceived noise was calculated at both the sideline (lift-off) and approach measuring stations. Noise goals as low as 106 PNdB could be met with 20 PNdB of acoustic treatment with a two stage fan having a pressure ratio of 2.25 at cruise. With this amount of suppression, a noise goal about 10 PNdB lower could be met with a single stage fan having a pressure ratio of 1.70. The airplane figure of merit (range or gross weight) was compromised by the reduction in fan pressure ratio, however. Although these parameters were optimized by reducing cruise speed to about Mach 0.90, direct operating cost was minimized by designing for cruise at Mach 0.94. Noise goals as low as 96 PNdB can probably be met at what looks to be only a moderate economic penalty. Author

N71-33278# Army Board for Aviation Accident Research, Fort Rucker, Ala.

ARMY MIDAIR COLLISIONS

Morris L. Marty and Leroy B. Spivey 1971 25 p refs

(AD-724682; USABAAR-71-1) Avail: NTIS CSCL 1/2

The report contains analyses of 56 Army midair collisions which occurred during the period January 1963 to November 1969 and conclusions and recommendations based on the analyses. Author (GRA)

N71-33283*# Edgerton, Germeshausen and Grier, Inc., Albuquerque, N.Mex.

SONIC BOOM IN TURBULENCE

W. A. Horning Washington NASA Sep. 1971 82 p refs

(Contract NAS1-9284)

(NASA-CR-1879) Avail: NTIS CSCL 20A

Statistics of random overpressure peaks observed in a single sonic boom at ground are derived. The Fourier transform of the wave equation for sound in weak homogeneous turbulence is the starting point. A temporal propagation equation for the spectral density of scattered waves is derived including multiple scattering effects insofar as they are important in weak turbulence at long sonic pathlengths. Author

N71-33304# National Aerospace Lab., Tokyo (Japan).

TWO DIMENSIONAL CASCADE TEST OF AN AIR COOLED TURBINE NOZZLE. PART 1: ON THE EXPERIMENTAL RESULTS OF A CONVECTION COOLED BLADE

Toyoaki Yoshida, Kitao Takahara, Hiroyuki Nouse, Shigeo Inoue, Fujio Mimura et al 1971 31 p refs In JAPANESE; ENGLISH summary

(NAL-TR-231-Pt-1) Avail: NTIS

An experimental investigation was made of the aerodynamic and heat transfer performance of an air-cooled nozzle cascade for a high temperature turbine. The experimental equipment consisted of a low speed wind tunnel, a cooling air system, and a heater. For the representation of the heat transfer performance of the cooled blade, the relations between temperature difference ratio eta which expresses the cooling effectiveness of the blade surface temperature and several parameters such as main stream Reynolds number, incidence angle, weight flow ratio and temperature ratio are shown. Some possible corrections for the cooling effectiveness are discussed for the application of the data obtained from the cascade test to the turboengines. The value of eta at the leading edge is kept at a high level by an effective impingement cooling; on the other hand eta on the latter half of the blade toward the trailing edge region does not decrease extremely by virtue of rear injection. This indicates an improved cooling method for high temperature turbine nozzles. Author

N71-33305+ Czechoslovak Academy of Sciences, Prague. Aeronautical Research and Test Inst.

APPLICATION OF SEVERAL METHODS BASED ON LEAST-SQUARES PRINCIPLE FOR DETERMINING LONGITUDINAL AERODYNAMIC DERIVATIVES OF AEROPLANE FROM FLIGHT TEST DATA Summary Report

Vladislav Klein May 1969 45 p refs

(Z-12) Avail: NTIS

Problems concerning the estimation of longitudinal aerodynamic derivatives from light data are discussed from the standpoint of the identification of a linear system with a given structure. The presented methods for calculation are based on the least-squares principle. The results of the measurement are considered in the form of input and output time histories or in the form of frequency responses. The individual methods are analysed and their results compared. They are demonstrated on the numerical example for which the data of the hypothetical aeroplane were chosen and on

the examples taken from real measurements on three different types of aeroplanes. Author

N71-33307*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
ANALYSIS OF A COUPLED ROLL SPIRAL MODE, PILOT INDUCED OSCILLATION EXPERIENCED WITH THE M2-F2 LIFTING BODY
Robert W. Kempel Washington Sep. 1971 58 p refs
(NASA-TN-D-6496; H-633) Avail: NTIS CSCL 01B

During the 16 glide flights of the M2-F2 lifting body vehicle, severe lateral pilot-induced oscillations occurred on three occasions in the low-angle-of-attack, final-approach, preflare situation. These oscillations were analyzed qualitatively to determine the type and similarity and by a systems analysis to determine the root cause. The analysis was complemented by a piloted simulator study, which verified the results. The systems analysis revealed the presence of a coupled roll-spiral mode which cause the pilots to generate a closed-loop lateral instability in the low-angle-of-attack, preflare flight region. A systems analysis, a piloted simulator study, and flight data showed that the addition of a fixed center fin lessened the pilot-induced-oscillation tendencies in the critical flight region. Author

N71-33312# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ROTOR BLADE BOUNDARY LAYER CALCULATION PROGRESS Final Report
David R. Clark and Douglas R. Arnoldi Mar. 1971 236 p refs
(Contract DAAJ02-69-C-0039)
(AD-723989; USAAVLABS-TR-71-1) Avail: NTIS CSCL 1/3

The development of the turbulent compressible boundary layer on two typical helicopter rotors, for a range of hover conditions, has been calculated using two different analytical methods: the differential method, which uses the differential form of the boundary layer momentum equations and solves for the local velocity gradients, and the integral method, which uses the integrated form of the momentum equations and solves for the development of the characteristic boundary layer thickness parameters and skew angle. Both methods decouple the chordwise and spanwise boundary layer equations without making any small crossflow assumptions. The effects of rotational speed, vortex-induced crossflows, surface curvature, and applied chordwise pressure gradients were evaluated separately and in combination to simulate rotor airfoil boundary layer growth. Author (GRA)

N71-33315# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
A LITERATURE SURVEY OF NOISE POLLUTION
H. H. Shih Mar. 1971 97 p refs
(Contract N00014-69-A-0432)
(AD-724344; Rept-71-5) Avail: NTIS CSCL 20/1

Physically, noise is a complex sound that has little or no periodicity. However, the essential characteristic of noise is its undesirability. Thus, noise can be defined as any annoying or unwanted sound. In recent years, the rapid increase of noise level in our environment has become a national public health hazard. Noise affects mans state of mental, physical, and social well-being. The problem forms a special type of air pollution. Noise study is a rather new subject among other branches of science. The transition from art to near-science started from before the World War II. The work is an attempt to arrive at an understanding of the general situation on the problem of noise. The survey consists of four major parts: the present status of noise pollution, its sources, its effects, and the control. Many urgent research needs are also identified. Finally, lists of terminology and bibliography relating to noise pollution problems are provided. Author (GRA)

N71-33325*# Princeton Univ., N.J.
TURBULENCE AND LONGITUDINAL FLYING QUALITIES
James A. Franklin Washington NASA Jul. 1971 184 p refs
(NASA Order W-12994)
(NASA-CR-1821) Avail: NTIS CSCL 01B

The results of an experimental investigation into the influences of atmospheric turbulence on longitudinal flying qualities are presented. In-flight evaluations of various combinations of simulated turbulence disturbances and open loop airplane dynamics were made for the ILS approach task. Test configurations were chosen to permit an independent study of the effects of turbulence to be made for a set of satisfactory longitudinal dynamics. Further testing was performed for a selective combination of turbulence and dynamics characteristics to assess their interacting influences on flying qualities for the ILS task. The turbulence disturbances were defined in terms of rms magnitudes of the pitch and heave components, the bandwidth or frequency content of the turbulence power spectrum, and the correlation between pitch and heave disturbances. Variations of longitudinal dynamics were made in the short period natural frequency (or angle of attach stability), shorth period damping, and lift curve slope. Data in the form of pilot opinion ratings and commentary, and time histories of airplane response, control inptus, and simulated turbulence disturbances were obtained. The time histories were digitally processed for rms measures of the precision of task performance and the pilot's control workload. Author

N71-33393*# Rochester Applied Science Associates, Inc., N.Y.
THE EFFECTS ON NONUNIFORM SWASH PLATE STIFFNESS ON COUPLED BLADE CONTROL SYSTEM DYNAMICS AND STABILITY. PART 1: ANALYSIS AND APPLICATION
Vincent J. Piarulli Washington NASA Sep. 1971 81 p ref
(Contract NAS1-9496)
(NASA-CR-1817; Rept-70-70) Avail: NTIS CSCL 20D

The results are presented of a study investigating the effects of an anisotropically mounted flexible swash-plate, including blade out-of-track, on the vibratory and mechanical stability characteristics of helicopter rotor systems. The analysis which was developed is based on a combined Laplace transform and associated matrix approach. The program yields complex eigenvalues which indicate frequency and rate of growth or decay of a natural mode of the complex system. Blade modal response and swash-plate motion corresponding to a given eigenvalue are predicted. Author

N71-33395*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
DRAG COEFFICIENTS FOR PARTIALLY INFLATED FLAT CIRCULAR PARACHUTES
Stanley H. Scher and Irene G. Young Washington Sep. 1971 11 p refs
(NASA-TN-D-6423; L-7723) Avail: NTIS CSCL 01C

Free-body tests were made in a spin tunnel to determine drag coefficients for 1.07 m diameter flat circular parachutes when restrained by wire frames in a series of shapes representing those that parachutes assume during the inflation process. Both high-porosity (stable) and low-porosity (unstable) parachutes were investigated. The results obtained should be applicable to inflation analyses for flat circular parachutes. Author

N71-33402# Aeronautical Research Labs., Melbourne (Australia).
A WIND TUNNEL INVESTIGATION OF LEVEY'S SHOCK-FREE AEROFOIL
D. A. Secomb Aug. 1970 41 p refs
(ARL/Aero-325) Avail: NTIS

Surface pressure measurements and schlieren photographs of the flow about a 5.0 in. chord model of Levey's shock free

airofoil are presented. The results cover the Mach number range 0.60 – 0.95 and the Reynolds number range 0.2 million to 0.9 million. A few results at nonzero angle of attack are included. At the higher Reynolds numbers the results suggest that a low loss transonic compression from a local Mach number of about 1.14 does occur, at a free stream Mach number somewhat in excess of the design value, 0.80. Unsteady wavelets are present in the compression region near 0.6 of chord, but boundary layer separation does not occur. Agreement with the predicted inviscid distribution is reasonable. At the lower Reynolds numbers flow separation from the surface occurs near 0.6 of chord. The reattachment point moves forward with the increase of Reynolds number so that at about 0.45 million the separation is suppressed. Leading edge roughness bands were present at all times. The effect of a small increase of angle of attack on the upper surface pressure distribution at Mach number 0.8 is very similar to the effect of a small increase in Mach number. The model profile errors and their effects are discussed in some detail. The influence of the model at the upper and lower slotted test section walls is found to be small. Author

N71-33403# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
A COMPUTER-PLOTTER PROGRAM ON JOUKOWSKI AIRFOIL
J. H. T. Wu, K. S. Wong, and P. P. Ostrowski Apr. 1971 26 p refs
(Tech-71-4) Avail: NTIS

Steady, incompressible flow about a Joukowski airfoil section is simulated at moderate angles of attack using a digital computer and plotter. The effect of various transformation parameters as well as the streamline pattern and pressure distribution about the airfoil is illustrated. Numerical integration of the pressure distribution at 6.50 angle of attack yields a lift coefficient that agrees favorably with known experimental results. The value of the simulation technique as a teaching tool is demonstrated. The method is shown to be particularly useful for flow visualization as all the basic features of the Joukowski transformation and the potential flow streamline patterns are clearly depicted. Since only relatively unsophisticated computing methods are required, the simulation process provides a flexibility that is conveniently coupled with an obvious time saving and economic advantage as compared to that done by slide rules or desk calculators. Author

N71-33438# Lundberg (Bo), Bromma (Sweden).
IS CIVIL SUPERSONIC AVIATION JUSTIFIED?
Bo Lundberg 5 Jul. 1971 51 p refs Presented at Meeting of the Council of Europe, Stockholm, 6 Jul. 1971
(BL-147) Avail: NTIS

A balance sheet is presented of the pros and cons of the SST, in its currently conceived form, for use in worldwide civil air operations. Discussed are: (1) need for the SST; (2) economics; (3) safety; (4) production costs; (5) fuel consumption; (6) cosmic radiation risks to passengers; (7) climatological change risks; (8) airport noise; and (9) sonic booms. The author concludes that the serious drawbacks to the SST make it imperative that the SST be prevented from being introduced into regular operation. A.L.

N71-33439# Lundberg (Bo), Bromma (Sweden).
OZONE: SORRY, BUT THERE'S STILL MORE TO SAY ON THE SST
In its Is Civil Supersonic Aviation Justified? 5 Jul. 1971 3 p Excerpt from the New York Times, 30 May 1971, Science

Avail: NTIS

Excerpts are presented from a New York Times article, and editorial, on the possible effects of SST exhaust on the ozone content of the stratosphere. Dr. Johnston of the University of California at Berkeley contends that the nitric oxides from a fleet of 500 SST's operating an average of seven hours a day could reduce the ozone content of the atmosphere by half within less than one year, and that SST's would wipe out virtually all ozone in the lower stratosphere where the planes would operate. Predictions are also made of the effects this depletion would have on humans, animals, weather, climate, and rates of ozone production. A.L.

N71-33440# Lundberg (Bo), Bromma (Sweden).
[STATEMENT TO THE SECOND MEETING OF THE ICAO SONIC BOOM PANEL]
In its Is Civil Supersonic Aviation Justified? 5 Jul. 1971 10 p Held 12 – 21 Oct. 1970
Avail: NTIS

The SST sonic boom carpets and their potential effects over land and sea areas are discussed. A.L.

N71-33441# Lundberg (Bo), Bromma (Sweden).
GENERAL COMMENTS ON RAPPORTEUR'S REPORT NO. 3
In its Is Civil Supersonic Aviation Justified? 5 Jul. 1971 2 p

(BL-139; SBP-WP/6) Avail. NTIS

The two different approaches to solving probable and possible effects of sonic booms resulting from future extensive SST operations are discussed. The two approaches are: (1) the known facts only; and (2) attempt of full assessment. The pros and cons of the two methods are briefly evaluated. A.L.

N71-33491# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
TUNNEL FLOW BREAKDOWN FROM INCLINED JETS
R. A. Tyler and R. G. Williamson Mar. 1971 53 p refs
(NRC-LR-545; NRC-11994) Avail: NTIS

Inclined single and paired jets were operated through the regime of floor vortex formation in the NRC 10-ft × 20-ft V/STOL propulsion tunnel. Observed floor stagnation positions are correlated in terms of a jet force coefficient. Limiting conditions for vortex formation (incipient stagnation) are derived for a wide range of jet inclination to the vertical. The observations are discussed in relation to limited existing information on tunnel flow breakdown with models involving vertical jets, and used to infer the influence of jet inclination on testing limits. Correlated results for the single jet and tandem jet-pair were generally similar, at the same total nozzle area. Author

N71-33494*# Scientific Translation Service, Santa Barbara, Calif.
SIMULATION OF THE GROUND EFFECT IN THE HYDRODYNAMIC TUNNEL [SIMULATION DE L'EFFECT DE SOL AU TUNNEL HYDRODYNAMIQUE]
H. Werle Washington NASA Aug. 1971 18 p refs Transl. into ENGLISH from French report TP-63, 1963
(Contract NASw-2035)
(NASA-TT-F-13799) Avail: NTIS CSCL 20D

The ground effect on the flow around models in water tunnels has been simulated by various devices: fixed plates, endless belts, image-models, etc. It has been analyzed by visualizations. A systematic study was made in two dimensional flow (without and with jet effect) and a few three dimensional examples were also studied (low aspect-ratio wings, simulated engine intakes and exhausts). Author

N71-33517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN INVESTIGATION OF A FULL-SCALE ADVANCING BLADE CONCEPT ROTOR SYSTEM AT HIGH ADVANCE RATIO

Robert H. Stroub, Michael D. Falarski, John L. McCloud, and Paul T. Soderman Aug. 1971 54 p Prepared jointly with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.

(NASA-TM-X-62081) Avail: NTIS CSCL 01B

Modern helicopters have been limited in high speed capability and cruise performance by stall of retreating blade and by compressibility effects of advancing blade. One technique for minimizing those adverse effects is to locate the rotor's total life centroid on the advancing side of the rotor disk. The retreating blade lift requirements would then be greatly lessened, and the advancing blade would be operating at conditions favorable for better lift to drag ratios: A rotor system has been built based upon this lift offset or advancing blade concept (ABC). This ABC rotor system featured two, counter rotating coaxial rotors utilizing blades that were very stiff in torsion and in flatwise and chordwise bending. The ABC rotor system was tested in the 40 by 80 foot wind tunnel to demonstrate the system's performance capability, rotor loads, and to determine stability and control power derivatives over an advance ration range of 0.2 to 0.9. Data were obtained over a range of lift and propulsive force. Author

N71-33545# . Aeronautical Research and Test Inst., Prague (Czechoslovakia).

ON AIRCRAFT LONGITUDINAL MOTION AFTER BOUNDARY LAYER CONTROL SYSTEM FAILURE DURING TAKE-OFF AND LANDING Summary Report

Vladimir Silhanek Oct. 1969 29 p refs *Its* Zprava Vzlu Z-13

Avail: NTIS

The aircraft longitudinal motion during take-off and landing, caused by loss of lift, arising after BLC system failure is studied. The theoretical part of this study deals with the estimation of the critical altitude of BLC failure and with the analysis of the influence of some parameters. This task is solved as a non-classical variation problem and the method of Pontrjagin's principle of maximum is applied. Some flight measurements on the E 33 test aircraft with BLC by blowing, where the BLC system failure was simulated. Some comparisons of these flight measurements and the results of theory are also presented. Author

N71-33546*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CALCULATION OF CAMBER USING SLENDER WING THEORY AT MACH NUMBER 1.0

William B. Igoe Sep. 1971 73 p refs

(NASA-TM-X-2311; L-7666) Avail: NTIS CSCL 01A

A calculation procedure based on slender wing theory at Mach number 1.0 is presented for the determination of the mean line camber ordinates for laterally symmetrical wings with polygonal planforms. A uniform chordwise load and a continuous but otherwise arbitrary spanwise load distribution is assumed. The procedure is generally limited to slender wings at high subsonic speeds and low lift coefficients. Graphs of functions required in the calculation procedure are presented. In addition, an application of the method of calculation for a variable-sweep wing planform is described and some calculated camber results are shown. Although the slender wing theory for Mach number 1.0 is considered to be inadequate for the calculation of the detailed shape of airfoil section camber for supercritical wings designed for near-sonic speeds, a comparison with experimental results shows that it predicts the general magnitude and trend of the spanwise variation of the wing twist angle. Author

N71-33547# National Aerospace Lab., Tokyo (Japan).

STUDIES ON PSD METHOD FOR AIRCRAFT STRUCTURAL DESIGN FOR ATMOSPHERIC TURBULENCE

Kazuyuki Takeuchi and Kosaburo Yamane Jan. 1971 36 p refs In JAPANESE; ENGLISH summary

(NAL-TR-233) Avail: NTIS

The currently adopted gust criterion for airplane structural strength is based on discrete gusts of the (1-cos) type. With the increase of airplane speed and the structural flexibility, the discrete gust criterion has been thought to be insufficient for the examination of gust loads and structural strength, especially for civil transport. A power spectral density (PSD) method is discussed. Some comments on the proposed PSD method and the calculated results on the YS-11 twin turboprop transport by this method are presented. Author

N71-33549# National Aerospace Lab., Tokyo (Japan).

A TWO-DIMENSIONAL CASCADE TEST OF AN AIR-COOLED TURBINE NOZZLE. PART 2: ON THE TEMPERATURE DISTRIBUTIONS OF A CONVECTION-COOLED BLADE AS DETERMINED BY NUMERICAL CALCULATION AND BY ANALOGUE SIMULATION TEST

Toyoaki Yoshida, Kitao Takahara, Hiroyuki Nouse, Shigeo Inoue, Fujio Mimura et al Jan. 1971 24 p refs In JAPANESE; ENGLISH summary

(NAL-TR-232) Avail: NTIS

A numerical calculation by the finite difference method and an experiment by an analogue simulation test by means of an electric resistance paper on the convection-cooled blade temperature are described. These trials are intended to be compared with the measured values by the cascade test that have been shown in Part I of the present pair of Technical Reports. Both of those methods need heat transfer coefficient- and cooling air temperature-distributions and other data as boundary conditions, therefore the results depend on the estimation of these boundary conditions. The calculated values subject to some dependence upon boundary conditions are in fair agreement with the cascade test data. On the other, hand the blade temperature distribution at cross sectional area normal to the spanwise direction and the effect of blade thickness on these temperature distributions by the analogue simulation test are shown and then discussed. According to these results, heat flow near the leading edge region is almost normal to the direction of the blade surface but from halfway to the trailing edge region, the heat flow is almost parallel to the blade surface direction. Author

N71-33560*# Dynatech Corp., Cambridge, Mass.

AN EXPERIMENTAL STUDY OF NOISE ATTENUATION BY LIQUID INJECTION

Lewis A. Maroti and Gerald B. Gilbert Mar. 1971 52 p refs

(Contract NAS1-9809)

(NASA-CR-111905) Avail: NTIS CSCL 20A

The objective of this investigation was to define the magnitude of noise attenuation which can be produced by injecting evaporating droplets into a subsonic duct flow. This flow model, which is simple compared to the actual flow in an axial compressor or fan, was selected as a first step to explore the potential of noise attenuation by liquid injection. The reduction of noise generation by liquid injection was not studied; this must await testing on a fan or compressor. Author

N71-33581# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

TWO NUMERICAL METHODS FOR THREE DIMENSIONAL BOUNDARY LAYERS

L. S. Caretto, R. M. Curr, and D. B. Spalding Jul. 1971 37 p refs

(EF/TN/A/40) Avail: NTIS

Two finite-difference procedures are described for the computation of steady, three-dimensional boundary layers in ducts. In addition to the velocity components, one method uses pressure

as the fourth dependent variable, while the other uses vorticity. Both methods take full account of shear stresses and heat fluxes on planes aligned with the main flow direction, and allow for non-uniform transport and thermodynamic properties. There is no restriction as to boundary conditions. Author

N71-33583# National Aerospace Lab., Tokyo (Japan).
MEASUREMENTS AND ANALYSIS OF ATMOSPHERIC TURBULENCE ON THE PACIFIC COAST AIR ROUTE OF THE TOHOKU DISTRICT
Kazuyuki Takeuchi, Koichi Ono, Kosaburo Yamane, Kenji Yazawa, and Tokuo Sotozaki Oct. 1970 35 p refs In JAPANESE; ENGLISH summary
(NAL-TR-222) Avail: NTIS

Measurements on atmospheric turbulence were made on Japanese air routes. A tape recorder with fourteen tracks was used to record normal and horizontal accelerations and angular velocities at C.G. to give the airplane attitude, as well as the airspeed and the wind directions measured by flow vanes attached to the nose and wing tip. The wind direction was used to obtain the turbulence velocities. Temperatures, altitude, and displacements of the control surfaces were also recorded. The data were analyzed to obtain the turbulence spectrum and the relationship between the measured items including atmospheric temperature. Author

N71-33585# National Aerospace Lab., Tokyo (Japan).
TASK ANALYSIS OF JET TRANSPORT (DC-8)
Kazuo Higuchi, Moriyuki Momona, Noriko Miyoshi, Masanori Okabe, and Hiroyasu Kawahara 1970 180 p refs In JAPANESE; ENGLISH summary
(NAL-TR-215) Avail: NTIS CSCL 01B

As an aid to get an objective understanding of the behaviour of pilot-vehicle system, a task analysis of DC-8 pilots was carried out. Task was defined as a minimum unit of work made of information acquisition, central processing and control motion. The following implications were obtained; (1) information necessary to control airplane is not presented to pilots in the form which makes pilots able to grasp the entire situation, (2) the process of judgement is not specified clearly and liable to be subject to indivisual arbitrary standard of judgement, (3) at take-off and landing, legs and arms of captain among other crews are occupied by controls, (4) many unspecified tasks are assigned to pilots, (5) there are many tasks in which pilots can be replaced with automatic devices, (6) it is desirable to exempt captain from those tasks which he must perform as a simple operator, and also to lessen his task load. Furthermore, there is little mobility of task allocation among crews, (7) discrete tasks are liable to be left unperformed without confirming the execution of them, and (8) the appropriate warning device to prevent pilots from wrong operations is not provided. Author

N71-33611*# Scientific Translation Service, Santa Barbara, Calif.
ANALYSIS OF THE RELATIONS BETWEEN ACOUSTIC AND AERODYNAMIC PARAMETERS FOR A SERIES OF DIMENSIONALLY SIMILAR CENTRIGUGAL FAN ROTORS [BEITRAG ZUR ANALYSE DER BEZIEHUNGEN ZWISCHEN *DEN AKUSTISCHEN UND STROEMUNGSTECHNISCHEN* PARAMETERN AM BEISPIEL GEOMETRISCH AEHNLICHER RADIALVENTILATOR LAUFRAEDER]
J. Weidemann Washington NASA Aug. 1971 107 p refs Transl. into ENGLISH from the German report DLR-FB-71-12
(Contract NASw;2035)
(NASA-TT-F-13798; DLR-FB-71-12) Avail: NTIS CSCL 20D

Through the example of free running centrifugal rotors blowing against a sharp edge, it was shown that the fan laws of blade passage and broad band noise can be described by product notations. In particular, it was shown that the frequency dependence of the sound pressure established in the free field is essentially determined by velocity fluctuations on the edge and, independently thereof, by the dimension to the wavelength ratio. Finally, the measurements provided information on the accuracy with which the noise can be calculated for homologous fan series up to a size ratio of 1:10. Author

N71-33612* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL MODEL DAMPER Patent
Max B. Bryan, inventor (to NASA) Issued 28 Jun. 1971 8 p Filed 6 Nov. 1969

(NASA-Case-XLA-09480; US-Patent-3,587,306; US-Patent-Appl-SN-874435; US-Patent-Class-73-147) Avail: US *Patent Office* CSCL 14B

A damper system to alleviate some of the unsteady load forces normally experience on a wind tunnel model and its balances during sudden starting and shutdown of high speed wind tunnels is described. During the starting and stopping phases of high speed wind tunnels, for example, in the supersonic and hypersonic speed ranges, a state of unsteady flow exists in the test section. This unsteady flow induces undesirable oscillating aerodynamic loads on the test model that greatly exceed the load limits of the strain gage balances used to measure the steady state model forces and moments. Official Gazette of the U.S. Patent Office

N71-33615# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
SONIC PRESSURE DISTRIBUTIONS ON 12 PER CENT THICK POLYNOMIAL AEROFOILS IN SLOTTED AND CHOKED WIND TUNNEL TEST SECTIONS
G. R. Kittson Aug. 1970 39 p refs *Its* Aeron. Note 324
Avail: NTIS

Measurements were made at sonic and near sonic speeds and at zero and near zero angles of attack for each airfoil located symmetrically in a rectangular wind tunnel test section. Two slotted wall arrangements with open area ratios 0.10 and 0.17 were used, and a third arrangement with solid walls provided choked flow. Pressures along the test section walls were measured. The blockage ratios were 1.0% 1.7%, 2.4%, and 3.0%. The effects of variation in Mach number, angle of attack, spanwise displacement, and leading edge roughness bands were investigated for the normal and reversed airfoil orientations having maximum thickness at 0.7 and 0.3 of chord, respectively. Even at the highest blockage ratio the wall interference is small. Pressure distributions considered to be free of interference are derived. For the profile with maximum thickness at 0.7 of chord, the results are in good agreement with values calculated by the local linearization or the parametric differentiation methods. For the profile with maximum thickness at 0.3 of chord, the present results confirm the prediction of the parametric differentiation method that the pressure gradient beyond 0.5 of chord becomes zero and then positive. Author

N71-33625*# *Translation Consultants, Ltd.*, Arlington, Va.
ON THE WAY TOWARDS THE HYPERSONIC TRANSPORT [VERS L'AVION HYPERSONIQUE]
C. Dousset Washington NASA Sep. 1971 22 p Transl. into ENGLISH from *l'Aeronautique et l'Astronautique* (France), no. 26, Feb. 1971 p 37–46
(Contract NASw-2038)
(NASA-TT-F-13793) Avail: NTIS CSCL 01B

The mission, aircraft, traffic volume, operating conditions as well as the economic aspect of a commercially viable hypersonic transport are described. Author

N71-33671# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.

CLEAR AIR TURBULENCE IN THE AUSTRALIAN STRATOSPHERE

C. K. Rider and M. R. Thomson Jan. 1971 14 p refs *Its* Struct. and Mater. Note 362

Avail: NTIS

During the HICAT investigation in 1966, an instrumented U2 aircraft flew eight flights into the stratosphere over Australia in a search of clear air turbulence which might be of importance for SST flight. The most interesting features are summarized as follows: Patches of CAT may exceed 100 miles in dimension and persist for at least 2 hours. The terrain some 60,000 ft below flight level appears to influence the nature of CAT experienced; the presence of strong jet streams appears related to the occurrance of severe CAT. Horizontal temperature gradients of several degrees in a few miles may occur within the turbulent region. Author

N71-33678# Federal Aviation Administration, Oklahoma City, Okla.

AIRFRAME AND POWERPLANT MECHANICS: GENERAL HANDBOOK

1970 505 p

(FAA-AC-65-9) Avail: NTIS HC $6.00/MF $0.95

This handbook was developed by the Federal Aviation Administration as the first of three handbooks designed as study manuals for persons preparing for mechanic certification with airframe or powerplant rations, or both. It is intended that this handbook will provide basic information on principles, fundamentals, and technical procedures in the subject matter areas common to both the airframe and powerplant ratings. Emphasis in this volume is on theory and methods of application. Author

N71-33699# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.

PRESSURE DISTRIBUTIONS ON PLANAR DELTA WINGS ATTACHED TO CYLINDRICAL BODIES IN SUPERSONIC FLOW. PART 3: THEORETICAL RESULTS FOR SONIC LEADING EDGE, ANGLE OF ATTACK CASE

Judith E. Barrett Sep. 1970 65 p refs

(WRE-TN-HSA-186) Avail: NTIS

A method of calculating the linearized pressure fields on supersonic planar wing and quasi-cylindrical body combinations is used to find the theoretical pressure distributions for a wing-body combination consisting of a sonic-leading-edged delta wing and cylindrical body in supersonic flow. Results are given for the case where the combination is at an angle of attack, and the wing is taken to be of zero thickness. Comparisons with experimental data demonstrate that for this configuration the linearized theory may be used successfully to evaluate the pressure distribution. Author

N71-33747*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

AN APPROACH TO SEMIAUTOMATED OPTIMAL SCHEDULING AND HOLDING STRATEGIES FOR AIR TRAFFIC CONTROL

Michael Athans and Lynn W. Porter Dec. 1970 64 p refs

(Grants NGL-22-009-124; AF-AFOSR-1724-69A)

(NASA-CR-121466; AD-721474; ESL-P-437) Avail: NTIS CSCL 01B

The paper considers the problem of coordinating the traffic flow and holding patterns of N aircraft which desire to land in a single runway. A distance separation is to be enforced over the outer marker. It is shown that this problem can be attacked as a variation of a linear-quadratic optimal control problem. The solution of this optimization problem can be used to indicate which aricraft can accomplish headway corrections by velocity control, and which require to undergo path stretching or holding maneuvers. The gradual implementation of these strategies in current and evolutionary ATC systems will also be discussed. Author (GRA)

N71-33758# Committee on Appropriations (U.S. House).

CIVIL SUPERSONIC AIRCRAFT DEVELOPMENT (SST)

Washington GPO 1971 116 p Hearings before a Subcomm. of the Comm. on Appropriations at the 92d Congr., 1st Sess.

Avail: US Capitol, House Document Room

Comments on continuing fiscal year 1971 transportation appropriations for SST and Concorde development are presented. Environmental issues, productivity, technological leadership, and economic viability are discussed as well as international travel and the percentage of program completion. J.M.

N71-33760# Office National D'Etudes et de Recherches Aerospatiales, Paris (France).

REVIEW OF RECENT FRENCH RESEARCH ON UNSTEADY AERODYNAMICS OF AXIAL FLOW COMPRESSORS AND TURBINES [RECHERCHES FRANCAISES RECENTES SUR L'AERODYNAMIQUE INSTATIONNAIRE DES COMPRESSEURS AXIAUX ET TURBINES]

Jean Fabri 1971 19 p refs Presented at Symp. sur les Ecoulements Instationnaires, Tridimensionnels et Separes, Atlanta, Ga., 10 - 11 Jun. 1971

(TP-971) Avail: NTIS

Research on unsteady aerodynamics of axial flow compressors or turbines conducted in several French laboratories is summarized. Investigations into the passing blade problem and stage interaction, unsteady flow due to compressor stall, and blade vibration and aerodynamic damping are included along with pertinent results. Author

N71-33776*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED STATIC WIND-TUNNEL INVESTIGATION OF A HALF-SPAN FUSELAGE AND VARIABLE SWEEP PRESSURE WING MODEL

John E. Lamar and L. Wayne McKinney Washington Aug. 1971 324 p refs

(NASA-TN-D-6215; L-7548) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The experimental balance and pressure data obtained from tests of an untwisted variable sweep wing with an outboard pivot exhibited nonlinearities in both total normal force coefficient and pitching moment coefficient curves for all sweep angles and fuselage conditions. These total effects have been traced back through the section data and pressure distributions to find the causes. The causes of these nonlinearities were found to be: (1) separation of flow on the outer panel; and (2) a leading edge vortex flow on the inner panel. A fuselage added to the wing had little effect on the aerodynamic characteristics. Predictions of wing loadings and performance characteristics were made by using the modified Multhopp method and a comparison with experimental results indicated reasonable agreement. The changes in span loading *as a result of leading edge shed vortex formation and flow* separation at the higher angles of attack caused an increase in the induced drag parameter. Author

N71-33788# National Aviation Facilities Experimental Center, Atlantic City, N.J.

OPERATIONAL EVALUATION OF THE BRIGHT RADAR MICROWAVE REMOTING SYSTEM Final Report, May 1970-Feb. 1971

Enoch H. Wright Sep. 1971 27 p

(FAA-RD-7148; FAA-NA-71-14) Avail: NTIS

An operational evaluation to determine the capability of

a bright radar microwave remoting system to provide operationally useful radar data in a satellite control tower was conducted. The microwave equipment consisted of a 15 GHz microwave transmitter and receiver and two 6-foot parabolic antennas. The air traffic control tower used a pre-production model of a BRITE-I display with a 16-inch cathode ray tube (Bright Radar Indicator Tower Equipment) display for the first half of the evaluation and a BRITE-II display for the last half. A daily log was maintained to record any deterioration of display quality and also to record rain and thunderstorm activity. Air traffic control personnel completed questionnaires during and after the study. It was concluded that the bright radar microwave remoting system is capable of providing operationally useful radar information on BRITE-I/BRITE-II displays in a satellite airport tower and that the system was reliable during the rainfall periods. Author

N71-33794# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TRANSONIC TESTING OF THE ENGINE NACELLE AIR INTAKE AND AFTERBODY [ENTREE D'AIR ET ARRIERE-CORPS DE FUSEAU-MOTEUR EN TRANSSONIQUE]
Jacky Leynaert 1971 11 p refs In FRENCH; ENGLISH summary
(ONERA-TP-943) Avail: NTIS

An example is presented of a double-flux engine nacelle at high subsonic Mach numbers, the investigation being made at high Reynolds numbers with two separate models for the air intake and the afterbody. The test on the afterbody shows that the conditions of variable jets do not react significantly on the upstream flow around the nacelle intake and cowl, apart from the immediate vicinity of the exhaust; this fact justifies the large scale, study of the air intake with a model supported downstream by a cylindrical tube replacing the jet. In the same way, mass-flow rate variations of the air intake do not react on the flow around the afterbody, in a given margin; this allows the study of the afterbody on a upstream sting. Signification and limits of these studies are discussed according to the test results. Author

N71-33803*# National Aeronautics and Space Administration, Washington, D.C.
THEORETICAL AND EXPERIMENTAL TESTING ON JET FLAP WINGS. PART 1: TESTING OF A RECTANGULAR WING AT VARIOUS ASPECT RATIOS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ON STRAHLKLAPPENFLUGELN. GEIL 1: UNDERSUCHUNGEN ARE RECHTECKFLUGELN VON VERSCHIEDENEN SEITENVERHALTNISSER]
A. Das (German Res. Center for Flight, Braunschweig) Sep. 1971 83 p refs Transl. into ENGLISH from the German report
(NASA-TT-F-13715) Avail: NTIS CSCL 01A

Theoretical and experimental information is provided about the lift and pitching moment distribution on jet flap wings of a rectangular design with various aspect ratios. In this case the jet impulse coefficients were varied in the range from 0 to 2.0. Theretical computation of the lift distribution was made according to the airfoil theory with the adoption of the necessary profile data for slot wings. An airfoil model with an end plate was used for the experimental research. The wing had adjustable blowing slots for jet angles 0 deg; 30 deg and 60 deg. The aspect ratio could be changed by shifting the wing in the cross direction with the end plate. In this way the effective aspect ratios of 2.75; 3.5 and 4.5 for the three wing lengths used in consideration of an end plate correction were obtained. The tests include measurement of the static pressure on the airfoil and measurements of the total pressure in the wake in order to determine the jet shape. Author

N71-33805# Politecnico di Torino (Italy). Scovala di Ingegneria Aerospaziale.
THE THEORY OF AEROELASTIC MODELS [LA TEORIA DEI MODELLI AEROELASTICI
Giuseppe Surace 1970 44 p refs In ITALIAN
Avail: NTIS

The model theory is examined for static- and dynamic-aeroelastic phenomena. The results are applied to divergence and flutter. Transl. by F.O.S.

N71-33811 Rutgers Univ., New Brunswick, N.J.
THE NEAR WAKE OF A BLUNT BASED AXISYMMETRIC BODY AT MACH .14
Donald Paul McErlean (Ph.D. Thesis) 1970 149 p
Avail: Univ. Microfilms Order No. 70-16944

A special open circuit steady flow wind tunnel with a closed jet test section and a model support system contained entirely within the tunnel settling chamber were utilized. Detailed pressure measurements were made in all regions of the wake as well as in he approaching flow and on the body surface. The rear stagnation point was located and complete shear layer and recirculation region velocity profiles were obtained. The flow field was found to be quite insensitive to changes in free stream velocity with respect to the base pressure coefficient and the location of the rear stagnation point. The influence of the separation corner extended approximately two base diameters upstream on the body. The dividing streamline was nearly elliptical in shape. There is reasonable agreement for the base pressure but substantial scatter for the length of the recirculation region. Dissert. Abstr.

N71-33841# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
USING THE ONERA/S4MA HYPERSONIC WIND TUNNEL FOR SUPERSONIC COMBUSTION RAMJET TESTS [UTILISATION DE LA SOUFFLERIE HYPERSONIQUE S4MA POUR LES ESSAIS DE COMBUSTION SUPERSONIQUE DE STATOREACTEURS]
Christian Soulier and Jean Laverre 1971 15 p refs In FRENCH and ENGLISH Presented at 35th Meeting of the Supersonic Tunnel Assoc., Dallas, 8–9 Mar. 1971
(TP-924) Avail: NTIS

The wind tunnel description is limited to that of the heater and of the Mach 6 nozzle, and includes details of modifications and adaptations made for testing a supersonic combustion chamber of a hydrogen burning ramjet. The aerodynamic nozzle is replaced by the combustion chamber to be tested, supplied through a duct in such a way that at the engine inlet section it has the same velocity, temperature and pressure conditions as it would have in a ramjet flying at Mach 6 at 30 km altitude. The engine thrust is measured by a balance. The pressure of the air supplied by the heater was 10 to 15 bars, and its temperature 1750 deg. Author

N71-33926# Technische Hogeschool, Delft (Netherlands).
A METHOD TO DERIVE ANGLE OF PITCH, FLIGHT-PATH ANGLE AND ANGLE OF ATTACK FROM MEASUREMENTS IN NONSTEADY FLIGHT
R. J. A. W. Hosman Apr. 1971 107 p
(VTH-156) Avail: NTIS

A method is described to determine the angle of pitch theta, the flight-path angle gamma and the angle of attack alpha of an aircraft during steady or nonsteady flight. These angles are determine by integration of the rate of pitch Q and the specific forces A sub x and A sub z and not by directly measuring these angles. Errors in the estimates of the initial conditions of the integrations and of the zeroshifts in the measurements of q, A sub x and A sub z are corrected for by comparing the computed and the measured values of the change in altitude and airspeed. An

error analysis is carried out, to determine the accuracy with which the angles theta, gamma and alpha are determined by the described method for steady as well as for nonsteady flight. Author

N71-33937# Serendipity Associates, Arlington, Va. Operations Div.

A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 3: AIRPORT/AIRCRAFT SYSTEM NOISE Final Report

Nov. 1970 317 p refs

(Contract DOT-OS-A9-018)

(OST-ONA-71-1-Vol-3) Avail: NTIS

Alleviation of the airport noise problem involves changes to aircraft, airport, and airport surroundings. Individual aircraft can be designed and operated in a manner which will reduce the level of noise generated at the source and perceived on the ground. The introduction of the high bypass ratio engine/aircraft, and the expanded use of noise reducing materials in current and future aircraft engines are expected to reduce the severity of the aircraft noise problem. Aircraft operational alternatives can be employed to either reduce the level of noise perceived on the ground or to shift the incidence of the noise from some area to another less sensitive location. Insofar as possible, land areas affected by aircraft noise should be used for noise-compatible activities. Future airport development should take place in conjunction with land use planning for the surrounding environs. Author

N71-33938# Serendipity Associates, Arlington, Va. Operations Div.

A STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT. VOLUME 7: ABATEMENT RESPONSIBILITY Final Report

Nov. 1970 85 p refs

(Contract DOT-OS-A9-018)

(OST-ONA-71-1-Vol-7) Avail: NTIS

Existing noise regulations and enforcement experience were analyzed for air and surface transportation at the Federal, state, and local level. The influence of the public and industrial self-regulation was also investigated. The Federal Government can regulate the noise characteristics of new aircraft and the operation of all aircraft. The specification of an acceptable airport noise environment still rests with the airport proprietor. State and local governments have adopted motor vehicle noise control regulations. New York and California have adopted numeric limits while the other states only prohibit excessive noise without specifying what it is. Federal authority exists to insure the highway noise levels will be compatible with roadside land uses: This authority will take effect on July 1, 1972 and applies only to Federally funded developments. Railroads and mass transit do not appear to pose great noise problems compared to aircraft or highways. Several regulatory actions are recommended and discussed as they pertain to the control of air and surface transportation generated noise. Author

N71-33948# National Research Council of Canada, Ottawa (Ontario).

PUBLICATIONS OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, SERIES NO. 2, SUPPLEMENT 4

Jan. 1971 20 p refs

Avail: NTIS

An annotated bibliography is presented of aeronautical, mechanical engineering, and test reports published in January 1971. Feature articles from quarterly bulletins and miscellaneous papers are also listed. J.M.

N71-33964# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

SONIC BOOM ANALOGUES FOR INVESTIGATING INDOOR WAVES AND STRUCTURAL RESPONSE

Sui Lin Nov. 1970 47 p refs Sponsored by Natl. Res. Council of Can.

(UTIAS-TN-158) Avail: NTIS

Experimental results indicate that the maximum amplitude of the indoor pressure wave induced by a sonic boom for the case of a partly open window is larger than the maximum amplitude of the incident sonic boom. In such a case, the two undesirable effects of the sonic boom are the annoyance it causes people and the effect it has upon structural members are larger indoors than outdoors. The effects of window size, room dimension, the dimensions and the properties of structural members and the shape of the sonic boom, which influence the indoor acoustical pressure and the structural dynamic response, are investigated by using an electrical analog. The method of design for the electrical analog is described. The good agreement between the results from the electrical analog and those of Vaidya shows that the electrical analog is a suitable device for investigating the sonic boom problem. Author

N71-33992# National Aeronautical Establishment, Ottawa (Ontario).

ANALYSIS OF THE SUBSONIC WALL INTERFERENCE EFFECTS IN A TWO DIMENSIONAL PERFORATED WALL WIND TUNNEL

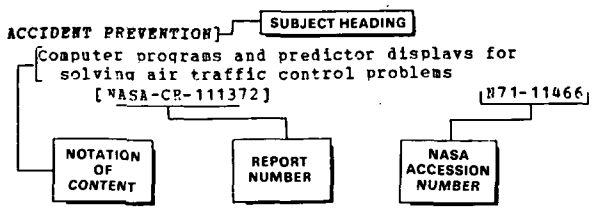
M. Morky Jun. 1970 48 p refs

(LTR-HA-5) Avail: NTIS CSCL 14B

The analytical method presented extends the classical linearized theory of the two dimensional subsonic interference in the perforated wind tunnel up to the perturbation terms of the second order. A doublet on the y-axis, in addition to the source, vortex, and the x-axis double, appeared in the analysis as a logical consequence of the generalized treatment of the problem. By virtue of this singularity it was possible to employ also the pitching moment as a quantity from which the interference directly arises, and thus improve the correction of test data on cambered airfoils. From expressions for the interference factors and the correction formulas it can be concluded that the corrections to stream quantities involve terms of order C/H and (C/H) squared, and corrections to force and moment coefficients involve terms of order C/H, (C/H) squared, and (C/H) cubed. Author

SUBJECT INDEX

Typical Subject Index Listing



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A

A-300 AIRCRAFT
European air traffic employed in transportation of tourists, considering European Airbus A-300B super twin
A71-37273

ABSORBERS (MATERIALS)
Sound absorptive materials selection for jet aircraft noise control
A71-39451

ACCIDENT PREVENTION
Air safety standards and objectives, discussing human factors as accident causes, piloting aids and management
A71-39395

ACOUSTIC ATTENUATION
Sound absorptive materials selection for jet aircraft noise control
A71-39451

ACOUSTIC FATIGUE
Aircraft structures sonic fatigue due to high frequency noise from turbofan engines, discussing case histories, failure diagnosis and precautionary design measures
A71-37843
Flight test measurements of shock cell noise loading of aircraft tail planes, noting alleviation by nozzle and mirror structural modifications
A71-38467

ACOUSTIC MEASUREMENTS
Jet aircraft flyover noise measurement, determining average intrusion level in residential communities under approach and departure corridors
A71-37497
Near field noise measurement on quarter-scale model to estimate fuselage pressure in VTOL aircraft for conventional, short and vertical takeoff configurations
A71-37844
Performance and acoustic near field measurements on variable camber propeller having STOL applications
[AD-724145] N71-32927

ACOUSTIC PROPERTIES
Structural response and acoustic transmission characteristics of glass pane and standard wood frame construction wall panels subjected to sonic booms
[NASA-CR-111925] N71-32488

ACOUSTIC STREAMING
Flow acoustic problems of ventilators, sound production mechanisms, and noise reduction
[NASA-TT-F-13798] N71-33611

ACOUSTICS
Review of September 1970 aerodynamic noise symposium covering jet and helicopter rotor noise, nonlinear acoustics and diffraction theory
A71-38205

ACTUATORS
Power by wire actuators and fly by wire flight controls, discussing systems configuration, reliability, economy and durability
A71-39150

ADHESION TESTS
Analysis of bonded metal surfaces used in manufacture of helicopter components
[AD-724663] N71-32953

ADHESIVE BONDING
Strength of adhesive of carbon fiber composite material bonds
[DLR-FB-71-31] N71-33100

AERIAL PHOTOGRAPHY
Installation and structure of aerial laser camera for photographic scanning from aircraft
[AD-723820] N71-31727

AERIAL RECONNAISSANCE
Closed cycle refrigeration system for cryogenic cooling of IR illuminator in helicopter mounted U.S. Army NVASS Night Vision System for night reconnaissance
A71-39275

AERODYNAMIC CHARACTERISTICS
Digital simulation for predicting static directional aerodynamic forces and moments characteristics of air cushion vehicle configuration through 180 degrees of sideslip
[AIAA PAPER 71-907] A71-37158
Augmentor wing high-lift aerodynamics, discussing results of wind tunnel tests and simulation studies
[CASI PAPER 72/20] A71-37606
Gas turbine engine adjustable nozzle ring flat arrays aerodynamic characteristics determination from profile loss factor dependence on setting angle
A71-39172
Aerodynamic characteristics of wings, propeller blades, and entire aircraft at various velocities including flow viscosity and compressibility - textbook
[AD-723542] N71-31932
Internal aerodynamics design manual considering internal air flow system effect on aircraft performance including bibliography
[AD-723823] N71-32059
Aerodynamic design manual considering internal air flow system effects on aircraft performance
[AD-723824] N71-32060
Aerodynamic characteristics at Mach numbers 1.60 to 2.16 of blunt-nose missile model having triangular cross section and fixed triform fins
[NASA-TM-X-2340] N71-32211
Flight test data on geometric, aerodynamic, and kinematic characteristics of two twin keel parawings during deployment
[NASA-CR-1788] N71-32303
Evaluation of performance, stability, and control characteristics of XV-11 A short takeoff aircraft
[AD-724124] N71-32818
Scheme of notation and nomenclature for aircraft dynamics and aerodynamics
[ARC-R/M-3562-PT-1] N71-33027
Mathematical and standardization data for aircraft dynamics and associated aerodynamics nomenclature and symbols system
[ARC-R/M-3562-PT-5] N71-33028
Computer program for aerodynamic characteristics evaluation of multiple-component airfoils in subsonic, viscous flow
[NASA-CR-1843] N71-33140

B

C

D

E

F

G

H

I

J

K

L

M

N

R

S

T

U

W

Y

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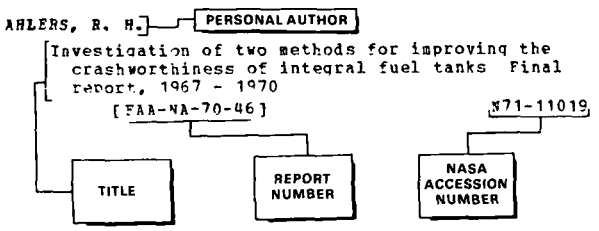
Typical Personal Author Index Listing



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C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

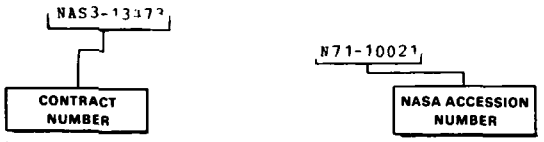
W

Y

Z

CONTRACT NUMBER INDEX

Typical Contract Number Index Listing



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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (11)		

4. Title and Subtitle	5. Report Date
AERONAUTICAL ENGINEERING A Special Bibliography (Supplement 11)	November 1971 6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D. C. 20546	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

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17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerodynamics Aeronautical Engineering Aeronautics Bibliographies	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
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