1981
Ames Research Center Publications: A Continuing Bibliography

NASA
National Aeronautics and Space Administration
Ames Research Center
Moffett Field, California 94035
INTRODUCTION

The Ames Research Center Publications: A Continuing Bibliography contains the research output of the Center indexed during 1981 in Scientific and Technical Aerospace Reports (STAR), Limited Scientific and Technical Aerospace Reports (LSTAR), International Aerospace Abstracts (IAA), and Computer Program Abstracts (CPA). This bibliography is published annually in an attempt to effect greater awareness and distribution of the Center’s research output.

For 1981, the output of the Ames Research Center included 20 NASA Formal Reports, 84 NASA Quick-Release Technical Memorandums, 179 NASA Contractor Reports, 181 Journal Articles and Chapters in Books, 140 Conference/Meeting Papers, and 13 Patents. The citations are listed by Division or Office and then under the following headings: NASA Formal Reports; NASA Technical Memoranda; NASA Contractor Reports; Journal Articles, Books, and Chapters in Books; Conference/Meeting Papers; and Patents.

The Continuing Bibliography will cease as a formal publication with the 1981 edition. It will be replaced with a report slightly different in purpose and content. This year marks the period of transition. Several features which appeared previously have been deleted from the 1981 edition. The subject, author, contract number, and report number indexes have been deleted. The external distribution of the report has been limited. Abstracts have been retained but will not appear in future issues.

A publication of this magnitude requires the efforts of many individuals. Special recognition is given to Marilyn Bonner, Susie Rydquist, Marianne Rudolph, Carol Sherman, and Betty Sherwood who were responsible for compiling the bibliography and ensuring the accuracy of citations assigned to the various divisions and offices. Finally, a note of thanks and appreciation to the Publications Branch of the Langley Research Center where the report was printed so expeditiously.
Availabilty sources of the different output categories are given below:

**Printed Copies**

**Patent Application Specifications**

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**Journal Articles, Chapters in Books, and Books**

**NASA Industrial Applications Centers (IAAC)**

**Baltimore/Washington International Airport, P.O. Box 8757, Facitily (STIF) NASA Scientific and Technical Information**

**Springfield, VA 22161**

**National Technical Information Service**

**Source**

**Category**

**Availabilty**
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Several buoyant-vehicle (airship) concepts proposed for short hauls of heavy payloads are described. Numerous studies identified operating cost and payload capacity advantages relative to existing or proposed heavy-lift helicopters for such vehicles. Applications involving payloads of from 15 tons up to 800 tons were identified. The buoyant quad-rotor concept is discussed in detail, including the history of its development, current estimates of performance and economics, currently perceived technology requirements, and recent research and technology development. It is concluded that the buoyant quad-rotor, and possibly other buoyant vehicle concepts, has the potential of satisfying the market for very heavy vertical lift but that additional research and technology development are necessary. Because of uncertainties in analytical prediction methods and small-scale experimental measurements, there is a strong need for large or full-scale experiments in ground test facilities and, ultimately, with a flight research vehicle.

Worldwide civil markets for heavy lift airships were investigated. Substantial potential market demand was identified for payloads of from 13 to 800 tons. The largest markets appear to be in applications to relieve port congestion, construction of power generating plants, and, most notably, logging. Because of significant uncertainties both in vehicle and market characteristics, further analysis will be necessary to verify the identified market potential of heavy lift airship concepts.

The need for and value of field work (surface truthing) in the verification of image identification from high altitude infrared and multispectral space sensor images are discussed in this handbook which presents guidelines for developing instructional and research procedures in remote sensing of the environment. For individual titles, see N81-32565 through N81-32572.
OFFICE OF THE DIRECTOR OF ADMINISTRATION

NO PUBLICATIONS

TECHNICAL INFORMATION DIVISION

NASA TECHNICAL MEMORANDA


This bibliography lists formal NASA publications, journal articles, books, chapters of books, patents, and contractor reports issued by Ames Research Center which were indexed by Scientific and Technical Aerospace Reports, Limited Scientific and Technical Aerospace Reports, and International Aerospace Abstracts in 1979. Citations are arranged by directorate, type of publication, and NASA accession numbers. Subject, Personal Author, Corporate Source, Contract Number, and Report/Accession Number Indexes are provided.

A

TECHNOLOGY UTILIZATION OFFICE

NASA CONTRACTOR REPORTS


The successful application of aerospace technology to problems related to highways and rail and rapid transit systems is described with emphasis on the use of corrosion resistant paints, fire retardant materials, and law enforcement. Possible areas for the use of spinoff from NASA technology by the California State Department of Corrections are identified. These include drug detection, security and warning systems, and the transportation and storage of food. A communication system for emergency services is also described.


An analysis of the effect of manufacturing solar collectors by California prison inmates is presented. It was concluded that the concept is feasible and would have little adverse effect on the private sector's solar industry.


A search was conducted to identify the technical and economic characteristics of both NASA and nonNASA obstacle detectors. The findings, along with market information were compiled and analyzed for consideration by DOT and NASA in decisions about any future automated transit vehicle obstacle detector research, development, or applications project. Currently available obstacle detectors and systems under development are identified by type (sonic, capacitance, infrared/optical, guided radar, and probe contact) and compared with the three NASA devices selected as possible improvements or solutions to the problems in existing obstacle detection systems. Cost analyses and market forecasts individually for the AGT and AMTV markets are included.
The Advanced Technology Display House (ATDH) project is described. Tasks are defined in the areas of energy demand, water demand, sewage treatment, electric power, plumbing, lighting, heating, and air conditioning. Energy, water, and sewage systems are defined.

Preliminary design concepts for water and sewer systems in the Advanced Technology Display House are described. Proposals for on-site waste disposal and water systems are analyzed.

The preliminary design concept for the energy systems in the Advanced Technology Display House is analyzed. Residential energy demand, energy conservation, and energy concepts are included. Photovoltaic arrays and REDOX (reduction oxidation) sizes are discussed.

A bibliography is presented for the Advanced Technology Display House. Information sources used in generating the design concepts studied are included.
**OFFICE OF THE DIRECTOR OF AERONAUTICS AND FLIGHT SYSTEMS**

**NO PUBLICATIONS**

**AERODYNAMICS DIVISION**

**NASA FORMAL REPORTS**

**N81-22018**

*National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.*

**NUMERICAL SIMULATION OF STEADY SUPERSONIC FLOW**

Lewis B. Schiff and Joseph L. Steger

May 1981 42 p refs

(NASA-TP-1749; AVRADCOM-TR-80-A-3; A-8543) Avail: NTIS HC A02/MF A01 CSCL 01A

A noniterative, implicit, space-marching, finite-difference algorithm was developed for the steady thin-layer Navier-Stokes equations in conservation-law form. The numerical algorithm is applicable to steady supersonic viscous flow over bodies of arbitrary shape. In addition, the same code can be used to compute supersonic inviscid flow or three-dimensional boundary layers. Computed results from two-dimensional and three-dimensional versions of the numerical algorithm are in good agreement with those obtained from more costly time-marching techniques.

**NASA TECHNICAL MEMORANDA**

**X81-10004**

*National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.*

**AERODYNAMIC CHARACTERISTICS OF A 0.1-SCALE MODEL OF A 2-PLACE A-10A AIRCRAFT**

John L. Holmberg and Douglas F. Pena (ARO, Inc., Moffett Field, Calif.)

Dec. 1980 220 p refs

(NASA-TM-81214; A-8241) Unclassified report


A 0.1 scale model of a two-place version of the A-10A close support aircraft was tested in the Ames 12-Foot Pressure Wind Tunnel. Static stability, control, and performance data were obtained to be used in assessing changes to the canopy, vertical tail, engine nacelles and wing trailing edge camber. Angle of attack was varied from -4 deg to 25 deg at sideslip angles of 0 deg and 6 deg and sideslip angle was varied from -16 deg to 8 deg at an angle of attack of 6 deg. Test Mach numbers ranged from 0.225 to 0.7 at unit Reynolds numbers varying between 6.56 and 8.37 million per meter (2.0 and 2.55 million per foot). The incremental effects on longitudinal and lateral aerodynamic characteristics associated with combinations of the component changes were minimal or as expected over the ranges of conditions tested.

**N81-10054**

*National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.*

**THE XV-15 TILT ROTOR RESEARCH AIRCRAFT**

Daniel C. Dugan, Ronald G. Erhart (Bell Helicopter Textron, Fort Worth, Tex.), and Laurel G. Schroers (AVRADCOM)

Sep. 1980 21 p refs Prepared in cooperation with AVRADCOM


The design characteristics of the XV-15 Tilt rotor research aircraft are presented. Particular attention is given to the following: control system; conversion system; and propulsion system. Flight test results are also reported.

**N81-14981**

*National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.*

**EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF TWO V/STOL FIGHTER/ATTACK AIRCRAFT CONFIGURATIONS AT MACH NUMBERS FROM 0.4 TO 1.4**

Walter P. Nelms, Donald A. Durston, and J. R. Lummus (General Dynamics, Fort Worth, Tex.)

Dec. 1980 529 p refs

(NASA-TM-81234; A-8538) Avail: NTIS HC A23/MF A01 CSCL 01A

A wind tunnel test was conducted to measure the aerodynamic characteristics of two horizontal attitude takeoff and landing V/STOL fighter/attack aircraft concepts. In one concept, a jet diffuser ejector was used for the vertical lift system; the other used a remote augmentation lift system (RALS). Wind tunnel tests to investigate the aerodynamic uncertainties and to establish a data base for these types of concepts were conducted over a Mach number range from 0.2 to 2.0. The present report covers tests, conducted in the 11 foot transonic wind tunnel, for Mach numbers from 0.4 to 1.4. Detailed effects of varying the angle of attack (up to 27 deg), angle of sideslip (-4 deg to +8 deg), Mach number, Reynolds number, and configuration buildup were investigated. In addition, the effects of wing trailing edge flap deflections, canard incidence, and vertical tail deflections were explored. Variable canard longitudinal location and different shapes of the inboard nacelle body strakes were also investigated.

**N81-28056**

*National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.*

**UNPOWERED AERODYNAMIC CHARACTERISTICS OF A 15-PERCENT SCALE MODEL OF A TWIN-ENGINE COMMUTER AIRCRAFT**

Daniel G. Morgan, Thomas L. Galloway, and Bruno J. Gambucci (Kendan Associates)

Jul. 1981 74 p

(NASA-TM-81284; A-8552) Avail: NTIS HC A04/MF A01 CSCL 01A
An experimental investigation was conducted in the Ames 12-Foot Pressure Wind Tunnel to determine the unpowere aerosodynamic characteristics of a 15-percent-scale model of a twin-engine commuter aircraft. Model longitudinal aerodynamic characteristics were examined at discrete flap deflections for various angle-of-attack and wind-tunnel-velocity ranges with the empennage on and off. Data are presented for the basic model configuration consisting of the fuselage, wing, basic wing leading edge, double slotted flaps, midengine nacelles, and empennage. Other configurations tested included a single-slip drooped leading edge (dropped outboard of the engine nacelles), a full-slip drooped leading edge, low- and high-mounted engine nacelles, and a single-slotted flap. An evaluation was made of the model mounting system by comparing data obtained with the model mounted conventionally on the wind-tunnel model-support struts and the model inverted.

Aerodynamic effects of nearly uniform slip-streams on thin wings in the transonic regime and vertical tail deflections were also explored as well as the aircraft concepts. One concept featured a jet diffuser ejector for twin V/STOL fighter/attack aircraft configurations at Mach numbers from 1.6 to 2.0. Test data show the influence of key aircraft configuration variables-inlet longitudinal position, wing leading-edge extension planform area. canopy-dorsal integration, and variable incidence canards-on top inlet performance over the Mach range of 0.6 to 2.0. Top inlet performance data are compared with those or more conventional inlet/airframe integrations in an effort to assess the viability of top-mounted inlet systems relative to conventional inlet installations.

Supersonic tactical aircraft with highly integrated jet propulsion systems were investigated. Primary attention was given to those interference effects which impact the external aerodynamics of the aircraft.

NASA CONTRACTOR REPORTS

N81-24068# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

TOP-MOUNTED INLET SYSTEM FEASIBILITY FOR TRAN-SONIC-SUPERSONIC FIGHTER AIRCRAFT
T. L. Williams (Northrop Corp., Hawthorne, Calif.), B. L. Hunt (Northrop Corp., Hawthorne, Calif.), D. B. Smeltzer, and W. P. Nelms

The more salient findings are presented of recent top inlet performance evaluations aimed at assessing the feasibility of top-mounted inlet systems for transonic-supersonic fighter aircraft applications. Top inlet flow field and engine-inlet performance test data show the influence of key aircraft configuration variables-inlet longitudinal position, wing leading-edge extension planform area, canopy-dorsal integration, and variable incidence canards-on top inlet performance over the Mach range of 0.6 to 2.0. Top inlet performance data are compared with those or more conventional inlet/airframe integrations in an effort to assess the viability of top-mounted inlet systems relative to conventional inlet installations.

N81-30083# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF TWO V/STOL FIGHTER/ATTACK AIRCRAFT CONFIGURA- TIONS AT MACH NUMBERS FROM 1.6 TO 2.0

Tests were conducted in the Ames 9 by 7 ft supersonic wind tunnel to measure the aerodynamic characteristics of two horizontal attitude takeoff and landing V/STOL fighter/attack aircraft concepts. One concept featured a jet diffuser ejector for its vertical lift system and the other employed a remote augmentation lift system (RALS). Test results for Mach numbers from 1.6 to 2.0 are reported. Effects of varying the angle of attack (4 deg to +17 deg), angle of sideslip (4 deg to +8 deg) Mach number, and configuration building were investigated. The effects of wing trailing edge flap deflections, canard incidence, and vertical tail deflections were also explored as well as the effects of varying the canard longitudinal location and shapes of the inboard nacelle body strakes.

N81-18044# Neilson Engineering and Research, Inc., Mountain View, Calif.

Joseph Mullen, Jr. Mar. 1978 139 p refs (Contract NAS2-8558)

The implementation of the changes to the program for Wing Aerelastic Design and the development of a program to estimate aircraft fuselage weights are described. The equations to implement the modified planform description, the stiffened panel skin representation, the trim loads calculation, and the flutter constraint approximation are presented. A comparison of the wing model with the actual F-5A weight material distributions and loads is given. The equations and program techniques used for the estimation of aircraft fuselage weights are described. These equations were incorporated as a computer code. The weight predictions of this program are compared with data from the C-141.

NASA CONTRACTOR REPORTS

N81-18045# Neilson Engineering and Research, Inc., Mountain View, Calif.


(Supersonic) Supersonic tactical aircraft with highly integrated jet propulsion systems were investigated. Primary attention was given to those interference effects which impact the external aerodynamics of the aircraft.


A HIGHER ORDER PANEL METHOD FOR LINEARIZED SUPERSONIC FLOW

(Supersonic) The basic integral equations of linearized supersonic theory for an advanced supersonic panel method are derived. Methods using only linear varying source strength over each panel or only quadratic doublet strength over each panel gave good agreement with analytic solutions over cones and zero thickness cambered wings. For three dimensional bodies and wings of general shape, combined source and doublet panels with interior boundary conditions to eliminate the internal perturbations lead to a stable method providing good agreement experiment. A panel system with all edges contiguous resulted from dividing

The ability of current methodologies to accurately predict the aerodynamic characteristics identified as uncertainties was evaluated for two aircraft configurations. The two wind tunnel models studied horizontal altitude takeoff and landing V/STOL fighter aircraft derivatives. R.C.T.


The longitudinal and lateral-directional aerodynamic characteristics of the RALS R104 wind tunnel model are summarized. Configurations for the E205 are also presented for comparison. R.C.T.


The ability of current methodologies to accurately predict the aerodynamic characteristics identified as uncertainties was evaluated for two aircraft configurations. The two wind tunnel models studied horizontal altitude takeoff and landing V/STOL fighter aircraft derivatives. R.C.T.


A turbulence was envisioned whose energy containing scales would be Gaussian in the absence of inhomogeneity, gravity, etc. An equation was constructed for a function equivalent to the probability density, the second moment of which corresponded to the accepted modeled form of the Reynolds stress equation. The third moment equations obtained from this were simplified by the assumption of weak inhomogeneity. Calculations are presented with this model as well as interpretations of the results. E.D.K.


A 1/8 scale jet-effects model was tested in the NASA Ames 11 ft transonic tunnel at static conditions and over a range of Mach numbers from 0.4 to 1.4. The data presented show that significant differences in aeropulsion performance can be expected by varying the exhaust nozzle type and its geometric parameters on a V/STOL underwing nacelle installation. T.M.


An interactive model for numerical computation of complicated two-dimensional flowfields including regions of reversed flow is proposed. The present approach is one of dividing the flowfield into...
three regions, in each of which a simplified mathematical model is applied: (1) outer, supersonic flow for which the full potential equation (hyperbolic) is used; (2) viscous, laminar layer in which the compressible boundary-layer model (parabolic) is used; and (3) recirculating flow modeled by the incompressible Navier-Stokes equations (elliptic). For matching of the numerical solutions in the three layers, two interaction models are developed: one for pressure interaction, the other for interaction between the shear layer and the recirculating flow. The uniform solution for the whole flowfield is then obtained by iteration of the local solutions under the constraints imposed by matching. The three-layer interactive model is used for solution of the flowfield past an asymmetric cavity. The method is shown to be capable of dealing with backflow without encountering problems at separation, characteristic to the boundary-layer approach. (Author)


The feasibility of the application of advanced state-of-the-art high lift STOL aircraft in the aircraft carrier environment was evaluated using the NASA Quiet Short-Haul Research Aircraft (QSRA). The QSRA made repeated unarrested landings and free deck takeoffs from the USS Kitty Hawk while being flown by three pilots of significant different backgrounds. The exercise demonstrated that the USB propulsion lift technology presents no unusual problems in the aircraft carrier environment. Optimum parameters for landing the QSRA were determined from the shore-based program; these proved satisfactory during operations aboard ship. Correlation of shipboard experience with shore-based data indicates that both free deck takeoffs and unarrested landings could be conducted with zero to 35 knots of wind across the deck of an aircraft carrier the size of the USS Kitty Hawk. B.J.


The XV-15 tilt rotor has shown good handling qualities in all modes of flight; in the helicopter mode it allows precision hover and agility with low pilot workload. Vibration and noise levels are low; the conversion procedure is easy, with satisfactory acceleration or deceleration. The XV-15 handling demonstrated its potential for many civil and military applications. A.T.


A fundamental analysis of two-dimensional supersonic boundary layer flow, both laminar and turbulent, is presented for a wide range of normal and nonnormal mass-transfer velocities. The analysis is based on the numerical solution of the Navier-Stokes equations, and results are compared with available theoretical and experimental data. Certain cases of practical importance, for which results are not presently available, are referred to. (Author)


A review of organized motion in turbulent flow indicates that the transport properties of most shear flows are dominated by large-scale vortex nondissipative motions. The mean velocity profile of a turbulent boundary layer consists of a viscous sublayer, buffer layer, and a logarithmic outer layer; an empirical formula of Coles (1956) applies to various pressure gradients. The boundary layer coherent structure was isolated by the correlation methods of Townsend (1956) and flow visualization by direct observations of complex unsteady turbulent motions. The near-wall studies of Willmarth and Woolridge (1962) used the space-time correlation for pressure fluctuations at the wall under a thick turbulent boundary layer; finally, organized motion in free shear flows and transition control of mixing demonstrated that the Reynolds number invariance of turbulence shows wide scatter. A.T.


Unsteady particle trajectories are used to study structural features associated with the Reynolds-number dependence of an axisymmetric jet. It is found that transition in the unbounded jet is in the nature of transition in Couette flow and occurs at specific critical values of the Reynolds number rather than in some range over which small disturbances are amplified. In the case of the creeping-flow solution, the particle-path pattern exhibits a structure which is not easily discerned in any of the other variables that govern the flow. For sufficiently small Reynolds number, the particle path converges to a single stable node which lies on the axis of the jet. At a Reynolds number of 6.7806, the pattern bifurcates to a saddle and two stable nodes; at a Reynolds number of 10.09089, it bifurcates a second time to form a saddle and two stable foci. V.L.


An interactive method is proposed for the solution of two-dimensional laminar flow fields with identifiable regions of recirculation, such as the shear-layer-driven cavity flow. The method treats the flow field as composed of two regions, with an appropriate mathematical model adopted for each region. The shear layer is computed by the compressible boundary layer equations, and the slowly recirculating flow by the incompressible Navier-Stokes equations. The flow field is solved iteratively by matching the local solutions in the two regions. For this purpose a new matching method utilizing an overlap between the two computational regions is developed, and shown to be most satisfactory. Matching of the two velocity components, as well as the change in velocity with respect to depth is amply accomplished using the present approach, and the stagnation points corresponding to separation and reattachment of the dividing streamline are computed as part of the interactive solution. The interactive method is applied to the test problem of a shear layer driven cavity. The computational results are used to show the validity and applicability of the present approach. (Author)

A81-41090 * Transonic swept wings studied by the lifting-line theory. H. K. Cheng, S. Y. Meng (Gournei California University, Los Angeles, CA); R. Chow (Grumman Aerospace Corp., Bethpage, NY), and R. C. Smith (NASA, Ames Research Center,

Transonic swept wings are analyzed as a lifting-line problem under a small-disturbance approximation. Basic concepts and principal results of the asymptotic theory are discussed. The study focuses on straight oblique wings and V-shaped swept wings, of which the local centerline curvature can be equated to zero. The three-dimensional (3-D) perturbation of the nonlinear component flow admits a similarity flow structure but requires that all wing sections are generated from a single airfoil profile; the reduced 2-D problems in this case are solved only once for all span stations. Examples of solutions involving high subcritical and slightly supercritical component flows are demonstrated and compared with surface pressure data from 3-D computer codes based on the full-potential equation (FLO 22). Except in the neighborhood of leading edges, where the small-disturbance assumption breaks down, and in the vicinities of wing tips and the symmetry plane, where neither the theory nor the 3-D codes may claim full validity, reasonable agreement is consistently found. The explicit results from the upwash analysis, along with the similarity flow structure, provides a rational approach to the control of 3-D effects in transonic aerodynamic design studies. (Author)


A new method is described for assessing the compatibility between inner and outer flow regimes in adaptive-wall wind tunnels. The method is applicable to both two- and three-dimensional flows, and unlike other schemes, requires the measurement of only one velocity component. Moreover, a complete solution to the outer flowfield is not required with the new method. Computer simulations of two- and three-dimensional flows are presented along with data from a two-dimensional pilot wind tunnel test using the new method. (Author)

AIAV-3107^# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. IMPACT OF HIGH-ALPHA AERODYNAMICS ON DYNAMIC STABILITY PARAMETERS OF AIRCRAFT AND MISSILES c02

Gerald N. Malcolm. In AGARD Dyn. Stability Parameters May 1981 18 p. refs (For primary document see N81-31105 22-01) Avail: NTIS HC A17/MF A01 CSCL 01A

The aerodynamic phenomena associated with high angles of attack and their effects on the dynamic stability characteristics of airplane and missile configurations are examined. Information on dynamic effects is limited. Steady flow phenomena and their effects on the forces and moments are reviewed. The effects of asymmetric vortices and of vortex bursting on the dynamic response of flight vehicles are reviewed with respect to their influence on: (1) nonlinearity of aerodynamic coefficients with attitude, rates, and accelerations; (2) cross coupling between longitudinal and lateral directional models of motion; (3) time dependence and hysteresis effects; (4) configuration dependency; and (5) mathematical modeling of the aerodynamics. (Author)

AIAV-31111^# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. ROTARY AND MAGNUS BALANCES c06


Two wind tunnel techniques for determining part of the aerodynamic information required to describe the dynamic behavior of various types of vehicles in flight are described. Force and moment measurements are determined with a rotary-balance apparatus in a coning motion and with a Magnus balance in a high-speed spinning motion. Coning motion is pertinent to both aircraft and missiles, and spinning is important for spin stabilized missiles. Basic principles of both techniques are described, and specific examples of each type of apparatus are presented. Typical experimental results are also discussed. (Author)

VSTOL attack aircraft to be developed in the mid- or late-1980's and research programs dealing with possible characteristics are discussed. Design studies of horizontal attitude takeoff and landing (HATOL) and vertical attitude takeoff and landing (VATOL) type aircraft were executed and wind tunnel models were built and tested. The configurations tested were a wing-canard HATOL concept with jet-defuser ejectors as a vertical lift system and a variety of the same with nacelles which are closer together. Other proposals were a HATOL concept with wing-canard design and two vertical tails on twin afterbodies, and a VATOL concept which is tailless with an extended leading-edge wing to increase lift. Aerodynamic uncertainties were defined and wind tunnel tests were made. Special research concerning top-mounted air induction systems is also covered.


The oblique and subsonic transport was assessed by analysis and wind tunnel radio control model and remotely piloted vehicle testing. A one-sixth scale wind tunnel model and a low speed manned oblique wing research airplane (AD-1) were developed. Model wind tunnel test data on dynamic structural response characteristics were used in a simulator to develop the control system. The airplane is of simple design with fiber glass skin, weight of approximately 2100 lbs and speeds of up to 175 knots at altitudes up to 15,000 ft. Flight testing will investigate handling and flying qualities, oblique wing flight control characteristics, aerelastic wing design and will compare actual with predicted aerodynamic characteristics. Nineteen flights were made at 12,000 to 13,000 feet with speeds of 100-160 knots. Flutter clearance as a function of wing sweep angle is now under investigation.


PAN AIR is a computer program for predicting subsonic or supersonic linear potential flow about arbitrary configurations. It uses linear source and quadratic doublet strength distributions. These higher-order distributions have been implemented in a manner that greatly reduces the numerical stability problems that have plagued earlier attempts to make surface paneling methods work successfully for supersonic flow. PAN AIR's problem-solving capability, numerical approach, modeling features, and program architecture are described. Numerical results are presented for a variety of geometries at supersonic Mach numbers.


An implicit delta form finite-difference algorithm for Euler equations in conservation law form has been used in preliminary calculations of three-dimensional wing-vortex interactions. Both steady and unsteady transonic flow wing-vortex interactions are computed. The computations themselves are meant to guide upcoming wind tunnel experiments of the same flow field. Various modifications to the numerical method that are intended to improve computational efficiency are also described and tested in both two- and three-dimensions.


A study of the shear-layer flow over a range of open-top cavity configurations is reported. Emphasis is placed on the effect that altering the cavity's span length and aspect ratio has on the development of the shear layer. Computational results are obtained using an interactive method which adapt the compressible boundary-layer model for the flow above the cavity and incompressible Navier-Stokes equations within the enclosure. Interaction of this composite model with the outer, inviscid supersonic flow is also considered in one case. The results show that the location of the stagnation points is sensitive primarily to the variation of the span. When the span was fixed and the aspect ratio varied, the shear layer was nearly unaffected except at aspect ratios less than 0.5. Interaction with the outer flow had a smoothing effect on the shape of the dividing streamline but did not significantly affect the location of the stagnation points.


A three-dimensional, inviscid, full-potential lifting rotor code was used to demonstrate that pressure distributions on both advancing and retreating blades could be significantly improved by perturbing local airfoil sections. The perturbations were described by simple geometric shape functions. To illustrate the procedure, an example calculation was made at a forward flight speed of 85 m/sec (160 knots) and an advance ratio of 0.385. It was found that a minimum of three shape functions was required to improve the pressures without producing undesirable secondary effects in high-speed forward flight on a hypothetical modern rotor blade initially having an NLR-1 supercritical airfoil. Reductions in the shock strength on the advancing blade could be achieved, while simultaneously lessening leading-edge pressure gradients on the retreating blade. The major blade section modifications required were blunting of the upper surface leading edge and some reshaping of the blade's upper surface resulting in moderately thicker airfoils.


The state-of-the-art of transonic wing design by use of computer codes based on the potential-flow theory is presented. The capabilities and limitations of these codes are exemplified by several experiment-theory correlations, including an assessment of pressure distribution from isolated wing and wing-body codes. Computer codes using both conservative and nonconservative differencing schemes were used, and the effects of boundary-layer corrections were considered. Results showed that calculations from a full
A wing-body configuration with body-mounted engines, typical of transonic Biz-Jet aircraft. J.F.

An analysis of the relative influences of forward lift-enhancing surfaces on the overall lift and drag characteristics of three wind-tunnel models representative of V/STOL fighter/attack aircraft is presented. Two of the models are canard-wing configurations and one has a wing leading-edge extension (LEX) as the forward lifting surface. Data are taken from wind-tunnel tests of each model covering Mach numbers from 0.4 to 1.4. Overall lift and drag characteristics of these models and the generally favorable interactions of the forward surfaces with the wings are highlighted. Results indicate that larger LEX's and canards generally give greater lift and drag improvements than ones that are smaller relative to the wings. (Author)


Results from a series of simulation and flight investigations undertaken to evaluate helicopter flying qualities and the effects of control system augmentation for nap-of-the-earth (NOE) agility and instrument flying tasks were analyzed to assess handling-quality factors common to both tasks. Precise attitude control was determined to be a key requirement for successful accomplishment of both tasks. Factors that degraded attitude controllability were improper levels of control sensitivity and damping and rotor-system cross-coupling due to helicopter angular rate and collective pitch input. Application of rate-command, attitude-command, and control-input decouple augmentation schemes enhanced attitude control and significantly improved handling qualities for both tasks. NOE agility and instrument flying handling-quality considerations, pilot rating philosophy, and supplemental flight evaluations are also discussed. (Author)
FLIGHT SYSTEMS AND SIMULATION RESEARCH DIVISION

NASA FORMAL REPORTS

N81-16040†/ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SAMPLE DATA EFFECTS OF HIGH-PASS FILTERS

Four mathematical models of linear first and second order high pass washout filters were analyzed. These models were Euler’s Integration, Zero-Order Hold, Bilinear Transformation, and Second-Order Adams-Bashforth Integration. Bode responses for each model at various sample rates were compared to the continuous filter response. Higher sample rates produced Bode responses approaching the continuous response and the Bilinear Transformation model produced the best responses over the frequency spectrum and sample rates. Pole location analysis of each model in the z-plane showed the Bilinear Transformation and Zero-Order Hold models gave stable poles regardless of time step size, whereas the other models did not display stable poles. A near constant gain error over the entire frequency spectrum was discovered in the Zero-Order Hold cases and a correction gain was calculated for the first-order high-pass filter case.

S.F.

N81-19131†/ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT-TEST EVALUATION OF STOL CONTROL AND FLIGHT DIRECTOR CONCEPTS IN A POWERED-LIFT AIRCRAFT FLYING CURVED DECELERATING APPROACHES

Flight tests were carried out to assess the feasibility of piloted steep curved, and decelerating approach profiles in powered lift STOL aircraft. Several STOL control concepts representative of a variety of aircraft were evaluated in conjunction with newly designed flight directions. The tests were carried out in a real navigation environment, employed special electronic cockpit displays, and included the development of the performance achieved and the control utilization involved in flying 160 deg turning, descending, and decelerating approach profiles to landing. The results suggest that such moderately complex piloted instrument approaches may indeed be feasible from a pilot acceptance point of view, given an acceptable navigation environment. Systems with the capability of those used in this experiment can provide the potential of achieving instrument operations on curved, descending, and decelerating landing approaches to weather minima corresponding to CTOL Category 2 criteria, while also providing a means of realizing more efficient operations during visual flight conditions.

Author

N81-22039†/ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
KINEMATIC PROPERTIES OF THE HELICOPTER IN COORDINATED TURNS

A study on the kinematic relationship of the variables of helicopter motion in steady, coordinated turns involving inherent sideslip is described. A set of exact kinematic equations which govern a steady coordinated helical turn about an Earth referenced vertical axis is developed. A precise definition for the load factor parameter that best characterizes a coordinated turn is proposed. Formulas are developed which relate the aircraft angular rates and pitch and roll attitudes to the turn parameters, angle of attack, and inherent sideslip. A steep, coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest. The bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor. The normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. Pitch rate is independent of angle of attack in a coordinated turn and in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft.

S.F.

N81-10006†/ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYSIS OF CONTROL ACTUATOR AUTHORITY REQUIREMENTS FOR ATTITUDE AND TRANSLATIONAL RATE COMMAND AUGMENTATION SYSTEMS FOR THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

Unclassified report


The methodology consists of applications of linear analysis and piloted simulation to determine actuator authority requirements. Aircraft characteristic modes were obtained from linear aircraft state equations and then approximated by resulting dominant modes. Dominant mode analysis was used to determine dynamic interaction on SCAS amplitude and phase of varying feedforward and feedback gains. Experimental data are presented for evaluation of the methodology for tasks and SCAS types which are likely candidates for future tilt rotor operation. Tasks include STOL approach to landing, terrain following, nap-of-the-Earth, accelerations and decelerations and gunnery runs. SCAS types include rate command, rate command/attitude hold, attitude command and translational rate command. Parameters of each SCAS type were varied to assess the effect on SCAS authority requirements. SCAS authorities were limited in all SCAS channels in a systematic fashion to determine the influence on task performance for each SCAS type. Pilot ratings were obtained to determine the implications for mission effectiveness and handling qualities degradation of limiting SCAS authority. A failure modes analysis was performed to ascertain the risk to pilot and aircraft given increased SCAS authority in the event of computer-commanded SCAS actuator handover.

T.M.

N81-10077†/ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PILOTED SIMULATOR INVESTIGATION OF STATIC STABILITY AND STABILITY/CONTROL AUGMENTATION EFFECTS ON HELICOPTER HANDLING QUALITIES FOR INSTRUMENT APPROACH

A motion base simulator was used to compare the flying qualities of three generic single rotor helicopters during a full attention to flight control task. Terminal area instrument approaches were flown with and without turbulence. The turbulence of helicopter static stability was investigated in terms of the values of cockpit control gradients as specified in the...
existing airworthiness criteria. The effectiveness of several types of stability control augmentation systems in improving the instrument flight rules capability of helicopters with reduced static stability was examined. Two levels of static stability in the pitch, roll, and yaw axes were examined for a hingeless rotor configuration: the variations were stable and neutral static stability in pitch and roll, and two levels of stability in yaw. For the lower level of static stability, four types of stability and control augmentation were examined for helicopters with three rotor types: hingeless, articulated, and teetering. S.F.

N81-11043# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATING STUDY OF THE INTERACTION BETWEEN THE PROPULSION AND FLIGHT CONTROL SYSTEMS OF A SUBSONIC LIFT FAN VTOL

The possibility of interactions between the propulsion and flight control systems of a three-fan subsonic VTOL aircraft was studied using nonlinear time simulation. Time histories of critical internal engine parameters were obtained and possible deleterious effects of engine dynamics on flight control were identified and analyzed. No deleterious effects, with the exception of the effects of the fan actuator deadband, were found. A method of alleviating these effects through feedback of the actuator output to the flight controller was developed. T.M.

N81-12065# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A MATHEMATICAL MODEL OF THE CH-53 HELICOPTER

A mathematical model suitable for real time simulation of the CH-53 helicopter is presented. This model, which is based on modified nonlinear classical rotor theory and nonlinear fuselage aerodynamics, will be used to support terminal-area guidance and navigation studies on a fixed-base simulator. Validation is achieved by comparing the model response with that of a similar aircraft and by a qualitative comparison of the handling characteristics made by experienced pilots. Author

N81-13873# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GLOBAL OPTIMALITY OF EXTREMALS: AN EXAMPLE
Eliezer Kreindler (Technion, Israel Inst. of Technology, Haifa) and Frank Newman Oct. 1980 23 p refs (NASA-TM-81240; A-8347) Avail: NTIS HC A02/MF A01 CSCL 12A

The question of the existence and location of Darboux points is crucial for minimally sufficient conditions for global optimality and for computation of optimal trajectories. A numerical investigation is presented of the Darboux points and their relationship with conjugate points for a problem of minimum fuel, constant velocity, and horizontal aircraft turns to capture a line. This simple second order optimal control problem shows that ignoring the possible existence of Darboux points may play havoc with the computation of optimal trajectories. E.D.K.

N81-19014# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT INVESTIGATION OF A FOUR-DIMENSIONAL TERMINAL AREA GUIDANCE SYSTEM FOR STOL AIRCRAFT


A series of flight tests and fast-time simulations were conducted, using the augmentor wing jet STOL research aircraft and the STOLAND 4D-RNAV system to add to the growing data base of 4D-RNAV system performance capabilities. To obtain statistically meaningful data a limited amount of flight data were supplemented by a statistically significant amount of data obtained from fast-time simulation. The results of these tests are reported. Included are comparisons of the 4D-RNAV estimated winds with actual winds encountered in flight, as well as data on on-track navigation, and guidance errors, and time-of-arrival errors at the final approach waypoint. In addition, a slight improvement of the STOLAND 4D-RNAV system is proposed and demonstrated, using the fast-time simulation. T.M.

N81-19100# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HISTORICAL OVERVIEW OF V/STOL AIRCRAFT TECHNOLOGY

The requirements for satisfactory characteristics in several key technology areas of an STOL and VTOL aircraft are identified. Special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects. T.M.

N81-20006# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DESIGN OF A FUEL-EFFICIENT GUIDANCE SYSTEM FOR A STOL AIRCRAFT

In the predictive mode, the system synthesizes a horizontal path from an initial aircraft position and heading to a desired final position and heading and then synthesizes a fuel-efficient speed-altitude profile along the path. In the track mode, the synthesized trajectory is reconstructed and tracked automatically. An analytical basis for the design of the system is presented and a description of the airborne computer implementation is given. A detailed discussion of the software, which should be helpful to those who use the actual software developed for these tests, is also provided. T.M.

N81-20030# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EXTENSION OF THE LOCAL MOMENTUM THEORY TO A DISTORTED WAKE MODEL OF A HOVERING ROTOR

The local momentum theory is based on the instantaneous balance between the fluid momentum and the blade elemental lift at a local station in the rotor rotational plane. Therefore, the theory has the capability of evaluating time wise variations of air loading and induced velocity distributions along a helicopter blades span. Unlike a complex vortex theory, this theory was developed to analyze the instantaneous induced velocity distribution effectively. The boundaries of this theory and a computer program using this theory are discussed. A concept introduced into the theory is the effect of the rotor wake contraction in
A SOLUTION FOR TWO-DIMENSIONAL FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND WITH PERIODIC, SEMIPERIODIC, OR NONPERIODIC KERNELS

A numerical scheme for solving two dimensional Fredholm integral equations of the second kind is developed. The proof of the convergence of the numerical scheme is shown for three cases: the case of periodic kernels, the case of semiperiodic kernels, and the case of nonperiodic kernels. Applications to the incompressible, stationary Navier-Stokes problem are of primary interest.

E.D.K.

MINIMUM FUEL HORIZONTAL FLIGHTPATHS IN THE TERMINAL AREA

Elizer Kreindler (Technion - Israel Inst. of Tech.) and Frank Neuman Aug. 1981 40 p refs

The problem of minimum fuel airplane trajectories from arbitrary initial states to be fixed final state is considered. There are four state variables (two position coordinates, heading, and constrained velocity) and two constrained controls (thrust and bank angle). The fuel optimality of circular and straight line flightpaths is examined. Representative extremals (trajectories satisfying the necessary conditions of the minimum principle) of various types are computed and used to evaluate trajectories generated by an on line algorithm. Attention is paid to the existence of Darboux points (beyond which an extremal ceases to be globally optimal). One fuel flow rate model includes a term quadratic in thrust: hence, the optimal thrust is continuous and nonsingular. The other fuel flow rate model is linear in thrust, and consequently the optimal thrust is discontinuous and singular.

M.G.

COMPARISONS OF AEROX COMPUTER PROGRAM PREDICTIONS OF LIFT AND INDUCED DRAG WITH FLIGHT TEST DATA

John Axelson and Gary C. Hill Aug. 1981 78 p refs

The AEROX aerodynamic computer program which provides accurate predictions of induced drag and trim drag for the full angle of attack range and for Mach numbers from 0.4 to 3.0 is described. This capability is demonstrated comparing flight test data and AEROX predictions for 17 different tactical aircraft. Values of minimum (skim friction, pressure, and zero lift wave) drag coefficients and lift coefficient offset due to camber (when required) were input from the flight test data to produce total lift and drag curves. The comparisons of trimmed lift drag polars show excellent agreement between the AEROX predictions and the in flight measurements.
CONTROL CONCEPTS

Final Report
E W Kruppa Sep 1980 514 p refs
(Contract NAS2-9196)
(NASA-CR-152348; D340-10105) Unclassified report


Wind tunnel data obtained from ARC 40 by 80 ft Test 515, are presented. The Quiet Short-Haul Research Aircraft (QSRA) was used to obtain six component force and moment data. The characteristics of the inboard and outboard spoilers, the double slotted trailing edge flaps and the ailerons were investigated at high, medium, and low G's at approach USB setting. Six runs were used for additional cruise performance study. The Boeing QSRA performance math model was updated and used to generate trimmed maps of velocity versus flightpath angle for various configurations.

E A K

NASA CONTRACTOR REPORTS

X81-10209*# Boeing Commercial Airplane Co., Seattle, Wash

LARGE-SCALE WIND TUNNEL INVESTIGATION OF QUIET SHORT-HAUL RESEARCH AIRCRAFT (QSRA) FLIGHTPATH

250 p refs
(Contract NAS2-9946)
(NASA-CR-152348; D340-10105) Unclassified report


A method by which modern and classical control theory techniques may be integrated in a synergistic fashion and used in the design of practical flight control systems is presented. A general procedure is developed, and several illustrative examples

A R H

American Electronic Labs., Inc., Lansdale. Pa

LOW COST AIRBORNE MICROWAVE LANDING SYSTEM RECEIVER, TASK 3 Final Report
James B Hager and James R. VanCleave Dec. 1979 191 p refs
(Contract NAS2-10323)
(NASA-CR-152373: D210-11659-1) Avail: NTIS HC A99/MF A01 CSCL 01A

A stability test program was conducted to determine the effects of airspeed, collective pitch, rotor speed and shaft angle on stability and loads at speeds beyond that attained in the BMR/BO-105 flight test program. Loads and performance data were gathered at forward speeds up to 165 knots. The effect of cyclic pitch perturbations on rotor response was investigated at simulated level flight conditions. Two configuration variations were tested for their effect on stability. One variable was the control system stiffness. An axially softer pitch link was installed in place of the standard 80-105 pitch link. The second variation was the addition of elastomeric damper strips to increase the structural damping. The BMR was stable at all conditions tested. At fixed collective pitch, shaft angle and rotor speed, damping generally increased between hover and 60 knots, remained relatively constant from 60 to 90 knots, then decreased above 90 knots. Analytical predictions are in good agreement with test data up to 90 knots, but the trend of decreasing damping above 90 knots is contrary to the theory.

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A R H
are included. Emphasis is placed not only on the synthesis of the design, but on the assessment of the results as well. The first step is to establish the differences, distinguishing characteristics and connections between the modern and classical control theory approaches. Ultimately, this uncovers a relationship between bandwidth goals familiar in classical control and cost function weights in the equivalent optimal system. In order to obtain a practical solution, it is also necessary to formulate the problem very carefully, and each choice of state, measurement and output variable must be judiciously considered. Once design goals are established and problem formulation completed, the control system is synthesized in a straightforward manner. Three steps are involved: filter-observer solution, regulator solution, and the combination of two into the controller. Assessment of the controller permits and examination and expansion of the synthesis results.

J.M.S.


VELOCity FIELD NEAR THE JET ORIFICE OF A ROUND JET IN A CROSSFLOW Interim Report
Richard L. Fearn and J. Paul Benson Dec. 1979 72 p refs
(Grants NsG-2288; NGL-10-005-127)
(NASA-CR-152353) Avail: NTIS HC A04/MF A01 CSCL 20D

Experimentally determined velocities at selected locations near the jet orifice are presented and analyzed for a round jet in crossflow. Jet to cross flow velocity ratios of four and eight were studied experimentally for a round subsonic jet of air exhausting perpendicularly through a flat plate into a subsonic crosswind of the same temperature. Velocity measurements were made in cross sections to the jet plume located from one to four jet diameters from the orifice. Jet centerline and vortex properties are presented and utilized to extend the results of a previous study into the region close to the jet orifice.

Author

N81-18397# Analytical Methods, Inc., Bellevue, Wash.

A THREE-DIMENSIONAL VISCOUS/POTENTIAL FLOW INTERACTION ANALYSIS METHOD FOR MULTI-ELEMENT WINGS: MODIFICATIONS TO THE POTENTIAL FLOW CODE TO ALLOW PART-SPAN, HIGH-LIFT DEVICES AND CLOSE-INTERFERENCE CALCULATIONS
B. Maskew Mar. 1979 143 p refs
(Contract NAS2-8788)
(NASA-CR-152277) Avail: NTIS HC A07/MF A01 CSCL 01A

The description of the modified code includes details of a doubled subpanel technique in which panels that are close to a velocity calculation point are replaced by a subpanel set. This treatment gives the effect of a higher panel density without increasing the number of unknowns. In particular, the technique removes the close approach problem of the earlier singularity model in which distortions occur in the detailed pressure calculation near panel corners. Removal of this problem allowed a complete wake relaxation and roll-up iterative procedure to be installed in the code. The geometry package developed for the new technique and also for the more general configurations is based on a multiple patch scheme. Each patch has a regular array of panels, but arbitrary relationships are allowed between neighboring panels at the edges of adjacent patches. This provides great versatility for treating general configurations.

T.M.

N81-18028# Kaman Aerospace Corp., Bloomfield, Conn.

MULTICYCLIC CONTROLLABLE TWIST ROTOR DATA ANALYSIS Final Report
Fu-Shang Wei and A. L. Weisbrich 15 Jan. 1979 170 p refs
(Contract NAS2-8726)
(NASA-CR-152251; R-1562) Avail: NTIS HC A08/MF A01 CSCL 01A

Results provide functional relationship between rotor performance, blade vibratory loads and dual control settings and indicate that multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads. Higher harmonic terms of servo flap deflection were found to be most pronounced in flatwise bending moment, transmission vertical vibration and pitch link vibratory load equations. The existing test hardware represents a satisfactory configuration for demonstrating MCTR technology and defining a data base for additional wind tunnel testing.

T.M.

N81-18060# Lear Siegler, Inc., Santa Monica, Calif. Astronics Div.

DEVELOPMENT AND EVALUATION OF AUTOMATIC LANDING CONTROL LAWS FOR POWER LIFT STOL AIRCRAFT Final Report
(Contract NAS2-10324)
(NASA-CR-152399) Avail: NTIS HC A12/MF A01 CSCL 01C

A series of investigations were conducted to generate and verify through ground based simulation and flight research a data base to aid in the design and certification of advanced propulsive lift short takeoff and landing aircraft. Problems impacting the design of powered lift short haul aircraft that are to be landed automatically on STOL runways in adverse weather were examined. An understanding of the problems was gained by a limited coverage of important elements that are normally included in certification process of a CAT 3 automatic landing system.

T.M.

N81-18319# Florida State Univ., Gainesville.

VELOCity FIELD NEAR THE JET ORIFICE OF A ROUND JET IN A CROSSFLOW
Richard L. Fearn and J. Paul Benson Dec. 1979 72 p refs
(Grants NsG-2288; NGL-10-005-127)
(NASA-CR-152293) Avail: NTIS HC A04/MF A01 CSCL 20D

Experimentally determined velocities at selected locations near the jet orifice are presented and analyzed for a round jet in crossflow. Jet-to-crossflow velocity ratios of four and eight were studied experimentally for a round subsonic jet of air exhausting perpendicularly through a flat plate into a subsonic crosswind of the same temperature. Velocity measurements were made in cross sections to the jet plume located from one to four jet diameters from the orifice. Jet centerline and vortex properties are presented and utilized to extend the results of a previous study into the region close to the jet orifice.

Author


FORWARD VELOCITY EFFECTS ON FAN NOISE AND THE SUPPRESSION CHARACTERISTICS OF ADVANCED INLETS AS MEASURED IN THENASA Ames 40 by 80 Foot WIND TUNNEL: ACOUSTIC DATA REPORT Final Report
(Contract NAS2-8675)
(NASA-CR-152329) Avail: NTIS HC A12/MF A01 CSCL 20A

Forward velocity effects on the forward radiated fan noise and on the suppression characteristics of three advanced inlets relative to a baseline cylindrical inlet were measured in a wind tunnel. A modified JT15D turbofan engine in a quiet nacelle was the source of fan noise: the advanced inlets were a CTOL hybrid inlet, an STOL hybrid inlet, and a treated deflector inlet. Also measured were the static to flight effects on the baseline inlet noise and the effects on the fan noise of canting the baseline inlet 4 deg downward to simulate typical wing mounted turbofan engines. The 1/3 octave band noise data from these tests are given along with selected plots of 1/3 octave band spectra and directivity and full scale PNL directivities. The test facilities and data reduction techniques used are also described.

M.G.
ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 1: NONPLANAR, NONLINEAR WING/JET LIFTING SURFACE METHOD

C. A. Shollenberger and D. N. Smyth Mar. 1978 91 p refs (Contract NAS2-9319)
(NASA-CR-152254; NEAR-TR-183) Avail: NTIS HC A04/MF A01 CSCL 01A

A method based on potential flow theory was developed for predicting forces and moments acting on augmentor wings for prescribed ejector jet characteristics. A three dimensional nonplanar vortex lattice is laid out on the chordal planes of the augmentor wing components. Jet induced effects are included in the boundary condition from which the horseshoe vortex strengths are obtained. The jet within the diffusor is made to expand from the primary nozzles to the diffusor exit and is represented by a distribution of vorticity on the jet boundary to provide proper entrainment. The jet downstream of the diffusor exit is modeled by a vorticity distribution and blockage panels and its centerline location and spreading rate are taken from experimental data. The vortex lattice and jet models are used in an iterative manner until the predicted diffusor exit velocity matches the specified one. Some comparisons with available data show good agreement at lower power settings.

Author

ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 2: NONPLANAR, NONLINEAR METHOD APPLICABLE TO THREE DIMENSIONAL JETS OF FINITE THICKNESS

C. A. Shollenberger Mar. 1978 36 p refs (Contract NAS2-9319)
(NASA-CR-152088-Pr-2) Avail: NTIS HC A03/MF A01 CSCL 01C

The ability of the potential flow analysis (POTFAN) to predict the influence of ground proximity on lift systems is examined. A two dimensional study employing vortex lattice methodology provides confidence that ground effect phenomenon can be predicted using discrete singularity representation. Two dimensional quasi-steady ascent and descent behavior determined provides guidance in interpreting three dimensional results. Steady and quasi-steady ground effect aerodynamic characteristics predicted by POTFAN are presented for several basic unpowered configurations. POTFAN results are compared with experimental data and results of other analytical methods. Modification of POTFAN to incorporate multienergy flow analysis is discussed. General aspects of thick jet models are examined to provide a basic for extending POTFAN's scope to include analysis of propulsive lift interactions.

S.F.

ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT FOR CLOSELY SPACED JETS

(NASA-CR-152321) Avail: NTIS HC A09/MF A01 CSCL 01C

Results of a series of in ground effect twin jet tests are presented along with flow models for closely spaced jets to help predict pressure and upwash forces on simulated aircraft surfaces. The isolated twin jet tests revealed unstable fountains over a range of spacings and jet heights, regions of below ambient pressure on the ground, and negative pressure differential in the upwash flow field. A separate computer code was developed for vertically oriented, incompressible jets. This model more accurately reflects fountain behavior without fully formed wall jets, and adequately predicts ground isobars, upwash dynamic pressure decay, and fountain lift force variation with height above ground.

E.A.K.

ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 1: NONPLANAR, NONLINEAR WING/JET LIFTING SURFACE METHOD

N81-19059#
C. A. Shollenberger and D. N. Smyth Mar. 1978 91 p refs (Contract NAS2-9319)
(NASA-CR-152087-Pr-1) Avail: NTIS HC A05/MF A01 CSCL 01C

A nonlinear, nonplanar three dimensional jet flap analysis, applicable to the ground effect problem, is presented. Lifting surface methodology is developed for a wing with arbitrary planform operating in an inviscid and incompressible fluid. The classical, infinitely thin jet flap model is employed to simulate power induced effects. An iterative solution procedure is applied within the analysis to successively approximate the jet shape until a converged solution is obtained which closely satisfies jet and wing boundary conditions. Solution characteristics of the method are discussed and example results are presented for unpowered, basic powered and complex powered configurations. Comparisons between predictions of the present method and experimental measurements indicate that the improvement of the jet with the ground plane is important in the analyses of powered lift systems operating in ground proximity. Further development of the method is suggested in the areas of improved solution convergence, more realistic modeling of jet impingement and calculation efficiency enhancements.

Author
Jeff G. Bohn and J. Edwin Jones  28 May 1978  316 p  refs  
(Contract NAS2-9665)  
(NASA-CR-152145) Avail: NTIS HC A14/ MF A01 CSCL 14B

The development and use of a digital computer simulation of the proposed wind tunnel facility is described. The feasibility of automatic control of wind tunnel airspeed and other parameters was examined. Specifications and implementation recommendations for a computer based automatic control and monitoring system are presented. T.M.

A SEMI-ANALYTIC APPROACH TO THE SELF INDUCED MOTION OF VORTEX SHEETS  
Leonard W. Schwartz  May 1980  42 p  refs  
(Contract NCC2-55)  
(NASA-CR-164177: SU-JIAA-TR-32) Avail: NTIS HC A03/ MF A01 CSCL 01A

The rolling up of the trailing vortex sheet produced by a wing of finite span was calculated as a series expansion in time. For a vorticity distribution corresponding to a wing with cusped tips, the shape of the sheet was found by summing the series using Padé approximants. The sheet remains analytic for some time but ultimately develops an exponential spiral at the tips. The centroid of vorticity was conserved to high accuracy. R.C.T.

N81-23026#  Lockheed-Georgia Co., Marietta.  
N. N. Reddy  Dec. 1978  435 p  refs  
(Contract NAS2-9615)  
(NASA-CR-152224; LG78ER0252) Avail: NTIS HC A19/ MF A01 CSCL 01A

Mean and fluctuating flow characteristics in the wake of upper surface blown flap configurations are presented. Relative importance of the longitudinal and the transverse components of the wake flow turbulence for noise generation are evaluated using correlation between the near-field noise and the wake turbulence. Effects of the jet velocity, the initial turbulence in the jet, and the flap deflection angle on noise and wake flow characteristics are studied. The far-field noise data is compared with the existing empirical prediction method. The measured wake flow properties are compared with an analytical model used in the existing USWB wake flow noise theory. The detailed wake flow profiles, wake flow turbulence space-time correlations, wake flow turbulence cross-power spectra, and near-field noise third octave band spectra are presented in the appendices. Author

TRANSMITTED SOUND FIELD DUE TO AN IMPULSIVE LINE ACOUSTIC SOURCE BOUNDED BY A PLATE FOLLOWED BY A VORTEX SHEET  
Toshihi Miura and C. C. Chao  Jan. 1980  85 p  refs  
(Grant Nsg-2007)  
(NASA-CR-164180; SU-JIAA-TR-27) Avail: NTIS HC A05/ MF A01 CSCL 20A

The propagation of sound due to a line acoustic source in the moving stream across a semifiinfinite vortex sheet which trails from a rigid plate is examined in a linear theory for the subsonic case. A solution for the transmitted sound field is obtained with the aid of multiple integral transform and the Wiener-Hopf technique for both the steady state (time harmonic) and initial value (impulsive source) situations. The contour of inverse transform and hence the decomposition of the functions are determined through causality and radiation conditions. The solution obtained satisfies causality and the full Kutta conditions. The transmitted sound field is composed of two waves in both the steady state and initial value problems. One is the wave scattered from the edge of the plate which is associated with the bow wave and the instability wave. These waves exist in the downstream sectors. The other is the wave transmitted through the vortex sheet which is also associated with the instability wave. Regional divisions of the transmitted sound field are identified. M.G.

V/STOLAND DIGITAL AVIONICS SYSTEM FOR XV-15 TILT ROTOR Final Report  
Sam P. Liden  Jan. 1980  381 p  refs  
(Contract NAS2-10326)  
(NASA-CR-152320) Avail: NTIS HC A17/ MF A01 CSCL 01D

A digital flight control system for the tilt rotor research aircraft provides sophisticated navigation, guidance, control, display and data acquisition capabilities for performing terminal area navigation, guidance and control research. All functions of the XV-15 V/STOLAND system were demonstrated on the NASA-ARC S-19 simulation facility under a comprehensive dynamic acceptance test. The most noteworthy accomplishments of the system are: (1) automatic configuration control of a tilt-rotor aircraft over the total operating range; (2) total hands-off landing to touchdown on various selectable straight-in glide slopes and on a flight path that includes a two-revolution helix; (3) automatic guidance along a programmed three-dimensional reference flight path; (4) navigation data for the automatic guidance computed on board, based on VOR/DME, TACAN, or MLS rawdata; and (5) integration of a large set of functions in a single computer. Utilizing 10k words of storage for programs and data. A.R.H.

N81-23029#  Nielsen Engineering and Research, Inc., Mountain View, Calif.  
(Contract NAS2-10623)  
(NASA-CR-166150; NEAR-TR-237) Avail: NTIS HC A08/ MF A01 CSCL 01A

A study of jet exit profile, exit Mach number, swirl and turbulence level on jet-induced loadings for jets exhausting from a surface into a crossflow is presented. The importance of each of these real jet characteristics is assessed using available data. Where adequate surface pressure distribution data are available, a correlation method to predict surface pressure for jet exhausting from an infinite flat plate is used either to attempt to develop a correlation based on the real jet characteristics or to model the effects of that characteristic. Data comparisons are presented for selected cases. Also, a summary of information on surface pressure distribution data for jet exhausting from flat plates into a subsonic crossflow is presented. Author
ON CERTAIN INTEGRALS WHICH PERTAIN TO THE FORCED VIBRATION OF PLATES Interim Report

A comprehensive set of general aviation avionics were defined for integration into an advanced hardware mechanism for demonstration in a Cessna 402B aircraft. Block diagrams are shown and system and computer architecture as well as significant hardware elements are described. The multifunction integrated data control center and electronic horizontal situation indicator are discussed. The functions that the DAAS will perform are examined. This function definition is the basis for the DAAS hardware and software design.

A.R.H.


APPLICATION OF VARIABLE STRUCTURE SYSTEM THEORY TO AIRCRAFT FLIGHT CONTROL Interim Report

The current status of research on the application of variable structure system (VSS) theory to design aircraft flight control systems is summarized. Two aircraft types are currently being investigated: the Augmentor Wing Jet STOL Research Aircraft (AWJSRA), and AV-BA Harrier. The AWJSRA design considers automatic control of longitudinal dynamics during the landing phase. The main task for the AWJSRA is to design an automatic landing system that captures and tracks a localizer beam. The control task for the AV-BA is to track velocity commands in a hovering flight configuration. Much effort was devoted to developing computer programs that are needed to carry out VSS design in a multivariable framework, and in becoming familiar with the dynamics and control problems associated with the aircraft types under investigation. Numerous VSS design schemes were explored, particularly for the AWJSRA. The approaches that appear best suited for these aircraft types are presented. Examples are given of the numerical results currently being generated. A.R.H.

Stanford Univ., Calif.

ON SOURCE RADIATION Interim Report

The power output from given sources is usually ascertained via an energy flux integral over the normal directions to a remote (far field) surface; an alternative procedure, which utilizes an integral that specifies the direct rate of working by the source on the resultant field, is described and illustrated for both point and continuous source distribution. A comparison between the respective procedures is made in the analysis of sound radiated from a periodic dipole source whose axis performs a periodic linear motion in a plane wall in which a compact circular piston executes normal steady rectilinear motion, dependent only on Mach number in the plane flow, and on the respective procedures is made in the analysis of sound radiated from a periodic dipole source whose axis performs a periodic planar movement about a fixed direction. Thus, adopting the conventional approach, Sretenski (1956) characterizes the rotating dipole in terms of an infinite number of stationary ones from a periodic dipole source whose axis performs a periodic planar movement about a fixed direction. Thus, adopting a conventional approach, Sretenski (1956) characterizes the rotating dipole in terms of an infinite number of stationary ones.


NASA-CR-166178; SU-JIAA-TR-29) Avail: NTIS HC A02/MF A01 CSCL 20A

Various properties of multivariable root loci are analyzed from a frequency domain point of view by using the technique of Newton polygons, and some generalizations of the SISO root locus rules to the multivariable case are presented. The behavior of the angles of arrival and departure is related to the Smith-MacMillan form of (s) and explicit equations for these angles are found. After specializing to first order and a restricted class of higher order poles and zeros, some simple equations for these angles that are direct generalizations of the SISO equations are found. The unusual behavior of root loci on the real axis at branch points is studied. The SISO root locus rules for break-in and break-out points are shown to generalize directly to the multivariable case. Some methods for computing both types of points are presented. Author

Stanford Univ., Calif.

A NOTE ON SOUND RADIATION INTO A UNIFORMLY FLOWING FLUID Interim Report

The various plate integrals previously considered by Crighton (1972) are directly cast in a manner that permits their systematic development near the source point; and thus to dispense with manipulation of the velocity transform. The advantage is the ease with which distributed forces over the plate are incorporated into the analysis. After the procedure is introduced in connection with a line source problem and followed by consideration of a point source, the analogous problems relative to uniformly distributed forces over strips or circular areas of the plate receive attention.

S.F.


FLAP SURVEY TEST OF A COMBINED SURFACE BLOWING MODEL: FLOW MEASUREMENTS AT STATIC FLOW CONDITIONS

The Combined Surface Blowing (CSB) V/STOL lift/propulsion system consists of a blown flap system which deflects the exhaust from a turbojet engine over a system of flaps deployed at the
trailing edge of the wing. Flow measurements consisting of velocity measurements using split film probes and total pressure surveys using a miniature Kiel probe were made at control stations along the flap systems at two spanwise stations; the centerline of the nozzle and 60 percent of the nozzle span outboard of the centerline. Surface pressure measurements were made in the wing cove and the upper surface of the first flap element. The test showed a significant flow separation in the wing cove. The extent of the separation is so large that the flow into the first flap takes place only at the leading edge of the flap. The velocity profile measurements indicate that large spanwise (3 dimensional) flow may exist. T.M.

N81-24064*  Flight Dynamics Research Corp., Van Nuys, Calif. A JET-DIFFUSER FOR EJECTOR A V/STOL FIGHTER Contractor Final Report, Sep. 1979 - Apr. 1981 Morton Alperin and Jiunn-Jeng Wu Feb. 1981 50 p refs Sponsored in part by Naval Air Development Center (Contract NAS2-10373) (NASA-CR-169161) Avail: NTIS HC A03/MF A01 CSCL 21E A single ejector equipped with only one vector control jet and a diffuser flap was installed close to the leading edge of the strakes at a one-fifth scale, semi-span model of the aircraft, without wing, canard, or tail surface. Tests of the system at a nozzle pressure ratio of 1.24 indicated a thrust augmentation of 1.92 and a thrust in the flight direction of about 12% of the total thrust under static conditions. An ejector stall speed can be delayed by using a boundary layer control jet at the front inlets of the ejector. T.M.


As a means to achieve a minimum interference correction wind tunnel, a partially actively controlled test section was experimentally examined. A jet flapped wing with 0.91 m (36 in) span and R = 4.05 was used as a model to create moderately high lift coefficients. The partially controlled test section was simulated using an insert, a rectangular box 0.96 x 1.44 m (3.14 x 4.71 ft) open on both ends in the direction of the tunnel air flow, placed in the University of Washington Aeronautical Laboratories (UWAL) 2.44 x 3.66 m (8 x 12 ft) wind tunnel. A tail located three chords behind the wing was used to measure the downwash at the tail region. The experimental data indicates that, within the range of momentum coefficient examined, it appears to be unnecessary to actively control all four sides of the test section walls in order to achieve the near interference free flow field environment in a small wind tunnel. The remaining wall interference can be satisfactorily corrected by the vortex lattice method. Author


The feasibility of remote, high-resolution infrared imagery of the Shuttle Orbiter lower surface during entry to obtain accurate measurements of aerodynamic heat transfer was demonstrated. Using available technology, such images can be taken from an existing aircraft/telescope system (the C161 Air RO) with minimum modification or addition of systems. Images with a spatial resolution of 1 m or better and a temperature resolution of 2.5% between temperatures of 800 and 1900 K can be obtained. Data reconstruction techniques can provide a geometrically and radiometrically corrected array on addressable magnetic tape ready for display by NASA. Author


The robustness of the stability of multivariable linear time invariant feedback control systems with respect to model uncertainty is considered using frequency domain criteria. Available robustness tests are unified under a common framework based on the nature and structure of model errors. These results are derived using a multivariable version of Nyquist’s stability theorem in which the minimum singular value of the return difference transfer matrix is shown to be the multivariable generalization of the distance to the critical point on a single input, single output Nyquist diagram. Using the return difference transfer matrix, a very general robustness theorem is presented from which all of the robustness tests dealing with specific model errors may be derived. The robustness tests that explicitly utilized model error structure are able to guarantee feedback system stability in the face of model errors of larger magnitude than those robustness tests that do not. The robustness of linear quadratic Gaussian control systems are analyzed. M.G.
A ROBUST FEEDBACK SYSTEM FOR STALL-FLUTTER SUPPRESSION

A mathematical model of a high performance airplane capable of vertical attitude takeoff and landing (VATOL) was developed. An off line digital simulation program incorporating this model was developed to provide trim conditions and dynamic check runs for the piloted simulation studies. Development details for the various simulation components and the application of the off line simulation program, Vertical Attitude Take-Off and Landing Simulation (VATLAS), to develop a baseline control system for the Vought SF-121 VATOL airplane concept are described. E.A.K.

A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 2: MODEL EQUATIONS AND BASE AIRCRAFT DATA


Equations incorporated in a VATOL six degree of freedom off-line digital simulation program and data for the Vought SF-121 VATOL aircraft concept which served as the baseline for the development of this program are presented. The equations and data are intended to facilitate the development of a pilot's VATOL simulation. The equation presentation format is to state the equations which define a particular model segment. Listings of constants required to quantify the model segment, input variables required to exercise the model segment, and output variables required by other model segments are included. In several instances a series of input or output variables are followed by a section number in parentheses which identifies the model segment of origination or termination of those variables. E.A.K.

A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 3: USER'S MANUAL FOR VATOL SIMULATION PROGRAM


Instructions for using Vertical Attitude Takeoff and Landing Aircraft Simulation (VATLAS), the digital simulation program for application to vertical attitude takeoff and landing (VATOL) aircraft developed for installation on the NASA Ames CDC 7600 computer system are described. The framework for VATLAS is the Off-Line Simulation (OLSIM) routine. The OLSIM routine provides a flexible framework and standardized modules which facilitate the development of off-line aircraft simulations. OLSIM runs under the control of VOTOLTH, the main program, which calls the proper modules for executing user specified options. These options include trim, stability derivative calculation, time history generation, and various input-output options. E.A.K.

A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 1: MODEL DESCRIPTION APPLICATION

Final Report


A mathematical model of a high performance airplane capable of vertical attitude takeoff and landing (VATOL) was developed. An off line digital simulation program incorporating this model was developed to provide trim conditions and dynamic check runs for the piloted simulation studies and support dynamic analyses of proposed VATOL configuration and flight control concepts. Development details for the various simulation components and the application of the off line simulation program, Vertical Attitude Take-Off and Landing Simulation (VATLAS), to develop a baseline control system for the Vought SF-121 VATOL airplane concept are described. E.A.K.

AEROELASTIC AND STRUCCTURES RESEARCH LAB.

TESTING AND EVALUATION OF A STALL-FLUTTER SUPPRESSION SYSTEM FOR HELICOPTER ROTORS USING INDIVIDUAL-BLADE-CONTROL


The development and testing of a feedback system designed to alleviate the violent blade first torsion mode oscillations associated with stall flutter are described. The system, based on previously developed M.I.T. Individual-Blade-Control hardware, employs blade-mounted accelerometers to sense torsional oscillations and feeds back rate information to increase the damping of the first torsion mode. A linear model of the blade and control system dynamics is developed and is used to give qualitative and quantitative guidance in the design process as well as to aid in analysis of experimental results. System performance in wind tunnel tests, both in hover and forward flight, is described, and evidence is given of the system's ability to provide substantial additional damping to stall-induced blade oscillations. Author

AEROELASTIC AND STRUCTURES RESEARCH LAB.

ALLEVIATION OF HELICOPTER FUSELAGE-INDUCED ROTOR UNSTEADY LOADS THROUGH DETERMINISTIC VARIATION OF THE INDIVIDUAL BLADE PITCH


The effect of fuselage-induced upwash on the flapwise motion of a hinged rotor blade is considered. The typical upwash field is simulated through the flow produced by a moving point source. The resulting blade response is then approximated by its rigid flapping and first bending mode. The perturbation blade pitch variation required to alleviate its response to the upwash in the sense of either reducing the increased hub sheari or minimization of the blade overall time averaged deflection, is determined. Calculations are carried out for a model rotor and for the case with increased Lock number. The results are presented in graph form. It is found that the minimum blade deflection criteria suppress the rigid flapping by a large amount and reduce the peak-to-peak value of the blade hub shear by at least 50 percent without causing an additional increase in blade stresses. Author

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SEQUENTIAL DECISION RULES FOR FAILURE DETECTION

Edward Y. Chow (Schlumberger-Doll Research, Ridgefield, Conn.) and Alan S. Willsky Jul. 1981 12 p refs (Grant NGL-22-009-124; Contract N00014-77-C-0224; NR Proj. 041-516) (NASA-CR-164847: AD-A102025; UDS-P-1109) Avail: NTIS HC A02/MF A01 CSCL 12A

The formulation of the decision making of a failure detection process as a Bayes sequential decision problem (BSDP) provides a simple conceptualization of the decision rule design problem. As the optimal Bayes rule is not computable, a methodology that is based on the Bayesian approach and aimed at a reduced computational requirement is developed for designing suboptimal rules. A numerical algorithm is constructed to facilitate the design and performance evaluation of these suboptimal rules. The result of applying this design methodology to an example shows that this approach is a useful one. Author (GRA)

AEROELASTIC AND STRUCTURES RESEARCH LAB.

ON REGULATORS WITH A PRESCRIBED DEGREE OF STABILITY M.S. Thesis


The effect of fuselage-induced upwash on the flapwise motion of a hinged rotor blade is considered. The typical upwash field is simulated through the flow produced by a moving point source. The resulting blade response is then approximated by its rigid flapping and first bending mode. The perturbation blade pitch variation required to alleviate its response to the upwash in the sense of either reducing the increased hub sheari or minimization of the blade overall time averaged deflection, is determined. Calculations are carried out for a model rotor and for the case with increased Lock number. The results are presented in graph form. It is found that the minimum blade deflection criteria suppress the rigid flapping by a large amount and reduce the peak-to-peak value of the blade hub shear by at least 50 percent without causing an additional increase in blade stresses. Author

A discrete vortex method was used to analyze the separated non-steady flow about a cambered airfoil. The foil flow modelling is based on the thin lifting-surface approach, where the chordwise location of the separation point is assumed to be known from experiments or flow-visualization data. Calculated results provided good agreement when compared with the post-stall aerodynamic data of two airfoils. Those airfoil sections differed in the extent of travel of the separation point with increasing angle of attack. Furthermore, the periodic wake shedding was analyzed and its time-dependent influence on the airfoil was investigated. (Author)


A model of the human pilot is offered for pursuit tracking tasks; the model encompasses an existing model for compensatory tracking. The central hypothesis in the development of this model states that those primary structural elements in the compensatory model responsible for the pilot's equalization capabilities remain intact in the pursuit model. In this latter case, effective low-frequency inversion of the controlled-element dynamics occurs by feed-forward derived input rate through the equalization dynamics, with low-frequency phase droop minimized. The sharp reduction in low-frequency phase lag beyond that associated with the disappearance of phase droop is seen to accompany relatively low-gain feedback of vehicle output. The results of some recent motion cue research are discussed and interpreted in terms of the compensatory-pursuit-display dichotomy. Tracking with input preview is discussed in a qualitative way. In terms of the model, preview is shown to demand no fundamental changes in structure or equalization and to allow the pilot to eliminate the effective time delays that accrue in the inversion of the controlled-element dynamics. Preconceptive behavior is discussed, and a model that encompasses all the levels of skill development outlined in the successive organizations of perception theory is finally proposed. (Author)


Two off-line schemes are proposed for the identification of unknown noise covariance matrices Q and R of a discrete-time dynamic system. The first scheme is based on a maximum a posteriori cost function utilizing smoothed state estimates, while the second is based on a maximum likelihood cost function utilizing filtered state estimates. Sensitivity of the cost functions to Q and R is analyzed for the following cases: (1) single-input single-output systems; (2) multiple-input single-output systems; and (3) single-input multi-input systems with a diagonal R. Identifiability criteria are presented for the cases considered and demonstrated by examples. V.L.

An infrared radiometer system has been developed that can alert a pilot of an aircraft 2 to 9 minutes in advance of an encounter with clear air turbulence. The time between the warning and the clear air turbulence event varies with the flight altitude of the aircraft. In turbulence-free areas, the incidence of false alarms is found to be less than one in 3.4 hours of flight time compared to less than one per 10 hours of flight time in areas with turbulence. (Author)

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept applied to transport aircraft landing. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to electronic flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. (Author)

A81-20466 * Application of trajectory optimization principles to minimize aircraft operating costs. J. A. Sorensen (Analytical Mechanics Associates, Inc., Mountain View, Calif.) and R. S. Bray (NASA, Ames Research Center, Moffett Field, Calif.) An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept applied to transport aircraft landing. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to such flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. (Author)
In 1978 a joint NASA-FAA helicopter flight test was conducted to examine the use of weather-mapping radar for IFR guidance during landing approaches to oil rig helipads. The following navigation errors were measured: total system error, radar-range error, radar-bearing error, and flight technical error. Three problem areas were identified: (1) operational problems leading to pilot blunders, (2) poor navigation to the downwind final approach point, and (3) pure homing on final approach. Analysis of these problem areas suggests improvement in the radar equipment, approach procedure, and pilot training, and gives valuable insight into the development of future navigation aids to serve the off-shore oil industry.

(Author)


The state of the art of PAN based carbon fiber manufacture and the science of fiber behavior is surveyed. A review is given of the stabilization by oxidation and the subsequent carbonization of fibers, of the apparent structure of fibers deduced from scanning electron microscopy, from X-ray scattering, and from similarities with soft carbons, and of the known relations between fiber properties and heat treatment temperature. A simplified model is invoked to explain the electrical properties of fibers and recent quantum chemical calculations on atomic clusters are used to elucidate some aspects of fiber conductivity. Some effects of intercalation and oxidative modification of finished fibers are summarized.

E.D.K.


During the past 25 years over 60 V/STOL types were studied and flown with varying degrees of success. The requirements for satisfactory characteristics in several key technology areas are discussed and a review is made of various V/STOL aircraft for the purpose of assessing the success or failure of each design in meeting design requirements. This survey shows that in spite of many problems revealed, special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects.

T.M.


Recent history underscores the need for in-cockpit alerts of LLWS for takeoffs and landings. The 13-15 micron portion of the CO2 molecular spectrum can be used to remote sense LLWS in and around thunderstorms. A radiometer with a designed look-distance of about 10 km remote senses an average air temperature along a forward, horizontal path. Wind shear alerts are based on the difference between this forward air temperature and the air temperature near the aircraft. Although spectral ranging, a major design improvement of an IR LLWS alert system, is not at present feasible with noncooled detectors, it is an important technique to keep in mind, given the rapid advance in IR technology.

(Author)


In 1978 a joint NASA-FAA helicopter flight test was conducted to examine the use of weather-mapping radar for IFR guidance during landing approaches to oil rig helipads. The following navigation errors were measured: total system error, radar-range error, radar-bearing error, and flight technical error. Three problem areas were identified: (1) operational problems leading to pilot blunders, (2) poor navigation to the downwind final approach point, and (3) pure homing on final approach. Analysis of these problem areas suggests improvement in the radar equipment, approach procedure, and pilot training, and gives valuable insight into the development of future navigation aids to serve the off-shore oil industry.

(Author)


A ground simulator experiment was conducted on the Flight Simulator for Advanced Aircraft at Ames Research Center to investigate the influence of several static stability and stability/control augmentation design parameters on helicopter flying qualities during terminal area operations in instrument conditions. Effects of light turbulence were included. Two levels of static stability in each rotational axis (pitch, roll, yaw) were examined for a hingeless rotor configuration. The variations in pitch and roll were: (1) stable and (2) neutral static stability; in yaw there were two stable levels. Four types of stability/control augmentation were also examined for the lower level of static stability in each axis. This latter investigation covered the helicopter rotor types: hingeless, articulated, and teetering. Four pilots performed a total of 105 evaluations of these parameters for a representative VOR instrument approach task. Pilot rating results indicate the acceptability of neutral static stability longitudinally and laterally and the need for pitch-rotor attitude augmentation to achieve a satisfactory system.

(Author)


The helicopter Microwave Landing System flight-test investigations, conducted by a joint NASA/FAA effort in order to gather statistical data for establishing terminal instrument procedures criteria, and to provide a performance data base for developing advanced MLS guidance concepts, are presented. The specific flight-test objectives were to: (1) develop acceptable angle-only MLS approach profiles; (2) determine tracking errors; (3) determine altitude loss during missed approach; (4) evaluate guidance display sensitivities; and (5) evaluate pilot acceptability. Seventeen pilots flew 140 manual (without stability augmentation) dual-pilot simulated instrument approaches in a UH-1H helicopter. The flight profiles flown included 3-, 6-, and 9-degree glideslope, centerline approaches to decision heights of 50, 100, and 150 ft, respectively. The angular guidance display sensitivities and the data acquisition system are also described. Eight major conclusions are made, and include the following: (1) the use of pitch attitude to control airspeed and collective to control glideslope was the preferred pilot technique for the steep glideslope approaches, and (2) angular guidance deviation indicator sensitivity requirements for helicopter MLS approaches to STOL ports and heliports have been found to be significantly different from standard ILS sensitivities.

K.S.
These equations are in a first-order, vector-matrix format, and are satisfactory, whereas ratings of adequate-but-unsatisfactory depend primarily on the control system; the control system required for determining the susceptibility of an aircraft to pilot induced oscillations (PIO) is formulated. Finally, a model-based metric for pilot rating prediction is discussed. The resulting modeling procedure provides a relatively simple, yet unified approach to the study of a variety of handling qualities problems.

An analytical approach to the study of flight dynamics of aircraft operating in a high-angle-of-attack flight regime and of helicopters operating in extreme thrust conditions is presented. Steady coordinated high-g turns are used to establish the initial equilibrium flight conditions near stalling angles of attack. The kinematic properties of the aircraft in steady coordinated turns are examined: high-g turns, pitch rate (independent of the angle of attack) is of a much larger magnitude than roll and yaw rate; a substantial roll rate is found to develop in steep turns for all angles of attack; the angle of attack also has a significant effect on the pitch attitude, with decreasing influence as the normal load factor increases. The exact small disturbance equations of motion of the aircraft in general steady turns are also developed for application to both rotary-wing and fixed-wing aircraft in extreme conditions. These equations are in a first-order, vector-matrix format, and are thus compatible with many efficient software packages developed in modern system theory.

A helicopter-approach concept is presented for Instrument Flight Rules (IFR) operation of rotorcraft into congested terminal areas where separation from high-speed jet traffic is highly desirable and the airport-precision approach aid is a Microwave Landing System (MLS). The concept takes advantage of the fact that rotorcraft need not land on the main runway but can operate from a pad that lies on an MLS radial offset from the centerline. The results of 48 flights using a UH-1H helicopter and a research avionics system are presented. Three levels of navigation sophistication were also investigated. It is shown that an approach helix can be contained in a relatively small volume and that being within the Instrument Landing System (ILS) Category II window at a 30-m (100-ft) altitude is not a requirement for a successful hover over a landing pad. Only two of the three navigation systems provided estimates that allowed all flights to descend from hover to touchdown.


A flight experiment was conducted using the NASA Army V/STOLAND UH-1H variable-static-stability helicopter to investigate the influence of several longitudinal-static-stability, control-augmentation, and flight-director parameters on helicopter flying qualities during terminal area operations in instrument conditions. This experiment, which was part of a joint NASA/FAA program pertaining to helicopter IFR airworthiness, was designed to corroboration and extend previous ground simulation results obtained in this program. Variations examined included stable and neutral longitudinal control position gradients, rate-damping and attitude-command augmentation, and raw data versus flight-director displays. Pilot rating results agreed excellently with the ground simulation data, indicating an adequate instrument capability with rate-damping augmentation and neutral statics and the need for pitch-roll attitude augmentation to achieve a satisfactory system.

A steep coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest in this study. Unlike fixed-wing aircraft, the helicopter in a steady coordinated turn will inherently sideslip. A set of exact kinematic equations describing this motion in steady helical turns has been developed, and a rational definition for the load factor that best characterizes a coordinated turn for a helicopter has been proposed. An analysis has also been completed on the effects of sideslip on the kinematic relationships in a coordinated turn which is based on new closed-form solutions which relate the aircraft angular rates and pitch and roll attitudes to the turn parameters, angle of attack, and sideslip. The results show that the bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor and that the normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Generally, sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. The study also indicates that pitch rate is independent of angle of attack.

A flight experiment was conducted using the NASA Army V/STOLAND UH-1H variable-static-stability helicopter to investigate the influence of several longitudinal-static-stability, control-augmentation, and flight-director parameters on helicopter flying qualities during terminal area operations in instrument conditions. This experiment, which was part of a joint NASA/FAA program pertaining to helicopter IFR airworthiness, was designed to corroboration and extend previous ground simulation results obtained in this program. Variations examined included stable and neutral longitudinal control position gradients, rate-damping and attitude-command augmentation, and raw data versus flight-director displays. Pilot rating results agreed excellently with the ground simulation data, indicating an adequate instrument capability with rate-damping augmentation and neutral statics and the need for pitch-roll attitude augmentation to achieve a satisfactory system.
in a coordinated turn and that in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft. (Author)


A piloted simulator experiment, designed to evaluate and optimize certain backup control system (BUCS) engagement parameters and to provide pilot familiarization with aircraft response prior to flight test of the BUCS in the YAH-64 Advanced Attack Helicopter, is described. Key elements of the simulation were the representation of a control system jam, the pilot’s breaking of a shear pin in the jammed control, and the resultant BUCS engagement. To minimize the excursions in aircraft motion which could result from the pilot’s control inputs after shear pin breakage, the BUCS control function is blended in gradually. The experiment’s results indicate that optimum time to full control authority after shear pin breakage is three seconds in all axes for certain critical tasks. Special pilot training in the recovery from a control system jam may be necessary to minimize unacceptably large aircraft transients in the off-axis.

(Author)

HELICOPTER AND POWERED LIFT TECHNOLOGY DIVISION

NASA TECHNICAL MEMORANDA

N81-20065†§ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RECENT PROGRESS IN V/STOL AIRCRAFT TECHNOLOGY Final Report


Results from wind tunnel and flight test investigations for V/STOL aircraft are reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft; and a turbofan V/STOL aircraft. Comparison and correlation between theoretical and experimental results and between wind tunnel and flight test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Technology (QST) program. The QSTRA aircraft uses an upper surface blown flap and develops a usable engine-out landing approach lift coefficient of 5.5 and landing distances less than 1,000 ft. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Bell (XV-15-TRRA) aircraft flight investigations. The TRRA is a twin rotor research aircraft capable of vertical takeoff and landing and cruise speeds of 300 knots. The turbofan V/STOL aircraft technology results are from static ground facility and wind tunnel investigations of a NASA/NAVY/Grumman full scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. Author

N81-23039†§ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FULL-SCALE AERODYNAMIC CHARACTERISTICS OF A PROPELLAR INSTALLED ON A SMALL TWIN-ENGINE AIRCRAFT WING PANEL


Full-scale measurements of shaft thrust and torque were made. Wind-tunnel speeds and blade angles were set for full-scale flight conditions. Excellent quality measurements were obtained of the thrust coefficient, the power coefficient, and the propeller efficiency for various values of the advance ratio and the blade incidence angle at 3/4-blade radius. A conventional propeller theory found in the literature was applied to the present results. Although thrust, power, and efficiency were somewhat overpredicted, the advance ratio for maximum efficiency was predicted quite accurately. It was found that, for some conditions, spinner drag could be significant. A simple correction that was based on the spinner base pressure substantially accounted for the changes in efficiency that resulted from this cause. T.M. Author

N81-24025†§ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A GENERAL ALGORITHM FOR THE CONSTRUCTION OF CONTOUR PLOTS


An algorithm is described that performs the task of drawing equal level contours on a plane, which requires interpolation in two dimensions based on data prescribed at points distributed irregularly over the plane. The approach is described in detail. The computer program that implements the algorithm is documented and listed. Author

N81-24025†§ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMICS, AEROELASTICITY, AND STABILITY OF HANG GLIDERS. EXPERIMENTAL RESULTS


One-fifth-scale models of three basic ultralight glider designs were constructed to simulate the elastic properties of full scale gliders and were tested at Reynolds numbers close to full scale...
values. Twenty-four minor modifications were made to the basic configurations in order to evaluate the effects of twist, reflex, dihedral, and various stability enhancement devices. Longitudinal and lateral data were obtained at several speeds through an angle of attack range of -30 deg to +45 deg with sideslip angles of up to 20 deg. The importance of vertical center of gravity displacement is discussed. Lateral data indicate that effective dihedral is lost at low angles of attack for nearly all of the configurations tested. Drag data suggest that lift-dependent viscous drag is a large part of the glider's total drag as is expected for thin, cambered sections at these relatively low Reynolds numbers.

A helicopter bearingless main rotor was tested. Areas of investigation included aeroelastic stability, aerodynamic performance, and rotor loads as a function of collective pitch setting. The test was designed to determine aeroelastic stability of the fundamental flexbeam/blade chordwise bending mode. The rotor was stable for all conditions. Damping of the rotor chordwise bending mode increases with increased collective pitch angle at constant operating conditions. No significant decrease in rotor damping occurred due to frequency coalescence between the blade chordwise fundamental bending mode and the support system.

NASA CONTRACTOR REPORTS

N81-26074# General Electric Co., Cincinnati, Ohio

DESIGN OF A V/STOL PROPULSION SYSTEM FOR A LARGE-SCALE FIGHTER MODEL

W. S. Willis May 1981 58 p ref

(Contract NAS2-10568)

NASA-CR-166162; R81AE257) Avail: NTIS HC A04/MF A01 CSCL 21E

Modifications were made to the existing Large-Scale STOL fighter model to simulate a V/STOL configuration. Modifications included the substitutions of two dimensional lift/cruise exhaust nozzles in the nacelles, and the addition of a third J87 engine in the fuselage to supply a remote exhaust nozzle simulating a Remote Augmented Lift System. A preliminary design of the inlet and exhaust ducting for the third engine was developed and a detailed design was completed of the hot exhaust ducting and remote nozzle.

Author
The performance of a conventional engine/inlet installation, in which inlet and engine flow field interaction occurs, was compared to the performance of the same inlet remote coupled to the engine. The remote coupled inlet configuration decouples the influence of the engine on the inlet flow field and simulates current small scale inlet test techniques in which inlet airflow is provided by a vacuum source or coupled engine. The investigation was conducted in the NASA-Ames 40- by 80-foot wind tunnel using a General Electric TF-34 turbofan engine and a subsonic inlet having an average inlet contraction ratio of 1.26. Test results indicated that engine interaction allows the inlet to operate with lower distortion levels at and beyond the separation angle-of-attack experienced without engine interaction. T.M.

A comprehensive presentation is made of the engineering analysis methods used in the design, development and evaluation of helicopters. After an introduction covering the fundamentals of helicopter rotors, configuration and operation, rotary wing history, and the analytical notation used in the text, the following topics are discussed: (1) vertical flight, including momentum, blade element and vortex theories, induced power, vertical drag and ground effect; (2) forward flight, including in addition to momentum and vortex theory for this mode such phenomena as rotor flapping and its higher harmonics, tip loss and root cutout, compressibility and pitch-flap coupling; (3) hover and forward flight performance assessment; (4) helicopter rotor design; (5) rotary wing aerodynamics; (6) rotary wing structural dynamics, including flutter, flap-lag dynamics ground resonance and vibration and loads; (7) helicopter aeroelasticity; (8) stability and control (flying qualities); (9) stall; and (10) noise. O.C.
Both the X-Wing rotor and Circulation Control Rotor had higher sound levels than the conventional rotor at identical advancing-tip Mach numbers. There is excess noise due to the compressor on the X-Wing rotor and excess broadband noise on the Circulation Control Rotor. The X-Wing rotor had lower sound levels than the conventional rotor at identical forward speeds because of the lower tip speed feasible with the use of circulation control. (Author)


The Quiet Short-Haul Research Aircraft (QSRA), used to conduct a broad program of terminal area and low speed propulsive-lift flight research, is discussed. Flight performance of the QSRA is presented together with the results of the joint Navy/NASA flight program. It is found that both free-deck takeoffs and unarrested landings can be conducted with winds across the deck of zero to 25 knots on an aircraft carrier the size of the USS Kitty Hawk with all engines operating. QSRA characteristics and aerodynamic data are included. C.R.

N81-33144# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. RECENT PROGRESS IN V/STOL AIRCRAFT TECHNOLOGY L. Roberts, W. Deckert, and D. Hickey. In AGARD The Impact of MIL Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 10 p refs (For primary document see N81-33137 24-01) Avail: NTIS HC A12/MF 001 CSCL O1B

Recent results from wind-tunnel and flight-tests investigations for V/STOL aircraft were reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft, and a turbofan V/STOL aircraft. Comparison and correlation between theoretical and experimental results, and between wind-tunnel and flight-test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Aircraft (QSRA) program. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Ball (XW-15-TTRA) aircraft flight investigations. The turbofan V/STOL aircraft technology results are from static ground facility and wind-tunnel investigations of a NASA/Army/Circulation Control Rotor full-scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-54 engines. T.M.


A review of factors related to the acquisition and life-cycle cost, and mission reliability of helicopters is given. The potential for advanced vehicle configurations with improvements in energy efficiency, operating economics, and characteristics to satisfy the demands of the future market are identified. Special attention is given to advanced propulsion systems and related component technologies, and system requirements, powerplants and component thrusts, compressor design, combustion systems, turbine efficiency, blade tip treatment concepts and shaft dynamics are discussed in detail. E.B.


The structure of the attached turbulent flow in the vicinity of a NASA 4412 airfoil equipped with a single-slotted flap was studied. The airfoil/flap configuration was tested at a Mach number of 0.08 and a Reynolds number of 1.3 x 10^6 to the 6th in a 7-10 Foot Wind Tunnel. Surface-pressure measurements were made on the main airfoil and on the flap. Detailed measurements, obtained using a high-spatial-resolution laser Doppler anemometer, were made of the mean velocity flow field and of the second-order statistical quantities (Reynolds stresses) in the boundary layers, wakes, and merging shear layers. The experimental observations are compared with theoretical predictions of pressure, mean velocity, and Reynolds stress. (Author)


Linear regression techniques are used to obtain 9- and 12-degree-of-freedom linear rotorcraft models from the input-output data generated by a nonlinear, blade-element rotorcraft simulation in hover. The resulting models are used to evaluate the coupling of the fuselage modes with the rotor flapping and lead-lag modes at various frequencies. New techniques are proposed and evaluated to improve the identification process, including a method of verifying the assumed model structure by using data sets generated at different input frequencies. (Author)


Wind-tunnel tests and analyses of the aerodynamics of wing-canard combinations for low speed applications are presented. Systematic tests are conducted in a 7 x 10 wind tunnel to explore various combinations of wing-canard vertical and horizontal positioning. The goal of the tests are (1) to investigate potential improved stall characteristics over conventional tail-slit configurations, (2) to investigate the existence of a lift coefficient advantage, and (3) to determine induced drag levels. The measurements obtained are compared with calculations made using the Prandtl-Munk theory and with a vortex-lattice panel code. Results indicate that the panel code gives excellent results for lift and induced drag at moderate lift coefficient, whereas Prandtl-Munk theory gives conservative results for induced drag. The application is a light transport aircraft used for short-haul operations. K.S.


An investigation is conducted concerning the extent to which a program for rotorcraft research presented by NASA meets the user needs. Problems of civil operators are examined, taking into account
powerplants, reliability and maintainability, environment, noise and vibration, and lack of space for passengers’ baggage. A description of applicable technology is provided, giving attention to aerodynamics and structures, propulsion, power transfer methodology, flight control, avionic systems, human factors, and vehicle configurations. One of the most difficult challenges in trying to bring research to bear on operator problems is that in general researchers are working on long-term solutions while operators are seeking short-term answers. Attention is also given to potential technological bright spots, higher risk technologies, highest technological risks, and advanced vehicle configurations.

G. R.


Measurements of the drag and of the nacelle internal pressures on a wing and nacelle that housed a horizontally opposed piston engine were made in the 50- by 80-Foot Wind Tunnel at Ames Research Center. These tests are follow-ons to earlier tests made with the same wing and nacelle but in which the engine was replaced with an electric motor and an adjustable orifice plate. In the initial tests the orifice plate was used to control the rate of cooling-air flow through the nacelle and thereby to simulate a range of gasoline engine types. Good agreement was found between the results of those tests and of the test reported here. Also, the upper and lower plenum pressure and cooling-air flow rate were found to be related by conventional equations used to represent the flow through orifices. Tests were run with three cooling air inlet sizes over a free-stream velocity range from 50 to 150 knots, an angle of attack range from 0 deg to 10 deg, and a cowl-flap deflection range from 0 deg to 30 deg. The data were analyzed by computing a flow coefficient similar to that used in the analysis of orifices. It was found that all of the flow coefficient values fell within a band that varied linearly with inlet area. The linear mean line through this band provides an estimate of the relationship between cooling-air flow rate and upper plenum pressure over a wide range of test conditions.

Author


A nonsteady vortex-lattice method is introduced for predicting the dynamic stability derivatives of a delta wing undergoing an oscillatory motion. The analysis is applied to several types of small oscillations in pitch. The angle of attack varied between +1 and -1 deg, with the mean held at 0 deg when the flow was assumed to be attached and between +1 and -1 deg and the mean held at 15 deg when both leading-edge separation and wake roll-up were included. The computed results for damping in pitch are compared with several other methods and with experiments, and are found to be consistent and in good agreement.

Author


The development needed for the evolution of selected V/STOL research vehicles into optimized antisubmarine warfare (ASW) aircraft configurations, using numerical procedures and traditional analytical methods, has been examined. Three propulsion systems, which represent state-of-the-art development aimed at solving the thrust-vectoring and attitude-control problems of V/STOL aircraft, are analyzed. The use of NASA computer programs for aircraft synthesis (ACSYNT), and for optimizing configurations (COMMINS), coupled with contractor-supplied propulsion system data provides for accurate performance prediction of the selected ASW configurations. Particular emphasis on the transition phase between the research vehicle and the optimized configuration demonstrates the strengths and weaknesses of using generic research aircraft instead of building prototypes to demonstrate new technology.

Author


The rotor studied in the wind tunnel had previously been flight tested on a BO-105 helicopter. The investigation was conducted to determine the rotor’s aeroelastic stability characteristics in hover and at airspeeds up to 143 knots. These characteristics are compared with those obtained from whirl-tower and flight tests and predictions from a digital computer simulation. It was found that the rotor was stable for all conditions tested. At constant tip speed, shaft angle, and airspeed, stability increases with blade collective pitch setting.
No significant change in system damping occurred that was attribut-
able to frequency coalescence between the rotor inplane regressing
mode and the support modes. Stability levels determined in the wind
tunnel were of the same magnitude and yielded the same trends as
data obtained from whirl-tower and flight tests.  
G.R.

HELIOPTER SYSTEMS OFFICE

NASA CONTRACTOR REPORTS

N81-10019*# Human Resources Research Organization,
Alexandria, Va  
CIVIL HELICOPTER WIRE STRIKE ASSESSMENT STUDY.
VOLUME 2: ACCIDENT ANALYSIS BRIEFS Final Report
Clyde H. Tuomela and Mark F. Brennan Oct. 1980 221 p
(Contract NAS2-10509)

SIMULATION SCIENCES DIVISION

NASA CONTRACTOR REPORTS

N81-23095*# Gjerding (B. K.) Simulation Electronics, Seattle,
Wash.
USER'S MANUAL FOR FLIGHT SIMULATOR DISPLAY
SYSTEM (FSDS)
Connie C. Egerdahl 18 Nov. 1979 14 p
(Contract NAS2-9434)
(NASA-CR-164295) Avail: NTIS HC A02/MF A01 CSCL

V/STOL AIRCRAFT TECHNOLOGY DIVISION

NASA CONTRACTOR REPORTS

X81-10214*# Textron Bell Helicopter, Fort Worth, Tex.
DEVELOPMENT SPECIFICATION FOR A TILT ROTOR
AIRCRAFT COMPOSITE BLADE. TILT ROTOR RESEARCH
AIRCRAFT
Oct. 1979 44 p
(Contract NAS2-10289)
NOTICE: Available to U.S. Government Agencies and Their
Contractors.

A preliminary design study of advanced composite rotor blades
for the XV-15 Tilt Rotor Research Aircraft was conducted. A
trade-off analysis was performed to select the design concept
that best satisfied the following objectives: (1) improve reliability,
productivity, and maintainability; (2) minimize manufacturing cost;
(3) achieve a fatigue life of at least 3600 hours; (4) increase
hover-maneuver thrust capability; and (5) provide redundant blade
retention capability. The elected design concept retains the XV-15
hub and rotor controls and is structurally and dynamically
compatible with the transmission, wing, and airframe of the
XV-15.
S.F.

X81-10218*# Bell Helicopter Co., Fort Worth, Tex.
INSPECTION, MAINTENANCE AND REPAIR OF THE
COMPOSITE XV-15 ROTOR BLADE: TILT ROTOR
RESEARCH AIRCRAFT
Oct. 1979 81 p refs
(Contract NAS2-10289)
NOTICE: Available to U.S. Government Agencies and Their
Contractors.

The XV-15 tilt rotor aircraft composite rotor blade manufacturing
processes and procedures for the fabrication, inspection, maintenance,
and repair requirements are discussed. Product assurance functions,
design and tooling review, material qualification and control, and inspection requirements during blade
manufacturing are presented. The destructive and nondestructive
test requirements for the blade are defined and are used to verify the component location and the strength of the various structural elements of the blade. Inspection and maintenance, field operations, blade repair criteria, field repairs, and major repairs and overhaul of the blade at the manufacturer's facilities are presented. A breakwire system is considered applicable. Inspection requirements for major repairs, blade overhaul, blade strikes, sudden rotor stoppage, and foreign object damage are outlined. The blade overhaul possibilities at the manufacturer's facilities are outlined with a brief discussion of each procedure.

E.A.K.

X81-10217*§ Bell Helicopter Co., Fort Worth, Tex.
PROGRAM PLAN FOR DEVELOPMENT, FABRICATION, AND QUALIFICATION OF COMPOSITE BLADES FOR THE XV-15 Final Report
Oct. 1979 79 p (Contract NAS2-10289)


Requirements for the development, fabrication, and qualification of composite rotor blades for the XV-15 aircraft are reported. Increased hover maneuver thrust capability and fatigue life is provided at the minimum manufacturing cost for small lot production with improved reliability and maintainability.

S.F.

PRELIMINARY FLIGHT TEST PLANNING FOR XV-15 TILT ROTOR AIRCRAFT Final Report
Aug. 1979 113 p refs (Contract NAS2-8799)
(NASA-CR-152392) Unclassified report


The flight test plan was considered from the viewpoint of flying qualities determination and recommendations made to improve the effectiveness of the tests. Preliminary parameter identification efforts show good results with simple control pulse inputs. The design of optimal control inputs was considered and recommendations are made of implementable, near-optimal inputs for flight test operations.

T.M.

(NASA-CR-152127; Near-TR-159) Avail: NTIS HC A05/MF A01 CSCL 01A

Analytical methods are developed to predict the pressure distribution and overall loads on the hulls of airships which have close coupled, relatively large and/or high disk loading propulsors for attitude control, station keeping, and partial support of total weight as well as provision of thrust in cruise. The methods comprise a surface-singularity, potential-flow model for the hull and lifting surfaces (such as tails) and a rotor model which calculates the velocity induced by the rotor and its wake at points adjacent to the wake. Use of these two models provides an inviscid pressure distribution on the hull with rotor interference. A boundary layer separation prediction method is used to locate separation on the hull, and a wake pressure is imposed on the separated region for purposes of calculating hull loads. Results of calculations are shown to illustrate various cases of rotor-hull interference and comparisons with small scale data are made to evaluate the method.

M.G.
The gross characteristics of an aircraft under study are specified to the subroutines SIZE. The principal quantities specified are both geometric (lengths and areas) and operational (altitude and Mach number). The sequence of computations carried out by SIZE is controlled by the parameter NPC which is passed into SIZE by COMMON. When NPC=0, the computation is initialized. Subsequently, NPC is set to 2 and the program advances through the geometric computations. Geometry models for the fuselage, wing, empennage, cabin pressurization, and nacelle area are examined.


Aerodynamics calculations are treated in routines which concern moments as they vary with flight conditions and attitude. The subroutines discussed: (1) compute component equivalent flat plate and wetted areas and profile drag; (2) print and plot low and high speed drag polars; (3) determine lift coefficient or drag increment for various flap types and flap settings; and (4) determine required lift coefficient and drag coefficient in cruise flight.


Propulsion system performance is computed during engine sizing and whenever aircraft performance is computed. The propulsion model user's and programmer's manual is presented. Routines are provided for jet and propeller driven aircraft.


Subroutines for determining the weights of propulsion system related components and the airframe components of an aircraft configuration are presented. Subroutines that deal with design load conditions, aircraft balance, and tail sizing are included. Options for turbine and internal combustion engines are examined. A.R.H.


Subroutines that deal with determination of weights (including parts and operating costs). Subroutines that deal with determination of weights. Subroutines that deal with determination of weights are included. A.R.H.


The economic analysis includes: manufacturing costs; labor costs; parts costs; operating costs; markups and consumer price. A user's manual for a computer program to calculate the final consumer price is included. S.F.
Engine improvements appear most promising and combined with propeller, airfoil, surface coating and composite advanced technologies give a 21-25 percent DOC savings. A 17 percent higher acquisition cost is offset by a 34 percent savings in fuel used.

V/STOL PROJECTS OFFICE

NASA CONTRACTOR REPORTS

LARGE SCALE WIND TUNNEL INVESTIGATION FOR FUTURE MODIFICATIONS TO THE QUIET SHORT-HAUL RESEARCH AIRCRAFT Final Report
Donald N. Hultman Sep. 1980 128 p refs
(Contract NAS2-9186)
(NASA-CR-152349; D340-1-1-3) Unclassified report

Results are presented of an investigation to eliminate the leading-edge blowing system on the baseline quiet short-haul research aircraft (QSRA.) This was accomplished by repositioning the leading-edge flaps to a slotted position. Gap, overlap, and deflection angle variations were investigated. A configuration was established that satisfies QSRA performance and safety margin requirements.

T.M.

USB PROPULSIVE-LIFT AIRCRAFT DESIGN AND PERFORMANCE STUDY Interim Report
Stanley Youth Nov. 1980 137 p refs
(Contract NAS2-9081)
(NASA-CR-152387; D340-10108) Unclassified report


The operational characteristics and performance were evaluated for two types of airplanes configured to use quiet short-haul research aircraft upper surface blown power lift technology. These aircraft, the short field commercial transport, and medium sized business jet, were designed for short field operation at approximately 500 nmi range. The assessment of community noise was included as well as an economic analysis of short-haul transport.

R.C.T.

ANALYSIS OF CONTRACTOR'S TAXI AND FLIGHT TEST OF THE QSRA
Oct. 1980 253 p refs
(Contract NAS2-9081)
(NASA-CR-152322; D340-13805) Unclassified report

Taxi and flight testing of the quiet short-haul aircraft (QSRA) was conducted. The basic airworthiness of the airplane was verified including structural integrity and systems operation and evaluation. A preliminary evaluation was made of the airplane's capability to carry out the intended research missions. The QSRA was found to be airworthy and capable of carrying out its research vehicle role.

R.C.T.
Remote sensing users from the 14 western states explained their diverse applications of Landsat data, discussed operational goals, and exchanged problems and solutions. In addition, conference participants stressed the need for increased cooperation among state and local governments, private industry, and universities to aid NASA's objective of transferring to user agencies the ability to operationally use remote sensing technology for resource and environmental quality management. A.R.H.

Six forest cover categories were mapped, along with 10 general land cover classes. To map the state's 100 million acres, 1.6 acre mapping units were utilized. Map products were created. Standing forest acreage for the state was computed to be 26.8 million acres. T.M.

The potential use of isotopically excited energy dispersive X-ray fluorescence (XRF) spectrometry for automated on-line fast real-time (5 to 15 minutes) simultaneous multicomponent (up to 20) trace (1 to 10 parts per billion) analysis of inorganic pollutants in reclaimed water was examined. Three anionic elements (chromium 6, arsenic and selenium) were studied. The inherent lack of sensitivity of XRF spectrometry for these elements mandates use of a preconcentration technique and various methods were examined, including: several direct and indirect evaporation methods; ion exchange membranes; selective and nonselective precipitation; and complexation processes. It is shown that XRF spectrometry itself is well suited for automated on-line quality assurance, and can provide a nondestructive (and thus sample storage and repeat analysis capabilities) and particularly convenient analytical method. Further, the use of an isotopically excited energy dispersive unit (50 mCi Cd-109 source) coupled with a suitable preconcentration process can provide sufficient sensitivity to achieve the current mandated minimum levels of detection without the need for high power X-ray generating tubes. DOE

Meteorologists are interested in modeling the vertical flow of heat and moisture through the soil in order to better simulate the vertical and temporal variations of the atmospheric boundary layer. The one-dimensional planetary boundary layer model of is modified by the addition of transport equations to be solved by a finite difference technique to predict soil moisture. Author

The viability of mobile communications is examined within the context of a frequency division multiple access, single carrier satellite system emphasizing digital techniques to serve a large population of users. The intent is to provide the mobile users with a grade of service consistent with the requirements for remote, rural (perhaps emergency) voice communications, but which approaches toll quality speech. A traffic model is derived.
on which to base the determination of the required maximum number of satellite channels to provide the anticipated level of service. Various voice digitization and digital modulation schemes are reviewed along with a general link analysis of the mobile system. Demand assignment multiple access considerations and analysis tradeoffs are presented. Finally, a completed configuration is described.

M.G.

N81-19478* McDonnell-Douglas Astronautics Co., St. Louis, Mo.
OUTER PLANET PROBE ENGINEERING MODEL STRUCTURAL TESTS
J. A. Smittkamp, W. H. Gustin, and M. W. Griffin Sep. 1977
159 p refs
(Contract NAS2-8027)
NASA-CR-152038 Avail: NTIS HC A08/MF A01 CSCL 20K

A series of proof of concept structural tests was performed on an engineering model of the Outer Planets Atmospheric Entry Probe. The tests consisted of pyrotechnic shock, dynamic and static loadings. The tests partially verified the structural concept.

Author

N81-19792* TRW Defense and Space Systems Group, Redondo Beach, Calif.
STUDY OF ADAPTIVE METHODS FOR DATA COMPRESSION OF SCANNER DATA
Mar. 1977 153 p refs
(Contract NAS2-8394)
NASA-CR-152037: TRW-26566 Avail: NTIS HC A07/MF A01 CSCL 098

The performance of adaptive image compression techniques and the applicability of a variety of techniques to the various steps in the data dissemination process are examined in depth. It is concluded that the bandwidth of imagery generated by scanners can be reduced without introducing significant degradation such that the data can be transmitted over an S-band channel. This corresponds to a compression ratio equivalent to 1.84 bits per pixel. It is also shown that this can be achieved using at least two fairly simple techniques with weight-power requirements well within the constraints of the LANDSAT-D satellite. These are the adaptive 2D DPCM and adaptive hybrid techniques.

N81-20063* ECON, Inc., San Jose, Calif.
STUDY OF MATERIALS PERFORMANCE MODEL FOR AIRCRAFT INTERIORS Final Report
K. Leary and J. Skratt 31 Aug. 1980 86 p
(Contract NAS2-10515)
NASA-CR-152378 Avail: NTIS HC A05/MF A01 CSCL 01C

A demonstration version of an aircraft interior materials computer data library was developed and contains information on selected materials applicable to aircraft seats and wall panels, including materials for the following: panel face sheets, bond plies, honeycomb, foam, decorative film systems, seat cushions, adhesives, cushion reinforcements, fire blocking layers, slipcovers, decorative fabrics and thermoplastic parts. The information obtained for each material pertains to the material's performance in a fire scenario, selected material properties and several measures of processability.

T.M.

N81-23553* California Univ., Berkeley.
REMOTE SENSING OF WATER QUALITY IN RESERVOIRS AND LAKES IN SEMI-ARID CLIMATES Final Report
Harold M. Anderson and Alexander J. Horne Dec. 1975 143 p refs
(Contract NSG-2003)
NASA-CR-166178: SERL-75-1 Avail: NTIS HC A07/MF A01 CSCL 08H

Overlaid measurements using aerial cameras (remote sensing) combined with water quality collected from boats most economically provided wide-band photographs rather than precise spectra. With use of false color infrared film (400-950 nm), the reflected spectral signatures seen from hundreds to thousands of meters above the lake merged to produce various color tones. Such colors were easily and inexpensively obtained and could be recognized by lake management personnel without significant cost. The characteristic spectral signatures of various algal types were also recognizable in part by the color tone produced by remote sensing.

T.M.

N81-26483* Humboldt State Univ., Arcata, Calif. Dept. of Forestry.
THE APPLICATION OF LANDSAT REMOTE SENSING TECHNOLOGY TO NATURAL RESOURCES MANAGEMENT. SECTION 1: INTRODUCTION TO VICAR - IMAGE CLASSIFICATION MODULE. SECTION 2: FOREST RESOURCE ASSESSMENT OF HUMBOLDT COUNTY. Final Report, Apr. - Dec. 1980
Lawrence Fox, III, Principal Investigator and Kenneth E. Mayer Dec. 1980 39 p refs ERTS
(Grant NAG2-2341)
(E81-10120; NASA-CR-164114) Avail: NTIS HC A03/MF A01 CSCL 05B

A teaching module on image classification procedures using the VICAR computer software package was developed to optimize the training benefits for users of the VICAR programs. The field test of the module is discussed. An intensive forest land inventory strategy was developed for Humboldt County. The results indicate that LANDSAT data can be computer classified to yield site specific forest resource information with high accuracy (82%). The 'Douglas-fir > 80%' category was found to cover approximately 21% of the county and 'Mixed Conifer > 80%' covering about 13%. The 'Redwood > 80% resource category, which represented dense old growth trees as well as large second growth, comprised 4.0% of the total vegetation mosaic. Furthermore, the 'Brush' and 'Brush-Regeneration' categories were found to be a significant part of the vegetative community, with area estimates of 9.4 and 10.0%.

E.D.K.

N81-28419* Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
(Contract NCC2-79)
NASA-CR-164639 Avail: NTIS HC A02/MF A01 CSCL 148

The detectors were fabricated from a Ge:Ge wafer from Eagle-Pitcher with a room temperature resistivity of approx.

35
12 ohms cm. The wafer is approximately 2 inches in diameter and 0.061 inches thick. The contact material was ion implanted with Boron using 10 to the 14th power ions/sq cm at 25 kev and 2 x10 to the 14th power ions/sq cm at 50 kev. The crystal was then sputter-cleaned and metallized first with sputtered Ti and then sputter Au. In addition to the usual infrared measurements of responsivity and noise, measurements were made of the detectors' response to ionizing radiation. T.M.


The detection of emission from the v = 1 approaches 0 Si(1) quadrupole transition of H2 toward the cluster of intense infrared and H2O maser sources in W51 (north) is reported. The apparent luminosity of this line in W51 (north) is only about 4% of the luminosity of the same line toward the Kleinmann-Low infrared cluster in Orion; however, additional line-of-sight extinction and spatial extent of the source may account for the lower apparent power in W51. Similarity in the infrared and H2O properties of these clusters is addressed. The implications of the H2 emission for mass loss in the W51 region is discussed and some proposed models of radiation-driven mass outflow are briefly considered. M.G.


Data collected in an effort to produce a master crop calendar in map and tabular format for the High Plains Aquifer are presented. Contents include: a key to the counties in the High Plains Aquifer; USDA Economics and Statistic Service data for 1979; Agricultural Stabilization and Conservation Service data for 1979 and 1980; Cooperative Extension Service data for 1979 and 1980; recording methods from questionnaire; scatterplots portraying ASCS, Extension and ESS data; crop irrigation maps; and weekly summary based optimal LANDSAT dates. A bibliography is included. A.R.H.


The need to determine the volume of ground water being pumped from the High Plains region aquifer (HPRA) for irrigation can be met using a LANDSAT based remote sensing system. Crop calendar differences in such a large area (most of Nebraska, half of Kansas, the Texas and Oklahoma Panhandle areas, a portion of South Dakota, and the eastern parts of Wyoming, Colorado, and New Mexico) can introduce local influences on the interpretation of the algorithms employed. A method is described for determining the optimal dates for inventorying various crops grown on these irrigated lands in support of an effort to identify irrigated and develop a computer model for predicting aquifer response to changes in ground water development. A crop calendar for the crops grown in the HPRA is presented. A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


Further data on the polarization of the far-infrared (wavelength greater than 40 microns) emission from the Orion Nebula shows no evidence for polarized emission by aligned grains. Results at wavelength about 71-115 microns are consistent with a small (about 1.5%) absorption-induced polarization with about the same position angle on the sky as the polarization measured at shorter wavelengths. (Author)


Recent far-infrared photometric and near-infrared spectroscopic observations of IC 1848 A/WS East are reported. The source appears to be excited by a star of spectral type near B0, which can explain the far-infrared luminosity, 2 micron spectrum, radio continuum, and radio molecular observations. Although this star appears surrounded by a local very compact H II region, the density over a large scale is relatively low. This puts constraints on models for the formation of this star. (Author)


Experiments using ground-based measurements of canopy temperatures have shown that plant temperatures are good indicators of plant water stress, and thus are useful for assessing water requirements and predicting yields. An intensive 23-day airborne-ground-measurement program was conducted in Phoenix, Arizona in 1977 to compare airborne-acquired wheat canopy temperatures with simultaneous ground measurements. For canopies that covered at least 85 percent of the soil surface, airborne measurements differed from ground measurements of plant temperature by less than 2 C.

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Regardless of the amount of plant cover, the airborne measurements were virtually identical to ground-nadir measurements, and thus represent a combination of plant temperature and solid background temperature. (Author)


Observations of the 1969 Perseid and Orionid meteor showers are presented and used to derive luminosity functions for the 288 Perseids and 68 Orionids detected. Visual counts were performed under very good to excellent seeing conditions at the times of peak activities, and the brightnesses of the meteoroids were estimated to the nearest magnitude by comparison with the magnitudes of known objects. Maximum likelihood estimates of the power law index of the luminosity function of 1.56 + 0.06 for the Perseids and of 1.85 + 0.1 for the Orionids are obtained which are lower than the values found by other investigators. Under the assumption that the luminosity of visual meteors is proportional to their mass, the luminosity function power law may also be used to characterize the mass function. A.L.W.


Dunnigan Agro-Meteorological Experiment airborne thermal scanner images of a large varying-terrain barley field are acquired and analyzed. Temperature variability that may occur within instantaneous fields of view (IFOV) is defined (coefficient of variation: standard deviation/mean temperature in degrees C), and the percentage of the area within various IFOV's within + or - 1, 2, 3, and 5 degrees of the mean is determined. With the exception of very rugged terrain, over 80% of the area within 4, 16, 65 and 258 ha cells was at temperatures within + or - 3 C of the mean cell temperature. Remote measurements of field temperature appeared to be slightly influenced by pixel size in the range 4 ha to 258 ha, and the area percentage within any pixel which contributes within + or - 1, 2, 3, and 5 degrees C of the mean, is nominally the same. In conclusion, no great advantage is found in utilizing a small IFOV instead of a large one for remote sensing of crop temperature. D.L.G.

CONFERENCE AND MEETING PAPERS

N81-19041*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. A METHOD FOR DETERMINING LANDING RUNWAY LENGTH FOR A STOL AIRCRAFT D. M. Watson, G. H. Hardy, J. F. Moran, and D. N. Warner, Jr. In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Prob. Pt. 1 Mar. 1981 p 127-144 refs (For primary document see N81-19035 10-03) Avail: NTIS HC A17/MF A01 CSCL 01C Based on data obtained from flight tests of the augmentor wing jet STOL research aircraft, a method is proposed for determining the length of the landing runway for powered-lift STOL aircraft. The suggested method determines runway landing length by summing three segments: the touchdown-dispersion distance, the transition distance from touchdown to application of brakes, and the stopping distance after brakes are applied. It is shown how the landing field length can be reduced either through improved autoland system design or by providing the pilot with appropriate information to allow him to identify a 'low probability' long or short landing and to execute a go-around.


Crop stress measured using thermal infrared emission is evaluated with the stress-degree-day (SDD) concept. Throughout the season, the accumulation of SDD during the reproductive stage of growth is inversely related to yield. This relationship is shown for durum wheat, hard red winter wheat, barley, grain sorghum and soybeans. It is noted that SDD can be used to schedule irrigations for...
maximizing yields and for applying remotely sensed data to
management of water resources. An airborne flight with a thermal-IR
scanner was used to examine the variability in temperature that may
exist from one field to another and to determine realistic within-field
temperature variations. It was found that the airborne and the
ground-based data agreed very well and that there was less variability
in the fields that were completely covered with crops than those of
bare soil. L.S.

A81-37220 * Kuiper Airborne Observatory / Space Science
Platform 1/ C. M. Gillespie, Jr. (NASA, Ames Research Center,
Medium Altitude-Missions Branch, Moffett Field, Calif.). In: Shuttle
pointing of electro-optical experiments; Proceedings of the Seminar,
Los Angeles, Calif., February 10-13, 1981. (A81-37219 16-19)
Bellingham, Wash., Society of Photo-Optical Instrumentation Engi-

It is pointed out that jet transport aircraft operating in the
stratosphere (often at 45,000 ft) have proved highly cost-effective
and convenient as telescope platforms. The Kuiper Airborne Observa-
tory (KAO) 91-cm telescope is described, with attention given to
specifications, pointing and tracking, data handling, instrument
development, and costs. It is noted that the observatory makes
possible important astronomical research, graduate-level instruction,
and the development and testing of rugged, remotely controlled
instruments. Contributions made by the KAO to planetary astrono-
y, extragalactic astronomy, the interstellar medium, and to the
study of star formation and evolution are enumerated. C.R.

A81-45879 * Atmospheric correction of Nimbus-7 Coastal
Zone Color Scanner imagery, H. R. Gordon (Miami, University, Coral
Gables, FL), J. L. Mueller (NASA, Goddard Space Flight Center,
Laboratory for Atmospheric Sciences, Greenbelt, MD), and R. C.
Wingley (NASA, Ames Research Center, Moffett Field, CA). In:
Remote sensing of atmospheres and oceans; Proceedings of the
Interactive Workshop on Interpretation of Remotely Sensed Data,
refs. Contract No. NAS5-22963.

The Coastal Zone Color Scanner (CZCS) on Nimbus-7 is a
scanning radiometer designed to view the ocean in six spectral bands
(centered at 443, 520, 550, 670, 750, and 1,115 nm) for the
purpose of estimating surface chlorophyll and temperature
distributions. In the visible bands, the atmosphere obscures the

imagery to the extent that at 443 nm, at most, only 20 percent of
the observed radiance originates from beneath the sea surface.
Retrieving this subsurface radiance from the imagery is complicated
by the highly variable nature of the aerosol's contribution. In this
paper, an algorithm for the removal of these atmospheric effects
from CZCS imagery is described, a preliminary application of the
algorithm to an image with very strong horizontal variations in the
aerosol optical thickness is presented, and retrieval of the spatial
distribution of the aerosol optical thickness is discussed. (Author)

A81-46054 * Bulk processing techniques for very large areas-
Landat classification of California. W. Newland (Technicolor
Graphic Services, Inc., Moffett Field, CA), D. Peterson, and S.
Norman (NASA, Ames Research Center, Moffett Field, CA). In:
Machine processing of remotely sensed data and soil information
systems and remote sensing and soil survey; Proceedings of the Sixth
Annual Symposium, West Lafayette, IN, June 3-6, 1980. (A81-
46026 22-43) New York, Institute of Electrical and Electronics

In 1977, California Law AB452 was passed to provide a
mandate for the California Department of Forestry (CDF) to design
and implement an information system to assess the forest land base
for multiple uses and values. In connection with this mandate, a
land-cover map of the entire state, emphasizing forest types, was
produced. In producing this map, the latest techniques in digital
image mosaicking were combined with the highspeed processing
capability available on the ILLIAC IV parallel processor and other
computer systems at the Ames Research Center (ARC). An opera-
tional and very responsive analysis method was developed at ARC
that permitted on-time response to weekly workshops conducted
with CDF field personnel to identify all 1,200 spectral classes and to
produce final products. Over 100,000,000 acres were classified in the
period between December 1, 1978, and April 15, 1979. All analyses
were conducted using existing software. G.R.

A81-49764 * Technical aspects of forest inventory demon-
strations using Landat data - Projects in the Pacific Northwest
States. D. L. Peterson, G. Gnauk (NASA, Ames Research Center,
Moffett Field, CA), and D. Noah (ESL, Inc., Sunnyvale, CA). In:
Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May

CHEMICAL RESEARCH PROJECTS OFFICE

NASA CONTRACTOR REPORTS

X81-10140® Sieracin Corp. Sylmar, Calif.
STUDY OF IMPROVED ENVIRONMENTAL STABILITY OF
EPOXY TRANSPARENT MATERIALS.
S. M. Hunter Mar. 1978 54 p refs
(Contract NAS2-9445)
(NASA-CR-152090) Unclassified report
NOTICE: Available to U.S. Government Agencies and Their
Contractors.

Techniques for protecting the NASA/Ames developed epoxy
transparency EX-112 from environmental damage were studied.
An additive system comprised of the ultraviolet absorber Cyasorb
1988 and the antioxidant Goodrite 3125 was shown to afford
considerable protection to EX-112. A laminated configuration in
which the faceply was an acrylic containing an ultraviolet absorber
provided excellent protection to EX-112 with the added potential
of impact resistance and field maintenance. A.R.H.

FABRICATION AND PHYSICAL TESTING OF GRAPHITE
COMPOSITE PANELS UTILIZING WOVEN GRAPHITE
FABRIC WITH CURRENT AND ADVANCED STATE-OF-THE-
ART REIN SYSTEMS Final Report
Samuel C. S. Lee Jun. 1979 26 p refs
(Contract NAS2-9977)
(NASA-CR-152282) Avail: NTIS HC A03/MF A01 CSCL
110

Three weave were evaluated: a balanced plain weave, a
balanced B-harness satin weave, and a semiumidirectional crowfoot
satin weave. The current state-of-the-art resin system selected
was Fibelite's 934 Epoxy: the advanced resin systems evaluated
were Phenolic, Phenolic/Novolac, Benzyl and Bismaleimide.
The panels were fabricated for testing on NASA/Ames Research Center's Composites Modification Program. Room temperature mechanical tests only were performed by Hitco; the results are presented. T.M.


Ten NASA Type A fire resistant aircraft interior panels were fabricated and tested to develop assembly techniques. These techniques were used in the construction of a full scale lavatory test structure for flame propagation testing. The Type A panel is of sandwich construction consisting of Nomex honeycomb filled with quinone dioxime foam, and bismaleimide/glass face sheets bonded to the core with polyimide film adhesive. The materials selected and the assembly techniques developed for the lavatory test structure were designed for obtaining maximum fire containment with minimum smoke and toxic emission. Author


The dynamic surface ignition characteristics of aircraft fuels and hydraulic fluids were investigated on heated stainless steel and titanium surfaces. Local air flow (0.8 to 50 meters per second) (0.4 to 152.4 ft/sec) effects were measured. Aircraft fuels evaluated on titanium surfaces ignited (25 to 75 C) (77 to 167 F) lower (600 to 600 C) (932 to 1112 F) than values required to ignite the fuels on a heated stainless steel surface. Higher local surface air speeds necessitated higher surface temperatures for ignition of an applied fluid. The same trends were noted for hydraulic fluids sprayed on the heated surfaces.

GRA


Selected flammability characteristics of glass cloth laminates of thermosetting resins are evaluated. A protocol for the evaluation of the flammability hazards presented by glass cloth laminates of thermosetting resins and the usefulness of that protocol with two laminates are presented. The glass laminates of an epoxy resin, M-751 are evaluated for: (1) determination of smoke generation from the laminates; (2) analysis of products of oxidative degradation of the laminates; (3) determination of minimum oxygen necessary to maintain flaming oxidation; (4) evaluation of toxicological hazards. S.F.


The synthesis of high performance elastomers with the high thermal stability and chemical inertness of perfluoroalkytriene triazine and a low glass transition temperature is discussed. Perfluoroether triazine elastomers were proposed as potentially superior. It is concluded that the difficulties experienced in fluoroalkytriazine elastomer synthesis can be overcome by a four-step reaction process involving chain extension, triazine ring closure, crosslinking, and elastomer curing. Molecular weight can be controlled in the initial polymer formation so that elastomer modulus can be determined. The final product elastomers exhibit a useful elastomeric range of approximately 45 to 325 C with an oxidative stability superior to either broad range elastomers.

M.G.


The Phase 3 study of the NASA 'Improved Fire Resistant Aircraft Seat Materials' involved fire tests of improved materials in multilayered combinations representative of cushion configurations. Tests were conducted to determine their thermal, smoke, and fire resistance characteristics. Additionally, a Design Guideline for Fire Resistant Passenger Seats was written outlining general seat design considerations. Finally, a three-abreast 'Tourist Class' passenger seat assembly fabricated from the most advanced fire-resistant materials was delivered. Author


Impact-survivable postcrash fire accidents were surveyed. The data base developed includes foreign and domestic accidents involving airlines and jet aircraft. The emphasis was placed on domestic accidents, airlines, and jet aircraft due principally to availability of information. Only transport category aircraft in commercial service designed under FAR Part 25 were considered. A matrix was prepared to show the relationships between the accident characteristics and the fire fatalities. Typical postcrash fire scenarios were identified. Safety concepts were developed for three engineering categories: cabin interiors - cabin subsystems: power plant - engines and fuel systems: and structural mechanics - primary and secondary structures. The parameters identified for concept evaluation are cost, effectiveness, and societal concerns. Three concepts were selected for design definition and cost and effectiveness analysis: improved fire-resistant seat materials; anti-misting kerosene; and additional cabin emergency exits. J.M.S.


Both materials possess a high degree of thermal stability, with total heat release values being essentially identical under...
The drag-reduction effectiveness of a number of high-polymer additives dissolved in aircraft fuel has been measured in a turbulent-flow rheometer. These solutions were further subjected to high elongational stress and breakup forces in a jet discharging in air. The jet was photographed using a high-resolution camera with special lighting. The object of the work was to study the possible spray-suppression ability of high-polymer additives to aircraft fuel and to correlate this with the drag-reducing properties of the additives. It was found, in fact, that the rheometer results indicate the most effective spray-suppressing additives. Using as a measure the minimum polymer concentration to give a maximum friction-reducing effect, the order of effectiveness of eight different polymer additives as spray-suppressing agents was predicted. These results may find application in the development of antimisting additives for aircraft fuel which may increase fire safety in case of crash or accident.

E.D.K.
A combustion toxicity test was developed to screen materials for aerospace applications. The system is called the radiant panel test facility. A description of the facility and some preliminary results from tests on a Navy 3501-6AS composite, a typical composite for fighter aircraft, are presented. E.D.K.

The fire extinguishing storage temperature requirements were examined for several commercially available dry chemicals. Particular emphasis was placed on the development of dry powder extinguishant that, when discharged into a jet engine fuel leak fire, would stick to the hot surfaces. Moreover, after putting out the initial fire, these extinguishants would act as antiglare catalysts, even when the fuel continued to leak onto the hot surface. R.C.T.

The value of resin/carbon fiber composites as lightweight structures for aircraft and other vehicle applications is dependent on many properties: environmental stability, strength, toughness, resistance to burning, smoke produced when burning, raw material costs, and complexity of processing. A number of woven carbon fiber and epoxy resin composites were made. The epoxy resin was commercially available tetracyclohexympyrene diamine. In addition, composites were made using epoxy resin modified with amine and carbonyl terminated butadiene acrylonitrile copolymer. Strength and toughness in flexure as well as oxygen index flammability and NBS smoke chamber tests of the composites are reported. E.D.K.

Croslinking elastomeric polytriazines are prepared by a 4 step procedure which consists of (1) forming a poly (imidoylamidine) by the reaction, under reflux conditions, of various mixtures of perfluorocyclofluorides with a range of perfluorified fluoroalcohols; (2) extending the linear polytriazine chain by further refluxing in anhydrous ammonia with certain perfluorinated alkyl or alkylether acid anhydrides or halides: (3) extending the linear polytriazine chain by further refluxing in anhydrous ammonia with certain perfluorinated alkyl or alkylether acid anhydrides or halides: (4) heating to cyclize the new imidoylamidine and thereby crosslinking at the iododifluoromethyl groups by elimination of iodine and formation of carbon-to-carbon bonds. Official Gazette of the U.S. Patent and Trademark Office
Stray radiation and the Infrared Astronomical telescop-ic rings forming groups such as nitrile or amidine or a mixture of such group with amidoxime, or (2) a mixture of the same monomer with RNC(NOH)NH2, with R in these formulas standing for a bivalent organic radical containing fluorine, hydrogen, or trifluoro-ethyl. In the monomer charge, the overall proportions of amidoxime groups to triazine ring-forming groups varies depending on the extent of crosslinking desired in the final polymer. The heat and chemical resistant elastomers disclosed can serve, for instance, as adhesives, caulking compounds, channel sealants, fuel tank liners. Official Gazette of the U.S. Patent and Trademark Office

IRAS TELESCOPE PROJECT OFFICE

CONFERENCE AND MEETING PAPERS


Stray light control is a major consideration in the design of infrared cryogenically cooled telescopes such as the Infrared Astronomical Satellite (IRAS). The basic design of the baffle system, and the placement, shape, and coating of the secondary support struts for the telescope subsystem are described. The intent of this paper is to highlight the stray light problems encountered while designing the system, and to illustrate how computer analysis can be a useful design aid. Scattering measurements of the primary mirror, and a full system level scatter measurement are presented. Comparisons of predicted performance with the measured results are also presented. (Author)

SPACE PROJECTS DIVISION

The Pioneer Program continues to achieve far beyond its original objectives because of the successful missions of Pioneers 10 and 11 which have been in space over 8 years and 7 years, respectively. An overview of the Pioneer Jupiter/Saturn mission is presented including the planning process; technical aspects of the spacecraft design and operation; and the scientific payloads and the experiments conducted during interplanetary flight and the flyby portion of the missions. Data obtained from the various experiments are analyzed. The imaging photopolarimeter is described and technical details of planetary images are examined. A.R.H.
SUPERFLUID HELIUM LEAK SEALANT STUDY
John W. Vorreiter Jan. 1981 19 p refs
(NASA-TM-81212: A-8233) Avail: NTIS HC A02/MF A01 CSCL 20D

The reference citations are grouped by experiment. Experiments include: the charged particle instrument experiment; the ultraviolet photometer experiment; imaging experiments; and magnetometer experiments. The asteroid detector experiment and the plasma analyzer experiment are also included. T.M.

SUPERFLUID HEUM LEAK SEALANT STUDY
John W. Vorreiter Jan. 1981 19 p refs
(NASA-TM-81212: A-8233) Avail: NTIS HC A02/MF A01 CSCL 20D

The reference citations are grouped by experiment. Experiments include: the charged particle instrument experiment; the ultraviolet photometer experiment; imaging experiments; and magnetometer experiments. The asteroid detector experiment and the plasma analyzer experiment are also included. T.M.

Surface Penetrators for Planetary Exploration: Science Rationale and Development Program
(NASA-TM-81251: A-8412) Avail: NTIS HC A03/MF A01 CSCL 03B

Work on penetrators for planetary exploration is summarized in particular, potential missions, including those to Mars, Mercury, the Galilean satellites, comets, and asteroids are described. A baseline penetrator design for the Mars mission is included as well as potential instruments and their status in development. Penetration tests in soft soil and basalt to study material eroded from the penetrator: changes in the structure, composition, and physical properties of the impacted soil: seismic coupling; and penetrator deflection caused by impacting rocks, are described. Results of subsystem studies and tests are given for design of entry decelerators, high-g components, thermal control, data acquisition, and umbilical cable deployment. M.G.

Hybrid Receiver Conceptual Design and Test Report
Stephen W. Klare and James J. Crawford 31 May 1978 85 p refs
(Contract NAS2-9707) Avail: NTIS HC A05/MF A01 CSCL 17B

The Hybrid Receiver described uses an acquisition and demodulation scheme tailored to the Jovian environment. The large Doppler offsets expected during initial acquisition led to development of the Hilbert Acquisition Aid, which provides for rapid acquisition for low signal to noise densities. S.F.

The stream function equation in conservation form is solved iteratively based on the artificial compressibility method. The density is not a unique function of the mass flux. In order to avoid the ambiguity near the sonic line, the density is updated in terms of the velocity, which is obtained through a simple integration of a first order equation step by step in the flow field. Iteration algorithms and finite difference approximations are discussed and numerical results of both conservative and nonconservative calculations are presented. E.D.K.

N81-27951* Arizona Univ., Tucson.
HIGH SENSITIVITY OPERATION OF DISCRETE SOLID STATE DETECTORS AT 4 K. Final Report

Techniques are described to allow operation of discrete, solid state detectors at 4 K with optimized JFET amplifiers. Three detector types cover the 0.6 to 4 mm spectral range with NEP approximately equal to 10 to the 16th power Hz (-1/2) for two of the types and potential improvement to this performance for the third. Lower NEP's are anticipated at longer infrared wavelengths. R.C.T.


Silicon: Gallium infrared detector assemblies were designed, fabricated, and tested using techniques representative of those employed for hybrid arrays to determine the suitability of this candidate technology for infrared astronomical detector array applications. Both the single channel assembly and the assembly using a 32 channel CMOS multiplexer are considered. The detector material was certified to have a boron background of less than 10 to the 13th power atoms/sq cm counter doped with phosphorus. The gallium concentration is 2 x 10 to the 16th power atoms/cu cm. A.R.H.


Stray light transmittance is analyzed. Mathematical models are evaluated. The results of scatter and diffraction are considered separately, and the combined transmittance values evaluated. For individual titles, see N81-29965 through N81-29968.


N81-31841: UCLA-ENG-8134) Avail. NTIS HC A03/MF A01 CSCL 20D

Continued studies are described in the area of vapor-liquid phase separator work with emphasis on permeabilities of porous sintered plugs (stainless steel, nominal pore size 2 micrometer). The temperature dependence of the permeability has been evaluated in classical fluid using He-4 gas at atmospheric pressure and in He-2 on the basis of a modified, thermosonic permeability of the normal fluid. Author

JOURNAL ARTICLES,
BOOKS AND CHAPTERS OF BOOKS


Various schemes of using adiabatic demagnetization to provide refrigeration in the 10-1000 mK range are discussed with particular reference to the requirements for use in space. The methods considered are complete demagnetization, isothermal demagnetization, moving magnet demagnetization, and continuous refrigeration. The requirements that are important for use in space are low mass, low power dissipation, high mechanical rigidity, modular design, and ease of use. (Author)


A refrigeration process is described which enables the production of a sub-gram-size point He-4 temperatures without the production of superfluid. The advantages of the process for zero gravity and low-noise refrigeration are described. The lowest temperature produced to date is 1.25 K. The process is also useful with other gases for refrigeration; the output temperature is selected by gas type. (Author)


Analytical and numerical models of plasma temperatures in the Venusian ionosphere are proposed. The magnitudes of plasma thermal parameters are calculated using thermal-structure data obtained by the Pioneer Venus Orbiter. The simple models are found to be in good agreement with the more detailed models of thermal balance. Daytime and nighttime temperature data along with corresponding temperature profiles are provided. L.S.


Two sensor systems for the direct detection of nonsolar planets from earth orbit are evaluated: (1) an apodized visual telescope (APOTS), and (2) a spinning infrared interferometer (IRIS). Their
from 4 to 13 microns and can be ascribed to optically thin graphite discussed quantitatively without the inclusion of HCN and C$_2$H$_2$. Since the band at 3.1 microns is known to be due to HCN and C$_2$H$_2$, the spectrum obtained at a temperature of 450 K. C.R. Witteborn, B. J. Taylor (NASA, Ames Research Center, Moffett Field, CA), and S. P. Willner (California, University. San Diego, CA). Astrophysical Journal, Part 1, vol. 246, June 1, 1981, p. 455-463. 56 refs.

The measured sensitivity and the apparent absence of anomalous effects make extrinsic silicon CIO arrays very promising for space-based astronomical observations. Optimum performance is obtained at a temperature of 11 K. The sensitivity is found to show no statistically significant differences. Based on observations made during orbit 345, an upper limit of 30 flashes/yr has been derived for the average lightning frequency on the dark side of Venus. This value assumes that the amplitude distribution of lightning and the attenuation of the optical pulse by clouds on Venus are not substantially different from that occurring on earth. (Author)


Complete 0.75-13 micron spectrometry, of a carbon-rich, Mira-class variable star is presented for the first time. It is noted that although the near-infrared is dominated by photospheric absorption bands of the CN red system, the infrared becomes progressively dominated by the bands of the polyatomic molecules HCN and C$_2$H$_2$. Since the band at 3.1 microns is known to be due to HCN and C$_2$H$_2$, it is possible to associate bands at 1.04, 1.53, 1.85, 2.5, 2.7, 3.56, 3.85, 4.8, and 7.1 microns with HCN and C$_2$H$_2$. The spectrum provides the necessary stabilization and pointing control. The charge coupled device fine guidance sensor tracks multiple stars simultaneously and, through the use of multistar processing algorithms in a high performance microcomputer, generates three-axis attitude errors and gyro-drift estimates to correct the pointing-mound gyro. A high-bandwidth feedforward loop, driven directly from the pointing-mound gyro package, controls the steering mirror in order to correct disturbances not compensated for by the pointing-mound control system. A prototype design for the SIRTF pointing and control system is described in detail. Performance analyses made using a high performance computer develop a control system. (Author)

The Large-Aperture Telescope (LAT), which will have a diameter of 10-30 m and will operate in the 2-1000 micron wavelength range, is described. It is noted that the LAT could be carried into orbit with a single launch of the Space Transportation System and semiautomatically deployed as a free flyer with a nominal 10-yr mission duration. Servicing and instrument changes would be made at 2-yr intervals. It is pointed out that the LAT would have to be placed above the earth's atmosphere to avoid both the absorption that occurs through much of the infrared and submillimeter and the turbulence which limits spatial resolution. Important technical considerations for the LAT are discussed; they include the telescope optical form, the primary mirror material, figure control techniques, the deployment techniques, and thermal control. The science objectives and rationale for the LAT are discussed and various hardware techniques and concepts for its implementation are described.

C.R.


Room temperature alignment and evaluation techniques for the Infrared Astronomical Satellite (IRAS) telescope, which has a primary mirror figured to correct for surface distortions and the 2 K operating temperature are discussed. Interferometric cryogenic testing of the 0.6 m; f/1.5 lightweighted beryllium primary mirror at its intended operating temperature reveals surface distortions that can be modeled with Zernike polynomials. With this model, it becomes possible to derive the 'inverse' of the cryowavefront error (ideal cryo mirror) and to figure the cryo correction into the primary mirror using Perkin-Elmer’s Computer Controlled Polisher. It is recognized that during room temperature assembly of the system, misalignment of the secondary mirror can introduce additional unwanted aberrations that may cancel or distort the wavefront errors purposely introduced by the cryo figuring. To avoid this possible degradation and to ensure optimum telescope performance, the system Zernike polynomial coefficients and wavefront maps generated from the in-process alignment interferograms are monitored and compared to Zernike coefficients and wavefront maps for the cryo corrected primary mirror.

C.R.

NASA FORMAL REPORTS

N81-17822‡ National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TWO-DIMENSIONAL MODEL STUDIES OF THE EFFECT OF SUPERSONIC AIRCRAFT OPERATIONS ON THE STRATOSPHERIC OZONE CONTENT


(NASA-RP-1064; A-8270) Avail: NTIS HC A04/MF A01 CSCL 13B

A method for the estimation of cross-bispectra of discrete real time series is developed. The asymptotic variance properties of the bispectrum are reviewed, and a method for the direct estimation of bispectral variance is given. The symmetry properties are described which minimize the computations necessary to obtain a complete estimate of the cross-bispectrum in the right-half-plane. A procedure is given for computing the cross-bispectrum by subdividing the domain into rectangular averaging regions which help reduce the variance of the estimates and allow easy application of the symmetry relationships to minimize the computational effort. As an example of the procedure, the cross-bispectrum of a numerically generated, exponentially distributed time series is computed and compared with theory.

T.M.

NASA CONTRACTOR REPORTS

N81-22794‡ California Univ., San Diego. Dept. of Applied Mechanics and Engineering Sciences

CROSS-BISPECTRUM COMPUTATION AND VARIANCE ESTIMATION

K. S. Li (California Univ., Riverside) and K. N. Helland (1981) 17 p refs (Grant NsG-2376)

(NASA-CR-164219) Avail: NTIS HC A02/MF A01 CSCL 12A

A method for the estimation of cross-bispectra of discrete real time series is developed. The asymptotic variance properties of the bispectrum are reviewed, and a method for the direct estimation of bispectral variance is given. The symmetry properties are described which minimize the computations necessary to obtain a complete estimate of the cross-bispectrum in the right-half-plane. A procedure is given for computing the cross-bispectrum by subdividing the domain into rectangular averaging regions which help reduce the variance of the estimates and allow easy application of the symmetry relationships to minimize the computational effort. As an example of the procedure, the cross-bispectrum of a numerically generated, exponentially distributed time series is computed and compared with theory.

Author

N81-22822‡ California Univ., San Diego. La Jolla. Dept. of Mathematics


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A Curtis matrix is used to compute cooling by the 15 micron and 10 micron bands of carbon dioxide. Escape of radiation to space and exchange the lower boundary are used for the 9.6 micron band of ozone. Voigt line shape, vibrational relaxation, line overlap, and the temperature dependence of line strength distributions and transmission functions are incorporated into the Curtis matrices. The distributions of the atmospheric constituents included in the algorithm, and the method used to compute the Curtis matrices are discussed as well as cooling or heating by the 9.6 micron band of ozone. The FORTRAN programs and subroutines that were developed are described and listed. A.R.H.

K. S. Li, K. N. Hailand (California Univ., Riverside), and M. Rosenblatt 30 Oct. 1980 69 p refs (Grant NAG-2376) (NASA-CR-164217) Avail: NTIS HC A04/MF A01 CSCL 12A

To obtain an estimate of the spectral transfer function that indicates the rate of decay of energy, an x-wire probe was set at a fixed position, and two single wire probes were set at a number of locations in the same plane perpendicular to the mean flow in the wind tunnel. The locations of the single wire probes are determined by pseudo-random numbers (Monte Carlo). Second order spectra and cross spectra are estimated. The assumption of isotropy relative to second order spectra is examined. Third order spectra are also estimated corresponding to the positions specified. A Monte Carlo Fourier transformation of the downstream bispectra corresponding to integration across the plane perpendicular to the flow is carried out assuming isotropy. Further integration is carried out over spherical energy shells.

E.A.K.

N81-23174∗# Kansas Univ., Lawrence.

Models of both the small and large Pioneer Venus probes were dropped from a helicopter to simulate the conditions of Mach and Reynolds numbers to be encountered by the probes upon entry into the Venus atmosphere. The models were dropped at an average Mach number of .10 and at an average Reynolds number of 2.84 million for the small probe and 2.90 million for the large probe. After the large amplitude launching oscillations were damped, the small probe oscillations in angle of attack and in sideslip were generally less than 2 degrees. The large probe oscillations were generally less than 10 degrees. Both exhibited distinct frequencies. The motion of the small probe in a plane perpendicular to the z axis was random while the large probe rotated (corkscrewed) at 1.1 cycles per second about the z axis. The average drag coefficients of the probe models were .714 for the small probe and .663 for the large probe.

M.G.

N81-27462∗# Lockheed Missiles and Space Co., Palo Alto, Calif.

The development of a commercially available two dimensional photon counter into an operational system for speckle imaging of astronomical objects is described. The system includes digital recording for field observations. The counter has a bialkali photomultiplier with a field size of 18 by 18 mm over which it resolves about 100 by 100 pixels. The system records photon positions as 16 bit words at rates up to 14.400 per second. Field tests at observatories verifying the operation of the system are described.

J.D.H.

N81-28839∗# Washington Univ, Seattle. Dept. of Atmospheric Sciences.

The photochemistry of the stratosphere of Venus was modeled using an updated and expanded chemical scheme, and the results of recent laboratory studies. The model satisfactorily accounts for the observations of CO, O2, (1) and SO2 in the stratosphere. Oxygen, derived from CO2 photolysis, is primarily consumed by CO2 recombination and oxidation of SO2 to H2SO4. Photolysis of HCl in the upper stratosphere provides a major source of odd hydrogen radicals essential for the catalytic oxidation of CO. Oxidation of SO2 by O occurs in the lower stratosphere, with the O-O bond broken by S + O2 and SO + HO2. The sensitivity of stratospheric chemistry to ambient H2 abundance was studied and the model prefers the high value (1 10 ppm) recently inferred from the Pioneer Venus ionospheric measurements. The importance of the photochemical production of S2O, (SO2, S2H2SO2 and H2S2O3 is speculated. A number of previously unsuspected similarities between the chemistry of the stratospheres of Venus and the Earth, presented and discussed.

A.R.H.


Fifteen lidar observations of the stratospheric aerosol were made between February and November 1975. All observations revealed the greatly increased particulate backscattering that followed the eruption of the volcano Fuego in October 1974. Vertical structure consisted initially of multiple layers, which later merged to form a single, broader peak. Essentially all of the increased scattering was confined to altitudes below 20 km. Hence, aerosol layer centroids in 1975 were typically several km below their altitude prior to the eruption. Radiative and thermal consequences of the measured post-Fuego layer were computed using several recently published models. The models predict a temperature increase of several K at the altitude of the layer, caused by the infrared absorption bands of the sulfuric acid particles. The surface temperature decrease predicted by the models is considerably smaller than 1 K, partly because of the small optical thickness of the volcanic layer, and partly because of its short residence time relative to the earth-ocean thermal response time. Author

N81-32748∗# Desert Research Inst., Reno, Nev.
When Mt. St. Helens produced several major eruptions in the late spring of 1980, there was a strong interest in the characterization of the cloud condensation nuclei (CCN) activity of the material that was injected into the troposphere and stratosphere. The scientific value of CCN measurements is two fold: CCN counts may be directly applied to calculations of the interaction of the aerosol (enlargement) at atmospherically-realistic relative humidities or supersaturations; and if the chemical constituency of the aerosol can be assumed, the number-versus-critical supersaturation spectrum may be converted into a dry aerosol size spectrum covering a size region not readily measured by other methods. The sampling method is described along with the instrumentation used in the experiments. 

T.M.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


Titan's geometric albedo varied noticeably from 1972 to 1978, in phase with variations in solar activity (Lockwood and Thompson, 1979). A series of radiative transfer and aerosol formation calculations were made to demonstrate the feasibility of the following scenario for these secular brightness changes. Solar activity changes, especially in the UV output of the sun, result in alterations to the mass production rate of aerosols in Titan's atmosphere, which lead to modifications of their microphysical properties. The latter, in turn, cause the albedo to vary. Current estimates of the change in the solar UV radiation below the dissociation limit of methane imply alterations to the mean radius of the aerosols over an 11 yr solar cycle that are consistent in sign and magnitude with those required to explain the observed secular brightness changes. (Author)


The spectra of carbon stars have been synthesized from the models of Querci, Querci, and Tsuji and Querci and Querci in the region of the 1-0 (5/1) vibration-rotation quadrupole line of H2. The line is shown to be sufficiently strong to be seen against the numerous lines of the CN red system for models with effective temperatures less than about 2700 K. The usefulness of the line as a probe of the outer atmospheric layers of carbon stars is discussed. (Author)


Observations of infrared fine-structure line emission from compact clouds of ionized gas within Sgr A West are presented. These clouds have diameters of 0.1-0.5 pc, internal velocity dispersions of 100 km/s (FWHM), and line center velocities up to + or - 260 km/s. Their masses are not accurately determined but are probably between 0.1 and 10 solar masses. They are ionized by radiation like that of stars of effective temperature not greater than 35,000 K. The clouds are shown to have lifetimes of 10,000 yr and so must be generated and dissipated at a rate of a few per 1000 yr. From analysis of the distribution of the velocities of the clouds, a most probable mass distribution is derived which includes a central pointlike mass of several x 10 to the 6th solar masses in addition to several x 10 to the 6th solar masses of stars within 1 pc of the center. (Author)


The postshock destruction of molecules is examined, including the processes of (1) collisions with neutral hydrogen atoms and molecules, (2) electronic collisions, and (3) neutral chemical reactions with atoms, particularly atomic hydrogen. By using conservative estimates of collisional dissociation rates from individual vibrational states, it is found that process (1) leads to the destruction of molecular hydrogen behind shocks with speeds equal to or greater than 25 km/s if the preshock molecular gas has hydrogen nucleus densities of equal to or greater than 10 to the 10th cm at. At lower densities (100 per cu cm), destruction occurs for shock speeds equal to or greater than 50 km/s and process (2) dominates. Dissociation of molecules such as CO, H2O, and O2 follows the destruction of H2, as the resultant hydrogen atoms chemically dissociate the metal atoms from their bonds (process 3) in the hot postshock gas. These results demonstrate that many of the observed high-speed interstellar molecules, if shock accelerated, must have dissociated and reformed in the postshock gas. (Author)


Although the dayside ionosphere of Venus is often field-free except for fine-scale features, large-scale steady ionospheric magnetic fields with magnitudes sometimes exceeding 100 gammas are occasionally observed by the Pioneer Venus Orbiter magnetometer. These fields are mainly horizontal and can assume any angle in the horizontal plane. The orientation of the field may change along the spacecraft trajectory. The field magnitude in the upper ionosphere usually shows a distinct minimum near approximately 200 km altitude, but the altitude profile is otherwise arbitrary. With few exceptions, the observations of these large scale fields occur when periaxis is at solar zenith angles less than 50 deg. The occurrence of large-scale fields is often coincident with the observation of high solar wind dynamic pressures by the Pioneer Venus Orbiter plasma analyzer closely following the ionosphere encounter. However, the detection of this phenomenon even during some orbits for which the dynamic pressure is not extraordinarily high suggests that other factors, such as hysteresis effects, must also play a role in determining the occurrence frequency of large-scale magnetic fields in the dayside Venus ionosphere. (Author)

A81-14425 * Reactivity of stratospheric aerosols to small amounts of ammonia in the laboratory environment. D. Hayes (LFE Environmental Laboratories, Richmond, Calif.), K. Snetsinger, G. Ferry, V. Oberbeck, and N. Farlow (NASA, Ames Research Center,
Trace ammonia in laboratory air reacts easily with sulfuric acid aerosol samples to form crystalline ammonium sulfate. Argon atmospheres, however, protect sampling surfaces from ammonia contamination. It is found that atmospheric aerosols treated in this way contain only sulfuric acid. After an hour exposed to laboratory air, these same samples convert to ammonium sulfate. Aerosol particles have been collected, using argon control, to determine if the absence of crystalline sulfate is common. But so far there is no evidence that aerosols are neutralized by ammonia in the stratosphere. (Author)


The possibility that tidal dissipation in a thin ice crust was sufficient to preserve liquid water on Jupiter's satellite Europa was suggested by Cassen et al. (1979). However, their calculation of the tidal heating rate for that situation is in error; for the same parameter values, the actual heating rate would be much less than given in their paper. Thus, their conclusion regarding the possibility that liquid water exists today on Europa is considerably weakened. This paper corrects the calculation of the tidal dissipation rate in an Euopian ice crust, and discusses the implications for Europa's thermal history, and clarifies certain aspects of the tidal heating problem. (Author)


The paper deals with the Pioneer 11 vector helium magnetometer observations of Saturn's planetary magnetic field, magnetosphere, magnetopause, and bow shock. Models based on spherical harmonic analyses of measurements inside 8 Saturn radii show that the planetary field has a high degree of symmetry about the rotation axis. The vector dipole moment has a tilt angle of less than 1 deg and is offset along the polar axis by 0.04 plus or minus 0.02 Saturn radius. Equatorial offsets derived from the models show pronounced variability and could be consistent with a very small offset. Large impulsive field compressions are observed in the magnetosheath near noon. Multiple crossings of the bow shock are observed, and the absence of significant changes in field direction indicates that it is quasi-perpendicular. V.P.


The southern H II region G333.6-0.2, which has a total luminosity of 3.3 million solar luminosities (for an assumed distance of 1 kpc) was mapped at 2.2, 10, 30, 50, and 100 micrometers. At all wavelengths, the surface brightness of the infrared radiation is unusually high and the structure of the source is compact and symmetrical. The present observations, along with previous data, suggest that G333.6-0.2 is excited by a single luminous object or a very compact cluster, which has formed on the front surface of a dense molecular cloud as seen from the earth. It is shown that the spectral and spatial characteristics of the infrared radiation can be understood in terms of this bluster model. B.J.


Optical scanner spectra are presented for ten positions in the lobes of GL 2688. Color gradients exist across the nebulae, probably due to systematic variations in the sizes of typical scattering grains. Molecular emissions C2, C3, and SiC2 are found, similar to the spectra of comets. Resonance fluorescence seems to be indicated. (Author)


The electromagnetic heating of the Io interior is considered as an alternative to tidal dissipation to account for the observed volcanic activity. The characteristics of the time-varying magnetic
field of Jupiter as seen from Io are discussed, and the range of possible rock conductivities is examined. Interior heating due to the transverse electric and transverse magnetic modes is calculated. It is found that the TM mode appears to be insignificant as a heating source due to the high conductivity of the ionosphere, even when TM heating is concentrated in local hot regions. The TE mode is a more promising source of heating, although electromagnetic heating by either mode does not appear significant in comparison with other heat sources at present.

A.L.W.


The structure of interstellar shocks driven by supernova remnants and by expanding H II regions around early-type stars is discussed. Jump conditions, along with shock fronts, post-shock relaxation layers, collisional shocks, collisionless shocks, nonradiative shocks, radiative atomic shocks, and shock models of observed nebulas. Effects of shock waves on interstellar molecules are examined, with reference to the chemistry behind shock fronts, infrared and vibrational-rotational cooling by molecules, and observations and by expanding H II regions. Some current problems and applications of the study of interstellar shocks are summarized, including the initiation of star formation by radiative shock waves, interstellar masers, the stability of shocks, particle acceleration in shocks, and shocks in galactic nuclei.

F.G.M.


The assumption that observed mass outflow from a star is due to a magnetically driven wind implies an upper bound on the surface magnetic field strength from regions where the wind originates. Evidence is reported that corroborates Rosendhal's observation of an abrupt change in the velocity-gradient-luminosity relationship for B8 and later supergiants. The smallest upper bounds correspond to later spectral types, for which radiation would be a relatively inefficient mechanism for driving wind; these winds may in fact be magnetically driven. Be stars are prime candidates for magnetically accelerated winds due to large rotation rates and small mass loss rates. Observed flows can be driven by 0.1-10 gauß surface fields. Intense field in fast rotators can lead to dramatic mass loss rates and large terminal velocities; sigma Ori E may be such an object. Finally, the effect of magnetic acceleration on the dispersal of solar nebula is considered. The increased velocities allow the wind to disperse a mass of 90 times the initial outflowing mass in the wind. (Author)


A 2 x 3 arcmin region surrounding the W3 cluster of near-infrared sources and compact H II regions has been mapped at 30, 50, and 100 microns with an angular resolution of about 30 arcsec. The data have been used to produce maps of the distribution of luminosity, color temperature, and opacity in the far-infrared which are used to analyze the properties and evolutionary states of the individual compact sources in the cluster and of the molecular cloud in which they are embedded. The total luminosity of the near-infrared source W3-IRS 5 is estimated on the basis of these observations to be 200,000 solar luminosities, and it is identified as a forming O star. (Author)


A numerical hydrodynamics computer code analysis of the collapse and establishment of equilibrium of adiabatic gas clouds restricted to axial symmetry found that the clouds are originally uniform in density and rotation. The method can compare the dynamic collapse and approach to equilibrium with the data on incompressible uniformly rotating equilibrium clouds and on equilibrium structures of differentially rotating polytropes. It is concluded that the stellar formation theory indicates that the low alpha fragments produced at the termination of the dynamic isothermal collapse phase of interstellar clouds may undergo significant dynamic collapse in an adiabatic regime leading to transitory ring formation and additional fragmentation on a smaller scale. A.T.
Temporal variations of the ozone density profile in the Martian atmosphere at high latitudes are calculated for the course of a Martian year, taking into account seasonal and diurnal variations in temperature, water vapor and solar radiation. Calculations are based on a model including 35 neutral photochemical reactions, and vertical eddy diffusion using a time step of 12 min for the region from the surface to 240 km altitude. Results are found to be in better agreement with Mariner 9 observations of the time and magnitude of the seasonal maximum than previous model calculations. The diurnal variation is predicted to be small near the subsoljces, with the nighttime ozone density greater than the daytime and the magnitude of the difference dependent on season. Opposite temporal variations are predicted for ozone densities above and below about 25 km, and an ozone density maximum at 35-40 km is obtained. It is suggested that the effects of an aerosol layer may not be important in enhancing predicted ozone concentration, and may even decrease it.

A.L.W.


There is currently no unambiguous observational evidence for the existence of other planetary systems. One possible way to detect and study such systems is infrared observations of continuum blackbody radiation from planets revolving around other stars. It is shown that the effective temperature of large planets revolving around mid- to late-spectral-type main-sequence stars is set by the radiation field of the central star, making them easier to detect than had been previously thought. Consideration is given to the two major observational constraints on detecting planetary companions to nearby stars, namely, angular resolution and sensitivity. A comparison is made between the performance of an ambient (T 200 K), single-aperture telescope and a cooled interferometer. In each case the required aperture (baseline) is large (in the 10-m class), but consistent with Shuttle launch capability.

(Author)


Laboratory spectra have been obtained for HNO3 with a Michelson-type Fourier transform interferometer using absorption cells with path lengths of 10.3, 25.5, and 49.8 cm at temperatures of 240, 248, 283, and 294 K. The measurements lead to a total band intensity value of 642 plus or minus 5% per sq cm amagat, which is a temperature independent value after the gas density correction has been made. However, the temperature dependence of the spectral absorption coefficients is apparent in the 885 kaysr regime.

V.L.


This article deals with the author's decision to study star formation and reviews the early days of infrared astronomy at O'Brien Observatory. The infrared equipment used to observe the T Tauri variable class is described.

L.S.


Temporal variations of the ozone density profile in the Martian atmosphere at high latitudes are calculated for the course of a Martian year, taking into account seasonal and diurnal variations in temperature, water vapor and solar radiation. Calculations are based on a model including 35 neutral photochemical reactions, and vertical eddy diffusion using a time step of 12 min for the region from the surface to 240 km altitude. Results are found to be in better agreement with Mariner 9 observations of the time and magnitude of the seasonal maximum than previous model calculations. The diurnal variation is predicted to be small near the subsoljces, with the nighttime ozone density greater than the daytime and the magnitude of the difference dependent on season. Opposite temporal variations are predicted for ozone densities above and below about 25 km, and an ozone density maximum at 35-40 km is obtained. It is suggested that the effects of an aerosol layer may not be important in enhancing predicted ozone concentration, and may even decrease it.

(Author)

The plume of the major eruption of Mount St. Helens on May 18, 1980 penetrated 10 to 11 km into the stratosphere, attaining heights of 22 to 23 km. Wind shears rapidly converted the plume from an expanding vertical cone to a thin, slightly inclined lamina. The lamina was extruded zonally in the stratosphere as the lower part moved eastward at jet stream velocities, while the upper part slowly moved westward in the region of nonsteady transition from the westerlies to the summer stratospheric easterlies. Trajectories computed to position the NASA U-2 aircraft for sampling in the plume are described. Plume volume after 8 hours of strong volcanic emission is estimated at 2,000,000 cu km. Only about 1% of this volume is attributed to the volcano; the rest was entrained from the environment. (Author)


Measurements in the stratosphere of gaseous constituents in the plume of Mount St. Helens were obtained during five flights of the NASA U-2 aircraft between 15 May and 17 June 1980. Mixing ratios from gas chromatographic measurements on samples acquired about 24 hours after the initial eruption show considerable enhancement over nonvolcanic concentrations for sulfur dioxide (more than 1,000 times), methyl chloride (about 10 times), and carbon disulfide (more than 3 times). The mixing ratio of carbonyl sulfide was comparable to nonvolcanic mixing ratios although 3 days later it was enhanced two to three times. Ion chromatography measurements on water-soluble constituents are also reported. Very large concentrations of chloride, nitrate, and sulfate ions were measured, implying large mixing ratios for the water-soluble gaseous constituents from which the anions are derived. Measurements of radon-222 present in the plume are also reported. (Author)


Samples from the stratosphere obtained by U-2 aircraft after the first three major eruptions of Mount St. Helens contained large globules of liquid acid and ash. Because of their large size, these globules had disappeared from the lower stratosphere by late June 1980, leaving behind only smaller acid droplets. Particle size distributions and mineralogy of the stratospheric ash grains demonstrate inhomogeneity in the eruption clouds. (Author)


A theoretical fit has been made to laboratory measurements of the 1-0 collisionally induced H2 absorption band over a temperature range of 100-273 K and for densities up to 22 amagats. Both the Birnbaum-Cohen and the MacTaggart-Hunt line shape profiles were used. In addition, an intermolecular potential of either a Lennard-Jones 6-12 or a Morse-spline-van der Waals has been used for each line shape. The best fit resulted in a chi-square of 5%. Line widths have also been derived as a function of temperature. The lifetimes of the states were calculated. (Author)


A sampling and analysis technique that uses the binomial distribution to characterize stratospheric aerosol populations at the 95% level of confidence is described. Particle samples obtained over Alaska during July 15-19, 1979, are used; the results show the presence of more small particles at lower altitude than at high altitudes. Calculations of the surface area and volume distributions for all aerosol samples collected are given. Evidence from these data suggests that either Aitken nuclei are injected or diffused across the tropopause and rise into the stratosphere, where they mature into larger particles, or nuclei form in the lower stratosphere and become mature aerosols at high altitude. Samples obtained at another site give the same results, supporting the view that the process of injection or nucleation and maturing of aerosols with altitude may be global and not occur only in locations exhibiting unique meteorologic features. (Author)


Calculations of the distribution of stratospheric sulfur gases and of stratospheric aerosols are compared with measurements obtained in Alaska during July 1979. Generally, the measurements are reasonably consistent with the model results. COS is the major sulfur-bearing gas in the stratosphere while CS2 plays a lesser role in the formation of sulfate aerosols. Ammonia, which earlier measurements suggested was a major aerosol constituent, is found to be a contaminant, so models without ammonia chemistry may be justified. The model and the measurements suggest that stratospheric sulfuric acid aerosols nucleate just above the tropopause, but they are older and have grown to larger sizes at higher altitudes. (Author)


A series of Mie scattering calculations has been performed to determine the wavelength-dependent, single scattering properties of aerosols present in the stratosphere during July 1979. Additional radiative transfer computations were conducted to assess the impact of aerosols on the earth's radiation budget. For these purposes, an extensive set of measurements of aerosol characteristics that were obtained in Alaska from aircraft and satellite platforms was used. At that time, the optical depth was too small for aerosols to significantly impact earth's climate. But the optical depth of the stratospheric aerosol layer has been large enough during some volcanically perturbed periods for the aerosols to have caused a noticeable warming of the stratosphere and cooling of the troposphere. (Author)

A one-dimensional aerosol model is employed in investigating the sensitivity of the stratospheric distributions of gaseous sulfur compounds and sulfate aerosol particles to changes in OH and CS2 concentrations, in eddy diffusion coefficients, and in important chemical rate constants. By comparing model predictions with recent observational data for SO2, OCS, and particulates, it is found that, with regard to atmospheric sulfur, CS2 is only a secondary source of sulfur for the stratosphere relative to OCS and that background tropospheric CS2 concentrations by volume are likely to be less than 70 parts per trillion. It is also established that under stratospheric conditions the rate coefficients for the reactions of OH with OCS and CS2 may be substantially smaller than the room temperature laboratory values of Kurylo (1978).

C.R.


The major aspects of the Pioneer Venus orbiter and multiprobe missions are documented. Specific topics covered include a program history, the scientific payloads, spacecraft descriptions, launch and interplanetary cruise features, encounter features, nominal mission descriptions, instrument anomalies, and the orbiter extended mission. The key scientific questions addressed by the missions are listed.

L.S.


Collection of data from the Ames plasma analyzer on the Pioneer Venus orbiter has permitted long-term measurements of the interaction of the solar wind with Venus. The paper presents a mapping of the ionosheath flow field, plasma measurements in the distant ionosheath and near the distant plasma cavity, and a summary of observations of jumps in the solar wind proton parameters across Venus’ bow shock. Also, the apparent detection of ionospheric O+(+) accelerated up to solar wind speeds downstream in Venus’ ionosheath is discussed.

(Author)


The suprathermal electron energy distribution for the dayside ionosphere has been derived from data returned by the Pioneer-Venus orbiter retarding potential analyzer. The shape and magnitude of the spectrum are consistent with the assumption that solar EUV radiation is the only significant source. The magnitude of the spectrum and its variation with altitude suggest that significant vertical transport occurs, with the electrons being lost through the ionopause. In turn, significant vertical transport suggests that the effective vertical electron heat conductivity may be comparable to the field-free value. The heat input to the thermal electron gas from the measured suprathermal electron flux is too small by a factor of at least five to maintain the observed electron temperature profile if the electron thermal conductivity is assumed to be close to the field-free value. It is thus inferred that most of the heat is supplied by the solar wind.

(Author)

The measurements taken during the first year of the Pioneer Venus orbiter retarding potential analyzer indicate the changes of ion and electron temperatures with solar zenith angles. The ion density decreases by an order of magnitude from day side to nightside; median ion temperatures above 300 km are constant with the solar zenith angle below 150 deg and reach 2300 K at the ionopause. The ion temperatures below 300 km are almost constant with solar zenith angles during the day side, but increase with the angles on the nightside. The electron temperatures suggest a constant heat flux into the electron gas at the ionopause which may be supplied by dissipation of energy by the whistler mode plasma waves at the ionopause and/or conduction of heat from the ionosphere through the mantle.

A.T.


The thermal structure of the Venus atmosphere and differences in structure with latitude (up to 60 deg) and clock hour (from midnight to 8 AM) have been measured in situ from a height of 126 km to the surface by instruments on the four Pioneer Venus entry probes. It is found that thermal contrasts below 45 km are a few K, with the midlatitudes warmer than both equatorial and high latitudes. Considerable temperature and pressure differences with latitude develop in the clouds (25 K and 2 mbar level). In addition, upward of 110 km, there is evidence of large-amplitude temperature oscillations with latitude, believed to signify the presence of large-amplitude waves, perhaps thermal tides. Agreement of structure data from other Pioneer Venus experiments is generally excellent.

B.J.


The Pioneer Venus data relevant to the dynamics and thermodynamics of the atmosphere is summarized and interpreted. On the day side there is a thermosphere in which temperatures increase with height to an exospheric temperature of about 300 K. On the night side there is a cryosphere in which temperatures decrease with height to an exospheric temperature of about 100 K. The atmosphere is stratified stably from the highest altitudes down to about 25 km except for a layer in the clouds between about 50 and 55 km which is nearly adiabatic. Horizontal thermal contrasts are approximately 1 to 2% in the deep atmosphere and 100% in the upper atmosphere. The temperatures generally decrease with latitude at and below the clouds on constant pressure surfaces. Above the clouds there is a reversed zonally averaged latitudinal temperature gradient. The dominant circulation of the atmosphere above the lowest one or two scale heights is a zonal retrograde motion with 100 m/s winds at 60 km altitude. There is also a superrotation at altitudes of 150 km and above.

L.S.


The results presented represent a synthesis of data from those Pioneer Venus experiments directed toward studying cloud problems. These orbiter and multiprobe experiments show the cloud system to consist of three altitude regions populated by cloud particles and smaller haze particles which extend above and below as well as coexist with the cloud particles. The optical properties derived are only consistent with the largest particles, having platelike morphology. The smallest particles are shown to require changes in chemical composition to explain observed behavior. The medium-sized H2SO4 droplets of 2 micrometers diameter appear to be the least volatile and are the best understood. The role of the cloud particles in precipitation dynamical processes, lightning, and radiation are all discussed.

(Author)


The nephelometer measurements by the four Pioneer Venus probes reveal an upper haze area in the vertical cloud structure with several less clearly delineated layers in the main cloud bank. Concentrated sulfuric acid is the main component of the majority of the particulate matter in the clouds; the near UV radiation is absorbed by the clouds. The particles ejected from the planet surface are in the 1 to 100 micron range.

A.T.


The model predictions were compared with the Pioneer Venus probe and orbiter to determine the composition of the UV absorbing materials. The simulations were carried out with radiative transfer codes which included spacecraft constraints on the aerosol and gas characteristics in the Venus atmosphere; gaseous SO2 (a source of opacity at the wavelengths below 0.32 microns), and a second absorber (which dominates above 0.32 microns) were required. The UV contrast variations are due to the optical depth changes in the upper haze layer producing brightness variations between equatorial and polar areas, and to differences in the depth over which the second UV absorber is depleted in the highest portion of the main clouds.

A.T.

Pioneer Venus orbiter and probes measured many of the properties of the Venus atmosphere which control its thermal balance and support its high surface temperature. Estimates based on orbiter data yield an effective radiating temperature of Venus of 228 + or - 5 K, corresponding to a solar emission of 153 + or - 13 W/sq cm. A mode of submicron particles is suggested as an important source of thermal opacity near the cloud tops to explain the orbiter and probe thermal flux measurements. A comparison of the measured solar flux profile with thermal fluxes computed from the measured temperature structure and composition shows that the greenhouse mechanism explains essentially all of the 500-K difference between the surface and radiating temperatures of Venus. B.J.

**A81-26826**  

Recent measurements conducted from the Pioneer Venus probes and orbiter have provided a significantly improved definition of the solar net flux profile, the gaseous composition, temperature structure, and cloud properties of Venus' lower atmosphere. Using these data, we have carried out a series of one-dimensional radiative-convective equilibrium calculations to determine the viability of the greenhouse model of Venus' high surface temperature and to assess the chief contributors to the greenhouse effect. New sources of infrared opacity include the permitted transitions of SO2, CO, and HCl as well as opacity due to several pressure-induced transitions of CO2. We find that the observed surface temperature and lapse rate structure of the lower atmosphere can be reproduced quite closely with a greenhouse model that contains the water vapor abundance reported by the Venera spectrophotometer experiment. Thus the greenhouse effect can account for essentially all of Venus' high surface temperature. The prime sources of infrared opacity are, in order of importance, CO2, H2O, cloud particles, and SO2, with CO and HCl playing very minor roles. (Author)

**A81-26526**  

A three-layer general circulation model of the Martian atmosphere is described, and the assumptions governing the model are discussed. The simulated, zonally averaged circulation is found to have only limited sensitivity to differences between this model and an earlier general circulation model; this circulation compares reasonably well with observations. It is also found that the meridional mass flow produced by the seasonal condensation of CO2 in the winter polar region has a major influence on the circulation; owing to the weak influence of atmospheric heat transport, however, the mass flow is governed almost entirely by radiation. Quasi-barotropic stationary waves, which are forced kinematically by the topography and which resemble topographically forced terrestrial planetary waves, are generated by the model in the winter hemisphere region of strong eastward flow, while baroclinic stationary waves are thermally forced by topography in the tropics and summer subtropics. It is also concluded that transient baroclinically unstable waves, of somewhat lower dominant wavenumber than those found on the earth, are generated in winter midlatitudes; their amplitudes, wavenumbers, and phase speeds closely agree with what has been deduced from the Viking lander observations. C.R.

**A81-29155**  

Numerical experiments are presented which were intended to verify the independence of bar formation in rotating galaxy models from special initial conditions. Three-dimensional n-body programs were run starting from aspherical initial conditions characterized by particle rotational and peculiar velocities and offsets from sphericity for a set of 100,000 particles. All the initial configurations examined are observed to collapse to a thin form, overshoot, collapse again and again overshoot, with diameters and central densities similar to those observed under spheric initial conditions. Every aspheric collapse is also found to result in bar formation within two rotation periods, which is even sooner than in initially spherical conditions. In the intermediate stages of collapse, transient sheet patterns are found to be destroyed at asymmetries of 2-3%, while transient rings survived asymmetries of 6-7% but not 15-19%. It is noted that the results may be applicable to galaxy formation in the early universe, and possible mechanisms for the arresting of protogalactic collapse are indicated. A.L.W.

**A81-31060**  

The large, fully three-dimensional n-body programs designed for numerical experiments on the dynamics of galaxies have been used for investigations of protogalactic collapses. The dynamical aspects of galaxy formation dominate in this approach. The present experiments start from a large rotating gaseous mass that is made up of many gas clouds. The large mass collapses because it is out of equilibrium. Stars form as the collapse proceeds. The problem is formulated, limiting-case examples are described, and results from simple 'first cut' models are given. Results with no star formation are contrasted with results for very rapid star formation. All models with gas formed in disklike structures; some were circular, while others were oval. The principal result from the simple models is that stars continue to form rapidly even after the gas has been depleted to unacceptable levels (1% of the galactic mass in gas). (Author)

**A81-32603**  

Observational and theoretical considerations, including near-surface energy constraints, suggest a model of Io that features a surface layer of sulfur overlying an active silicate crust. Such a model would imply frequent contact between silicate magma intrusions and the sulfur layer. This contact could produce volcanic plumes driven by high-temperature sulfur vapor. Plumes driven by sulfur vapor meet observational constraints for a wide range of possible conditions. In contrast to the special conditions required for plume generation by SO2, characteristics of the two models are compared, and it is suggested that high-resolution infrared radiometry could identify the driving volatile. (Author)
Asfrophysical 'Journal': Partial self-absorption bring the CO brightness temperatures into closer agreement with the gas temperatures inferred from far-infrared photometry.

It is shown that many of the observed properties of the Jovian ring can be explained by the presence of numerous small and unseen parent bodies, or 'moons', residing within the ring, whose sizes are less than 1 km. The small visible ring grains, which are destroyed in short times by sputtering and meteoroid erosion, are derived from these parent bodies largely through meteoroid impacts, and partly from Io's dust. Substantial orbit modification results from plasma drag, and the charge carried by the grains will influence their dynamics and may modify their shapes. It is concluded that the processes discussed, though present in other planetary ring systems, may be highlighted in Jupiter's ring because of its low optical depth and the small size of some of its particles. It is suggested that hidden reservoirs similar to the Jovian 'moons' proposed may be present in the rings of Saturn and Uranus.

O.C. O'Hara, P. J. Bauer, and D. J. Ennis.

ABSTRACT


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provide a novel opportunity to detect planetary-sized objects having 8 to 120 microns when the mission is flown in 1982. These data will...ref. Grant No. NCC2-36.

The response of Martian climate to changes in solar energy deposition caused by variations of the Martian orbit and obliquity is examined. A systematic study is presented of the seasonal cycles of carbon dioxide, water, and dust to provide a complete picture of the climate for various orbital configurations. A new theory for the formation of the polar laminae is developed on the basis of this systematic examination. For the present orbital configuration and climate of Mars, it is shown that regolith damping of the seasonal CO2 cycle is unlikely; the mean atmospheric pressure is probably in equilibrium with the regolith; the low albedo of the north H2O polar cap can be explained by an admixture of 85% ice and 15% dust; and the albedo of the polar caps and the polar heat budget are very sensitive to small variations in dust deposition. B.J.


Theoretical models are presented of the brightness of Saturn's rings at microwave wavelengths (0.34-21.0 cm) including both intrinsic ring emission and dust scattering by the rings of the planetary emission. In addition, several previously existing sets of interferometric observations of the Saturn system at 0.83, 3.71, 6.0, 11.1, and 21.0 cm wavelengths are analyzed. A comparison of models and experimental data make it possible to establish improved constraints on the properties of the rings. In particular, it is found that (1) the maximum optical depths in the rings is 1.5 ± 0.3 referred to visible wavelengths; (2) a significant decrease in ring optical depths from 3.7 to 21.0 cm makes it possible to rule out the possibility that more than 30% of the cross section of the rings is composed of particles larger than about a meter; and (3) the ring particles cannot be primarily of silicate composition (independently of particle size), and the particles cannot be primarily smaller than about 0.1 cm, independently of composition. B.J.


The Infrared Astronomical Satellite (IRAS) program will produce an extremely sensitive all-sky survey over the wavelength region 8 to 120 microns, with the mission being flown in 1982. These data will provide a novel opportunity to detect planetary sized objects having masses smaller than 0.08 solar masses in or near the solar system. The improvement detection limit of the IRAS will greatly increase the volume of space searched for such objects, as compared with previous optical and infrared studies. (Author)


A spectrum of Saturn obtained from the Kuiper Airborne Observatory exhibits an emission peak at 6.6 microns attributed to ethane, but is otherwise dominated by absorption from 5.3 to 7.2 microns. While the large absorption in this spectral region is consistent with the presence of ammonia gas or ammonia ice, or both, such an explanation is inconsistent with the lack of major absorption near 3.0 microns. (Author)


An outline is presented of the present status of knowledge of stratospheric aerosols, meteoric debris, nacreous clouds, and noctilucent clouds. Considerable progress has been made in studies of these particles during the previous decade and it is appropriate to synthesize the information to provide a background for studies planned for the 1980s. Numerical models of the formation, growth, and evolution are considered and a description is given of the physical processes involved, taking into account aspects of nucleation, coagulation, condensational growth, sedimentation, and questions of dynamical transport. A schematic outline of the physical and chemical processes included in a model of stratospheric aerosols is provided. G.R.


Formation mechanisms and nucleation processes are examined, and nucleation in the stratosphere is considered, taking into account binary nucleation, ternary nucleation, binary heterogeneous nucleation, and heteromolecular nucleation. Attention is also given to the growth of aerosol particles, nucleation and growth in models, and the role of aerosols in the upper atmosphere. It is pointed out that various sampling studies and numerical models have provided evidence that the in situ oxidation of sulfur-bearing gases is responsible for the sulfate mass of the stratospheric aerosol. Data obtained by Castleman et al. (1974) suggest that there is a common source of sulfur compounds for the stratosphere of both the northern and southern hemispheres. G.R.

At heliocentric distances between 14 and 22 AU, some 14 increases in the flux of 1 MeV protons have been identified over a 3 yr period by the NASA Geostationary/University of New Hampshire cosmic-ray experiment on Pioneer 10. These increases appear to be associated with large solar flares. Combining the particle data with the Pioneer 10 plasma observations from the NASA/Ames plasma analyzer reveals that the particle increases are produced by radially propagating shock waves generated by the solar events. While the characteristics of these particle events are distinct, they appear to differ greatly from those observed at 1 AU, they represent the evolution expected from the interplanetary medium model. These long-lived shocks provide a valuable in situ laboratory for directly studying particle acceleration under a variety of conditions. They may also represent a significant factor in producing the long-term modulation of galactic cosmic rays.

(Author)


The paper reviews current knowledge of the characteristics of atmospheres surrounding the terrestrial planets; attention is given to composition, temperature, characteristics of the upper atmospheres, and meteorology. In addition, the long-term history of the atmospheres is discussed, along with some of the major climatic changes that have occurred. Finally, consideration is given to future efforts that will enhance the understanding of these subjects.

B.J.


The paper reviews current knowledge about Titan’s atmosphere, surface, interior, and nearby environment. An attempt is made to place the satellite’s history within the context of the formation of the Saturn system and to describe possible evolutionary paths for its atmosphere and interior.

B.J.


The changing sky brightness during the Martian twilight as measured by the Viking lander cameras is shown to be consistent with data obtained from sky brightness measurements. An exponential distribution of dust with a scale height of 10 km, equal to the atmospheric scale height, is consistent with the shape of the light curve. Multiple scattering resulting from the forward scattering peak of large particles makes a major contribution to the intensity of the twilight. The spectral distribution of light in the twilight sky may require slightly different optical properties for the scattering particles at high levels from those of the aerosol at lower levels.

(Author)
A series of models is presented of Uranus and Neptune in which the relative amounts of (1) rock, (2) ices, and (3) hydrogen and helium are allowed to vary. By fitting the density and the gravitational quadrupole moment, the model composition can be determined. Because of the ambiguity in the rotation periods of these planets, several possible models are presented and discussed.


A theoretical fit has been made to our laboratory measurements of the 2-0 collissionally induced H2 absorption band for temperatures of 122 and 273 K and at a density of 20 amagats. A Lennard-Jones 6-12 intermolecular potential and a Birnbaum-Cohen line profile have been used. The fit resulted in a chi-square of 0.2%. Line widths have also been derived as a function of temperature. The lifetimes of the states have been calculated.


There is growing observational evidence that stratospheric OH concentrations are smaller than models have been predicting. Using very recent HOx reaction rate coefficient measurements in a two-dimensional photochemical model, results which support these observations are obtained. As a consequence of smaller OH concentrations, we show that perturbations of stratospheric ozone by NOx (SST emissions and nitrogen fertilizers) may be larger than models have been predicting, while perturbations due to added water vapor and chlorine (SST emissions and nitrogen fertilizers) may be smaller than models have been predicting. Using very recent HOx reaction rate coefficient measurements in a two-dimensional photochemical model, results which support these observations are obtained. As a consequence of smaller OH concentrations, we show that perturbations of stratospheric ozone by NOx (SST emissions and nitrogen fertilizers) may be larger than models have been predicting, while perturbations due to added water vapor and chlorine (SST emissions and nitrogen fertilizers, respectively) may be smaller.


Mixing ratios are presented for CF2Cl2, CFC13, and N2O in the lower stratosphere. They are derived from measurements made on samples collected by a high-altitude aircraft during a survey in the northern hemisphere in the summer of 1977. The vertical distributions of the mixing ratios of these species show a decrease with increasing altitude and a marked decrease at a given altitude with increasing latitude from 2 deg S to 73 deg N latitude. These results agree with measurements at similar latitudes in the fall of 1976 and with results of other experiments. The experimental apparatus and procedures are described in greater detail than in previous papers.


Voyager 1 images of Titan, when normalized to remove limb darkening, reveal an axially symmetric brightness pattern with significant north-south asymmetry. This hemispheric contrast seems to be a response to seasonal solar heating variations resulting from Titan's inclined spin axis. The contrast significantly lags the solar forcing, indicating that its production involves the atmosphere well below the unit optical depth level. The contrast has a significant effect on Titan's disk-integrated brightness as seen from earth, and probably accounts for most of the observed long term variation, with solar UV variations accounting for the remainder.


Certain radial brightness variations in the outer Cassini division of Saturn's rings may be spiral density waves driven by Saturn's large moon Iapetus, in which case a value of approximately 16 g/cm2 for the surface density is calculated in the region where the waves are seen. The kinematic viscosity in the same region is approximately 170 cm2/s and the vertical scale height of the ring is estimated to be a maximum of approximately 40 m.


The brightness structure within Cassini's division in Saturn's rings is explained in terms of perturbations produced by moonlets embedded within an optically thin disk of smaller ring particles. The moonlets exert gravitational torques on neighboring ring particles and create gaps; diffusion acts to fill the gaps. A new explanation is offered for the inner edge of the Cassini division being located at the 2:1 resonance with Mimas.


The possibility of detecting grains formed in supernovae by observations of their emission in the infrared is examined. The basic processes determining the temperature and infrared radiation of grains in supernova environments are analyzed, and the results are used to estimate the infrared emission from the highly metal enriched fast moving knots in Cas A. The predicted fluxes lie within the reach of current ground-based facilities at 10 microns, and their emission should be detectable throughout the infrared band with cryogenic space telescopes.


An objective method for deriving the components of a generalized transport tensor for a two-dimensional model is presented. Representational meridional and vertical velocities and thermodynamic scalars at a uniform grid are used to reduce the problem to the solution of two flux equations for two unknowns. One unknown is the stream-function, coefficient of an antisymmetric tensor, which
corrects the Eulerian mean motions for Stokes drift; the other is
a time constant, which converts the deviatory velocity tensor to
a symmetric transport tensor. The complete asymmetric tensor,
called a transport tensor, has a divergence which yields both advection
and diffusion by the deviatory velocities. Advantages and disadvantages
of Lagrangian and Eulerian averages are discussed, and meridional-
vertical velocity correlations are provided.

J.F.

A81-47274 * Formation of organic molecules on Titan. L.
A. Capone (San Jose State University, San Jose, CA), S. S. Prasad, W.
T. Huntress (California Institute of Technology, Jet Propulsion
Laboratory, Pasadena, CA), R. C. Whitten (NASA, Ames Research
Center, Space Science Div., Moffett Field, CA), J. Dubach (Massa-
chusetts, University, Amherst, MA), and K. Santhanam (Informatics,
A mechanism is proposed for the formation of complex organic
nitrogen compounds in the dense lower atmosphere of Titan. The
mechanism is based on three-body association reactions with
HCN(H+)+ ions formed by the reaction of N(+) with CH4, which lead
to the production of ethyl cyanide, vinyl cyanide and cyanoacet-
ylene. Calculations for a model atmosphere consistent with the
preliminary interpretation of Voyager 1 data for the region of
maximum cosmic ray activated chemistry, corresponding to a
temperature between 150 and 160 K and a pressure of 20 mb, are
presented which show substantial organic nitrile and hydrogen
cyanide production rates. Based on these production rates, it is
expected that significant equilibrium concentrations of these com-
pounds will be found on Titan.

A81-48034 * Are we beginning to understand T Tauri stars.
M. Cohen (NASA, Ames Research Center, Moffett Field, CA). Sky
An international meeting of astronomers in April 1981 in
Portugal to discuss recent data on T Tauri stars is described. It is
pointed out that T Tauri stars all vary irregularly in brightness, occur
in intimate association with dusty molecular clouds, and exhibit
bright optical emission lines, principally of hydrogen, helium, and
iron. Stars with masses roughly 0.2 to three times the sun's and with
ages from 100,000 to 1,000,000 years are typical of the T Tauri
regime. It is thought that the often rich emission-line spectra seen at
visible wavelengths indicate the presence of a stellar chromosphere,
where the temperature varies randomly. The theory of the random wandering of a vector of
interplanetary Alfvenic fluctuations in which the field direction
varies randomly. The theory of the random wandering of a vector of
minimum variance statistically aligned with the mean magnetic field
may be purely a consequence of the randomness of the fluctuation
and not imply that the fluctuations are necessarily plane waves.
Results suggest that the
tendency of the Alfvenic fluctuations to have a direction of
minimum variance statistically aligned with the mean magnetic field
may be purely a consequence of the randomness of the fluctuation
and not imply that the fluctuations are necessarily plane waves.

A81-48223 * Tunguska meteor fall of 1908 - Effects on
stratospheric ozone. R. P. Turco (R & D Associates, Marina del Rey,
CA), O. B. Toon, C. Park, R. C. Whitten, J. B. Pollack (NASA Ames
Research Center, Moffett Field, CA), and P. Norrdinger (Michigan
The Tunguska meteor, whose disintegration over Siberia in 1908
may have generated as much as 30 million metric tons of nitric oxide
(NO) in the stratosphere and mesosphere, is discussed. The photo-
chemical aftereffects of the event are simulated using a comprehen-
sive model of atmospheric trace composition. Calculations are made
which indicate that until 8 years after the Tunguska event, the mean
ozone concentration of the Northern Hemisphere may have been depleted by the meteor's nitric oxide
cloud early in 1909 and that large ozone reductions may have persisted until 1912. Measurements of atmospheric transparency by
the Smithsonian Astrophysical Observatory for the years 1909-1911
(Moskovski Institut Radiotechniki, Elektroni ki i Avtomatiki, Mos-
cow, USSR). Akademiia Nauk SSSR, Izvestiya, Fizika Atmosfery i
Okeana, vol. 16, Apr. 1980, p. 382-388.) Academy of Sciences,

USSR, Izvestiya, Atmospheric and Oceanic Physics, vol. 16, Nov.
980, p. 256-260. 9 refs. Translation.

A81-48735 * Spectropolarimetry of Herbig-Haro objects
and the exciting star of HH 30. M. Cohen (NASA, Ames Research
Center, Moffett Field, CA) and G. D. Schmidt (Minnesota
1981, p. 1228-1231. 17 refs. Research supported by the University
of Minnesota; NSF Grant No. AST-76-19753.
Spectrophotometric and spectropolarimetric observations are
presented of three HH objects: HH 11, 30, and 43. Although null
polarization results are obtained for HH 11 and 43, the unusually
strong continuum of HH 30 is linearly polarized by 3%. The emission
lines in this nebula are unpolarized. The electric vector position angle
appropriate to the continuum polarization, and the presence of Fe II
emission lines apparently from the photosphere of a T Tauri-like star,
indicates HL Tau as the exciting/illuminating star for HH 30.
Evidence is adduced for a highly anisotropic distribution of circumstellar
obscuration around this star.

A81-49037 * The abundance of argon at the galactic center.
D. F. Lester, J. D. Bregman, F. C. Witteborn (NASA, Ames Research
Center, Moffett Field, CA), D. M. Rank, and H. L. Dinerstein (Lick
Measurements of forbidden line Ar II 6.99 micron and Ar II
7.45 micron made from the Kuiper Airborne Observatory are
presented for Sgr A, the H II region at the center of the Galaxy.
These line strengths, when combined with ground-based measure-
ments, suggest a factor of enhancement of two in the Ar/H ratio in
the galactic center region relative to that in the sun and in the solar
neighborhood. The accuracy of the determination is presently
limited by the uncertainty in the collision strength for Ar(+)....

A81-49679 * Interplanetary Alfvenic fluctuations - A sto-
castic model. A. Barnes (NASA, Ames Research Center, Theoretical
and Planetary Studies Branch, Moffett Field, CA). Journal of
The concept of minimum variance is investigated for nonplanar
interplanetary Alfvenic fluctuations in which the field direction
varies randomly. The theory of the random wandering of a vector of
constant length is developed as a representation of the magnetic
field, and it is found that the minimum variance tends to coincide
with the mean field directions over the correlation time of the
fluctuations. The Fokker-Planck limit of the theory is then
developed and used to analyze the statistic distribution of field directions
with and without a reflecting barrier. Results suggest that the
tendency of the Alfvenic fluctuations to have a direction of
minimum variance statistically aligned with the mean magnetic field
may be purely a consequence of the randomness of the fluctuation
and not imply that the fluctuations are necessarily plane waves.

CONFERENCE AND MEETING PAPERS

A81-12466 * Large-scale modulation of galactic cosmic rays
and anomalous He observed at not less than 16 AU with Pioneer 10.
K. R. Pyle, J. A. Simpson (Chicago, University, Chicago, III.), J. D.
Mihalov, and J. H. Wolfe (NASA, Ames Research Center, Moffett
High-speed solar wind streams issued from specific ranges of solar longitude or evolved into a single stream at not less than 16 AU during 1978. Shock waves associated with these streams cause a large decrease in cosmic ray intensity starting at 1 AU in April and appears progressively with time outward to 16 AU; a stepwise intensity decrease then occurs for both the galactic cosmic rays and the anomalous He component. The flare-activated nuclei show a new aspect of solar wind propagation in the outer solar system; at about 16 to 18 AU, the intensity builds up between dispersion, reaching a high flux level, and finally declines when the outward rate of escape becomes dominant.

A.T.


New estimates for stratospheric ozone perturbations attributable to supersonic transport (SST) emissions are presented. First, a review is given of recent data pointing to lower OH concentrations below 30 km, as compared to the values predicted by photochemical models. The evidence for lower OH comes from a wide range of laboratory and atmospheric studies. The sensitivity of theoretical estimates of ozone change to OH abundances, and the coupling mechanisms between the O(\textit{x})-NO(\textit{x})-HO(\textit{x})-Cl(\textit{x}) families which are responsible for the sensitivity, are discussed. Updated calculations for SST-induced ozone alterations are compared with earlier predictions. For example, assuming continuous aircraft injection of NO\textsubscript{2} at 20 km at a rate of 1 x 10\textsuperscript{-9} kg per year (globally), a 4\% ozone decrease, is now calculated where earlier a 3\% ozone increase was found. This large variance from previous forecasts suggests that new assessments of certain other polluting agents, particularly nitrogen fertilizers, are needed. (Author)


Independent methods considered for use in the direct or indirect detection of extrasolar planetary systems are compared. Consideration is given to the principles, advantages and disadvantages of indirect astrometric, spectroscopic and photometric methods, and the direct detection of the intrinsic thermal radiation, reflected central star radiation or intrinsic nonthermal radiation of a planet. The importance of a redundancy of detection methods as well as instrumentation within a given method is pointed out. A.L.W.


Interstellar shock waves have a significant influence on the structure and dynamics of interstellar matter and probably trigger star formation in suitable dense regions. The overall structure of regions near shock waves is reviewed; in addition, the main observational effects of shocks on interstellar molecules are discussed including: (1) acceleration to velocities in the 1 km/s to 100 km/s range relative to the ambient gas, (2) excitation of infrared lines in the heated postshock gas, and (3) production of high abundances of certain molecular species such as H, OH, H\textsubscript{2}O, CH\textsubscript{3}, OCS, and STO through high temperature chemical reactions in the postshock gas at temperatures above 1000 K. The molecular region around the BN infrared source in Orion and the high velocity molecules in IC443 are discussed as possible examples of shocked molecular gas. (Author)


A nonspecular reflectometer and its operation at far-infrared wavelengths are described. Large differences in nonspecular reflectance were found to exist between different optically black coatings. Normal incidence bidirectional reflectance distribution function (BRDF) measurements at wavelengths between 12 and 316 microns of three black coatings show that their mean BRDFs increase with wavelength. The specularity of two of these coatings also showed a strong wavelength dependence, while the specularity of one coating seemed independent of wavelength. The BRDF of one coating depended on the angle of incidence at 12 and 38 microns, but not at 316 microns. Beyond 200 microns, it was found necessary to correct the measurements for the beam spread of the instrument. (Author)


The Shuttle Infrared Telescope Facility (SIRTF) is a cryogenically-cooled, 1-m-class telescope that will be operated from the Space Shuttle as an observatory for infrared astronomy. This paper discusses the scientific constraints on and the requirements for pointing and controlling SIRTF as well as several aspects of SIRTF orbital operations. The basic pointing requirement is for an rms stability of 0.25 arcsec, which is necessary to realize the full angular resolution of the 5-micron diffraction limited SIRTF. Achieving this stability requires the use of hardware and software integral to SIRTF working interactively with the gyrostabilized Shuttle pointing mount. The higher sensitivity of SIRTF, together with orbital and time constraints, puts a premium on rapid target acquisition and on efficient operational and observational procedures. Several possible acquisition modes are discussed, and the importance of source acquisition by maximizing the output of an infrared detector is emphasized. (Author)


The effects on the terrestrial ozone abundance and temperature (and hence on the earth's climate) of periodic variations in the solar spectrum are investigated. Temporal variations of the solar UV
spectrum are modeled in accordance with the measurements of Heath and Thakkar (1977), and the spectrum at wavelengths greater than 2000 Å is altered uniformly by small amounts so that the total luminosity remains constant with time. One-dimensional photochemical-radiative-convective models are used to predict the response of the earth's surface to the solar spectral changes. Results show that the data interpreted by Heath and Thakkar to indicate that the solar UV flux varies by a factor of 2.5 at 1750 Å from solar minimum to solar maximum are inconsistent with the historical records of ozone abundance. It is concluded, however, that if the amplitude of solar UV variations increases with increasing period, and if the spectral characteristics variations are similar to the well established solar UV variations over a solar rotation period, these variations could have a significant impact on the earth's climate and the biosphere. K.S.

**THERMO- AND GAS-DYNAMICS DIVISION**

**NASA FORMAL REPORTS**

N81-18077*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**STAY AND NONSTAY SUPersonic TURBulent AFTERBODY FLOW**


(NASA-TP-1768; A-8271) Avail: NTIS HC A02/MF A01 CSCL 01A

The effect of the specific heat ratio gamma of the incoming ideal gas on the flow properties, especially on pressure distributions along the base and sting surfaces, and on reattachment distance, was investigated. The specific heat ratios considered were gamma = 1.2, 1.4, and 1.687. Also, effects of other major parameters, such as eddy-viscosity coefficient (or effective Reynolds number) and Mach number, on the afterbody pressure and reattachment distance were studied and are discussed. Evolution of shock induced flow and stabilization time were examined and are discussed for a transient problem. The important influence of the flow-field geometry, pressure distributions, and reattachment distance on the aerodynamics radiative heat transfer for an atmosphere entry probe in high speed flight are briefly described. T.M.

N81-133856*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**NUMERICAL BOUNDARY CONDITION PROCEEDURES**


(NASA-CP-2201; A-8736) Avail: NTIS HC A17/MF A01 CSCL 12A

Topics include numerical procedures for treating inflow and outflow boundaries, steady and unsteady discontinuous surfaces, far field boundaries, and multiblock grids. In addition, the effects of numerical boundary approximations on stability, accuracy, and convergence rate of the numerical solution are discussed. For individual titles, see N81-33835 through N81-33879.

N81-16136*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**STRAIN RATE, TEMPERATURE, AND HUMIDITY ON STRENGTH AND MODULI OF A GRAPHITE/EPOXY COMPOSITE**


(NASA-TM-81248; A-8408) Avail: NTIS HC A04/MF A01 CSCL 20D

Results of an experimental study of the influence of strain rate, temperature and humidity on the mechanical behavior of a graphite/epoxy fiber composite are presented. Three principal strengths (longitudinal, transverse and shear) and four basic moduli (E1, E2, G12 and U12) of a unidirectional graphite/epoxy composite were followed as a function of strain rate, temperature and humidity. Each test was performed at a constant tensile strain rate in an environmental chamber providing simultaneous temperature and humidity control. Prior to testing, specimens were given a moisture preconditioning treatment at 60 C. Values for the matrix dominated moduli and strength were significantly influenced by both environmental and rate parameters, whereas the fiber dominated moduli were not. However, the longitudinal strength was significantly influenced by temperature and moisture content. A qualitative explanation for these observations is presented. Author


**Corrosion of 310 Stainless Steel in H2-H2O-H2S Gas Mixtures: Studies at Constant Temperature and Fixed Oxygen Potential**

D. Bhogeswara Rao (California Univ., Lawrence Berkeley Lab.), K. T. Jacob (California Univ., Berkeley), and Howard G. Nelson (NASA-TM-81242; A-8349) Avail: NTIS HC A03/MF A01 CSCL 11F

Corrosion of SA3 310 stainless steel in H2-H2O-H2S gas mixtures was studied at a constant temperature of 1150 K. Reactive gas mixtures were chosen to yield a constant oxygen potential of approximately 6 x 10^-10. The results were analyzed using metallography, scanning electron microscopy, and energy dispersive X-ray analysis. The kinetics of corrosion were determined using a thermobalance and a microbalance. The corrosion rates were found to be in good quantitative agreement with experiment. In particular, predicted history times of shock wave position, surface pressures, lift, and pitching moment were found to be in very good agreement with experiment for an unsteady flow. Depending upon the free stream Mach number for steady flows, the surface pressure downstream of the shock wave or the shock wave location was not well predicted. M.G.

**Numerical Approximation of Boundary Conditions with Applications to Inviscid Equations of Gas Dynamics**

H. C. Yee Mar. 1981 87 p refs

A comprehensive overview of the state of the art of well-posedness and stability analysis of difference approximations for initial boundary value problems of the hyperbolic type is presented. The applicability of recent theoretical development to practical calculations for nonlinear gas dynamics is examined. The one-dimensional inviscid gas dynamics equations in conservation law form are selected for numerical experiments. The class of implicit schemes developed from linear multistep methods in ordinary differential equations is chosen and the use of linear extrapolation as an explicit or implicit boundary scheme is emphasized. Specification of boundary data in the primitive variables and computation in terms of the conservative variables in the interior is discussed. Some numerical examples for the quasi-one-dimensional nozzle are given. Author

**Physical Aging in Graphite Epoxy Composites**

Eric S. W. Kong (Stanford Univ.) Apr. 1981 46 p refs

Postcured + or - 45 deg 4S specimens of Thornel 300 graphite/Harmco 5208 epoxy were quenched from above Tg and given a sub Tg annealing at 140 C for times up to 10 to the fifth power min. The ultimate tensile strength, strain to break, and toughness of the composite material were found to decrease as functions of sub Tg annealing time. No weight loss was observed during the sub Tg annealing. The time dependent change in mechanical behavior is explained on the basis of free volume changes that are related to the physical aging of the nonequilibrium glassy network epoxy. The results imply possible changes in composite properties with service time. Author

**Topology of Three-Dimensional Separated Flows**

Murray Tobak and David J. Peake Apr. 1981 25 p refs

Based on the hypothesis that patterns of skin-friction lines and external streamlines reflect the properties of continuous vector fields, topology rules define a small number of singular points (nodes, saddle points, and foci) that characterize the patterns on the surface and on particular projections of the flow (e.g., the crossflow plane). The restricted number of singular points and the rules that they obey are considered as an organizing principle whose finite number of elements can be combined in various ways to connect together the properties common to all steady three-dimensional viscous flows. Introduction of a distinction between local and global properties of the flow resolves an ambiguity in the proper definition of a three-dimensional separated flow. Adoption of the notions of topological structure, structural stability, and bifurcation provides a framework to describe how three-dimensional separated flows originate and succeed each other as the relevant parameters of the problem are varied. Author

**Tair: A Transonic Airfoil Analysis Computer Code**


The operation of the TAIR (Transonic Airfoil) computer code, which uses a fast, fully implicit algorithm to solve the conservative full-potential equation for transonic flow fields about arbitrary airfoils, is described on two levels of sophistication: simplified operation and detailed operation. The program organization and theory are elaborated to simplify modification of TAIR for new applications. Examples with input and output are given for a wide range of cases, including incompressible, subsonic compressible, and transonic calculations. A.R.H.
A VALIDATION OF LTRAN2 WITH HIGH FREQUENCY EXTENSIONS BY COMPARISONS WITH EXPERIMENTAL MEASUREMENTS OF UNSTEADY TRANSonic FLOWS

Kristin A. Hessenius and Peter M. Goorjian Jul. 1981 24 p refs
(NASA-TM-81307; A-8668) Avail: NTIS HC A02/MF A01 CSCL 01A

A high frequency extension of the unsteady, transonic code LTRAN2 was created and is evaluated by comparisons with experimental results. The experimental test case is a NASA 64A010 airfoil in pitching motion at a Mach number of 0.8 over a range of reduced frequencies. Comparisons indicate that the modified code is an improvement of the original LTRAN2 and provides closer agreement with experimental lift and moment coefficients. A discussion of the code modifications, which involve the addition of high frequency terms of the boundary conditions of the numerical algorithm, is included. 

A.R.H.

FAILURE OF MORPHOLOGY OF (0 DEG) GRAPHITE/EPoxy AS INFLUENCED BY ENVIRONMENTS AND PROCESSING

(NASA-TM-81318; A-8684) Avail: NTIS HC A02/MF A01 CSCL 11D

Optical and scanning electron microscopy were used to investigate the failure morphology of graphite/epoxy specimens which had been tested until tensile failure. Failure morphology was studied as a function of the quality control variables of specimen preparation technique, prepreg batch, and cure condition, and also as a function of the environmental parameters of temperature and moisture content. Defective specimens were found to exhibit a low energy failure morphology. Poor specimen edge preparation and one batch of prepreg when tested at elevated temperature or moisture content also exhibited energy failure morphology. Postcuring had no effect on strength but did slightly alter failure morphology. Temperature or moisture appeared to decrease flaw sensitivity and thus increase strength. However, moisture also appeared to increase interfacial debonding between filament and matrix. When combined moisture and temperature increased interfacial debonding, and made the epoxy matrix more prone to fracture. 

A.R.H.

CREEP-RUPTURE OF POLYMER-MATRIX COMPOSITES

(Grant NoG-2038) (NASA-CR-163706; VPI-E-80-18) Avail: NTIS HC A03/MF A01 CSCL 11D

An accelerated characterization method for resin matrix composites is reviewed. Methods for determining modulus and strength master curves are given. Creep rupture analytical models are discussed as applied to polymers and polymer matrix composites. Comparisons between creep rupture experiments and analytical models are presented. The time dependent creep rupture process in graphite epoxy laminates is examined as a function of temperature and stress level. 

A.R.H.

NASA CONTRACTOR REPORTS

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ACCELERATED CHARACTERIZATION OF GRAPHITE/EPoxy COMPOSITES  
W. I. Griffith, D. H. Morris, and H. F. Brinson  
Sep. 1980 28 p  ref  
(Grant NsG-2038)  
N81-18029#  
NASA CR-163723: VPI-E-80-27  
Avail: NTIS  
HC A03/ME 11D  
A method to predict the long term compliance of unidirectional off-axis laminates from short term laboratory tests is presented. The method uses an anisotropic transformation equation and the time-stress-temperature superposition principle. Short term tests are used to construct master curves for two off-axis unidirectional laminates with fiber angles of 10 and 80 degrees. Analytical predictions of long term compliance for 30 and 60 degrees laminates are made. Comparisons with experimental data are also given.  
Author  

VELOCITY MEASUREMENTS BY LASER RESONANCE FLUORESCENCE  
C. Y. She and W. M. Fairbank, Jr.  
1980 20E  
(Grant NsG-2112)  
N81-18006#  
NASA CR-163965: TFD-B1-01  
Avail: NTIS  
HC A10/MF A01 CSCL 01A  
High purity three dimensionally woven silica-silica materials were evaluated for use as a tough reflective heat shield for planetary entry probes. A special weave design was selected to minimize light piping effects through the heat shield thickness. Various weave spacings were evaluated for densification efficiency with an 0.7 micron particle size high purity silica. Spectral hemispherical reflectance was measured from 0.2 to 2.5 microns at room temperature. Reflectance increases due to densification and purity of material were measured. Reflectance of 3D hyperpure silica was higher than 3D astroquartz silica for all wavelengths. Mechanical properties were measured in beam flexure and beam shear tests. Results indicated strengths lower than reported for slip cast fused silica. Low strengths were attributed to low densities achieved through vacuum impregnation.  
S.F.  

VELOCITY MEASUREMENTS IN AIR WITH A SATURABLE ABSORBING SEED GAS  
C. Y. She and W. M. Fairbank, Jr.  
1980 20E  
(Grant NsG-2287)  
N81-18365#  
NASA CR-163971: VPI-E-80-27  
Avail: NTIS  
HC A02/MF A01 CSCL 01A  
The photonburst correlation method was used to detect single atoms in a buffer gas. Real time flow velocity measurements with laser induced resonance fluorescence from single or multiple atoms was demonstrated and this method was investigated as a tool for wind tunnel flow measurement. Investigations show that single atom and their real time diffusion motion on buffer gas can be measured by resonance fluorescence. By averaging over many atoms, flow velocities up to 88 m/s were measured in a time of 0.5 sec. It is expected that higher flow speeds can be measured and that the measurement time can be reduced by a factor of 10 or more by careful experimental design. The method is clearly not ready for incorporation in high speed wind tunnels because it is not yet known whether the stray light level will be higher or lower, and it is not known what detection efficiency can be obtained in a wind tunnel situation.  
A.R.H.
of the spectrum of iodine, the collection of saturation data in iodine, and the development of a mathematical model for correlating saturation effects were pursued for a mixture of 0.3 torr iodine in nitrogen and for mixture pressures up to one atmosphere. For the desired pressure range, saturation effects in iodine were found to be too small to be useful in allowing density measurements to be made. The effects of quenching can be reduced by detuning the exciting laser wavelength from the absorption line center of the iodine line used (resonant Raman scattering). The signal was found to be nearly independent of pressure, for pressures up to one atmosphere, when the excitation beam was detuned 8 GHz from line center for an isolated line in iodine. The laser amplitude was found to be nearly equal to the amplitude for fluorescence at atmospheric pressure, which indicates a density measurement scheme is possible. M.G.

An implicit finite difference scheme for an efficient computation of unsteady potential flow about airfoils is presented. The formulation uses density and velocity potential as dependent variables, and is cast in conservation form to assure the theoretically correct determination of shockwave location and speed. To enable boundary conditions to be imposed directly on the airfoil surface, a time varying sheared rectilinear coordinate transformation is employed. Calculated time history solutions on a pulsating airfoil are compared with the results of another unsteady transonic code. It is concluded that the method has excellent numerical stability and gives accurate solutions with sharply resolved shocks.

E.A.K.

N81-25132# Martin Marietta Corp., Denver, Colo.
INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 2 Final Report
Clifford J. Chocol Jan. 1978 58 p refs
(Contract NAS2-9381)
(NASA-CR-152123-Task-2-Summ; MCR-76-564-Task-2-Summ)
Avail: NTIS HC A04/MF A01 CSCL 22B
End-to-end tests of a 16 element indium antimonide sensor array and 10 channels of associated electronic signal processing were completed. Quantitative data were gathered on system responsivity, frequency response, noise, stray capacitance effects, and sensor paralleling. These tests verify that the temperature accuracies, predicted in the Task 1 study, can be obtained with a very carefully designed electro-optical flight system. Pre-flight and in-flight calibration of a high quality are mandatory to obtain these accuracies. Also, optical crosstalk in the array-dewar assembly must be carefully eliminated by its design. Tests of the stand alone tracking system have also demonstrated that the predicted tracking system accuracies can be met in the flight system. In addition, improvements in the reticle pattern and electronics are possible, which will reduce the complexity of the flight system and increase tracking accuracy.

Author
will provide a dc to 10,000 Hz bandwidth that is flat and contributes no more than 0.4% of full-scale uncertainty to the measurement. Conventional packaging is adequate for the transresistance amplifier design. Measurement errors expected from all sources tested are discussed. A.R.H.


Mean velocity, measured wall pressure and wall shear stress fields were made for a three dimensional pressure-driven turbulent boundary layer created by a cylinder with trailing edge placed normal to a flat plate floor. The direct force wall shear stress measurements were made with floating element direct force sensing shear meter that responded to both the magnitude and direction of the local wall shear stress. The ability of 10 near wall similarity models to describe the near wall velocity field for the measured flow under a wide range of skewing conditions and a variety of pressure gradient and wall shear vector orientations was used. A.R.H.


A carbon dioxide laser system was constructed for the demonstration of the heat pump processes induced by laser radiation. The system consisted of a frequency doubling stage, a gas reaction cell, and its vacuum and high purity gas supply system, and provisions to measure the temperature changes by pressure, or alternatively, by density changes. The theoretical considerations for the choice of designs and components are discussed. R.C.T.


The application of ab initio quantum mechanical approaches in the study of metal atom clusters requires simplifying techniques that do not compromise the reliability of the calculations. Various aspects of the implementation of the effective core potential (ECP) technique for the removal of the metal atom core electrons from the calculation were examined. The ECP molecular integral formulae were modified to bring out the shell characteristics as a first step towards fulfilling the increasing need to speed up the computation of the ECP integrals. Work on the relationships among the derivatives of the molecular integrals that extends some of the techniques pioneered by Kornreich for the calculation of the gradients of the electronic energy was completed and a formulation of the ECP approach that quite naturally unifies the various state-of-the-art 'shape- and Hamiltonian-consistent' techniques was discovered. A.R.H.


The point vortex and vortex blob methods for two dimensional flows are presented. Several results are discussed concerning the numerical analysis of the latter scheme, e.g., the preservation of globally conserved quantities and the analysis of the spatial discretization error resulting from the convection of fixed blobs of vorticity. An application to the two dimensional mixing layer is briefly described. The contour dynamics method is also discussed. The simulation of three dimensional flows with vortex methods is discussed. A natural way to represent the vorticity is in the form of closed tubes of filaments of vorticity, although other schemes are examined. Applications to aircraft trailing vortices and to a turbulent spot in a laminar boundary layer are presented. Hybrid schemes that use an Eulerian mesh to solve the Poisson equation for the velocity field are discussed. The goal of these schemes is to avoid the high cost of the Biot-Savart integration if many vortex elements are used while enjoying most of the advantages of pure Lagrangian schemes. R.C.T.


Recent progress in the development of vortex methods and their applications to the numerical simulation of incompressible fluid flows are reviewed. Emphasis is on recent results concerning the accuracy of these methods, improvements in computational efficiency, and the development of three-dimensional methods. Simulations of several example flows which display some of the strengths and weaknesses of vortex methods are presented. (Author)


A particularly simple conversion of a scanning Auger system for ESD ion energy distributions and scanning ESD has been developed. This approach combines the advantages of the small spot-size electron guns and mapping systems developed for SAM with the capability of ESD for the detection of hydrogen. Our intended use for the device is detection and mapping of surface concentrations of... A.R.H.
hydrogen on metals. The characteristics of SESD are illustrated with the preliminary results of an investigation into the ESD properties of hydrogenic adsorbates on Nb. It is shown that the ESDIED exhibit distinct differences indicative of the surface preparation, and that the ESD ion angular distributions have an effect on the observed contrast relationships in SESD. (Author)


The thin-layer approximation is extended to an axial corner that is formed by the intersection of two perpendicular plates, one of which has an inclination angle with respect to the free stream. A computer code developed by Hung and MacCormack (1978) is modified for the thin-layer approximation, and a case with Mach 5.9 and a wedge angle of 6 deg is computed. In addition, it is shown that it is not necessary to solve the complete Navier-Stokes equations for a three-dimensional high-Reynolds-number corner flow. B.J.


The development of a new insulation material for heat-shielding advanced reusable entry vehicles is reported. The material, called fibrous refractory composite insulation, is a composite of two ceramic fibers with no additional additives to bond the fibers together; it also includes silicon carbide, an emittance agent, to improve its optical properties at high temperature. One fiber is a drawn 11-micron-diameter aluminumborosilicate fiber, the other fiber is the silica fiber (microquartz) used in producing silica RSI (reusable surface insulation for the Space Shuttle), which is a blown fiber of 1.3 micron diameter and variable length. A composition containing 20%, with a thermal shock resistance of 1.8 that of all silica insulation, has been successfully produced in a pilot plant. V.L.


The potential energy curves, spectroscopic constants, and electron transition moments are calculated, along with electronic wave functions are described. The theoretical results are found to be in good agreement with the experimental measurements, and in the case of the dipole moment function calculations, to the complete dipole spectrum of CO2. B.J.


The results of the configuration calculations of six singlet electronic states and one triplet electronic state of CO are presented. The potential energy curves, spectroscopic constants, and electron transition moments are calculated, along with electronic dipole moment functions for three states. The self consistent field and configuration calculations used to obtain the electronic wave functions are described. The theoretical results are found to be in good agreement with the experimental measurements, and in the case of the dipole moment function calculations, to the complete dipole spectrum of CO2. B.J.


Semiclassical calculations are carried out for the quenching of excited-state fluorine atom by hydrogen molecule. The overall quenching probability is the sum of two contributions: the reactive quenching probability associated with the formation of hydrogen fluoride and the nonreactive quenching probability leading to ground-state fluorine atom and hydrogen molecule. The reactive probability is greater in the threshold region of the collision energy, whereas the nonreactive probability dominates for energies above the threshold region. (Author)


Newtonian flow theory for unsteady flow at very high Mach numbers is completed by the addition of a centrifugal force correction to the impact pressures. The correction term is the unsteady counterpart of Busemann's centrifugal force correction to impact pressures in steady flow. For airfoils of arbitrary shape, watt formulas for the unsteady pressure and stiffness and damping in pitch derivatives are obtained in closed form, which require only numerical quadratures of terms involving the airfoil shape. They are applicable to airfoils of arbitrary thickness having sharp or blunt leading edges. For wedges and thin airfoils these formulas are greatly simplified, and it is proved that the pitching motions of thin airfoils of convex shape and of wedges of arbitrary thickness are always dynamically stable according to Newton-Busemann theory. Leading-edge bluntness is shown to have a favorable effect on the dynamic stability; on the other hand, airfoils of concave shape tend toward dynamic instability over a range of axis positions if the surface curvature exceeds a certain limit. As a byproduct, it is also shown that a pressure formula recently given by Barron and Mandl for unsteady Newtonian flow over a pitching power-law shaped airfoil is erroneous and that their conclusion regarding the effect of pivot position on the dynamic stability is misleading. (Author)

The Pioneer Venus probes approached Venus with high relative velocity. As they entered the atmosphere, they were rapidly decelerated by aerodynamic drag, and a great deal of heat was generated. To protect the probe structure and the scientific instruments, a carbon phenolic heat shield was placed on the front of the probes. Because the design of heat shields for planetary entry is a developing technology, thermocouples were placed in the heat shields so that actual and predicted heat shield performance could be compared. The function of the heat shield is discussed, the probe environments during entry into the Venusian atmosphere are described, and some results from the heat shield experiment are presented. It was found that for the most part, the heat shields performed better than expected.

(Author)


The conservation law form of the inviscid gasdynamic equations has the remarkable property that the nonlinear flux vectors are homogeneous functions of degree one. This property readily permits the splitting of flux vectors into subvectors by similarity transformations so that each subvector has associated with it a specified eigenvalue spectrum. As a consequence of flux vector splitting, new explicit and implicit dissipative finite-difference schemes are developed for first-order hyperbolic systems of equations. Appropriate one-sided spatial differences for each split flux vector are used throughout the computational field even if the flow is locally sonic. The results of some preliminary numerical computations are included. (Author)


A laser-induced fluorescence technique based on the pulsed two-photon excitation of NO is presented which is especially suited for the measurement of fluctuating temperatures in cold turbulent flows. The technique uses the fluorescence from the UV gamma bands of NO produced by two-photon excitation of NO (A 2 Sigma +, nu-prime = 0 - X 2 Pi, nu-double prime = 0) to obtain a rotational temperature. An analysis is presented of relevant aspects of the two-photon absorption process including microphysical processes, spectral intensities as a function of transition and laser spectral widths, line-shape integrals, the nonequilibrium response of the medium to a laser pulse, fluorescence energies, signal to noise ratio, and focusing effects. An analysis of absolute two-photon absorptionivity measured in a nonflowing cell is then presented and used to predict signal to noise ratios greater than 50 for supersonic flows at temperatures below 300 K. A.L.W.


The third-order susceptibility of H2 has been calculated under coherent anti-Stokes Raman-scattering conditions, with use of wave functions specifically designed for accurate calculations of sum-rule properties. The theoretical values are in good agreement with experiment. (Author)


Potential curves as well as dipole moments and linking transition moments are calculated for the ground X 2 Sigma + and low lying excited A 2 Pi, B 2 Sigma +, C 2 Sigma +, (4) 2 Sigma +, (2) 2 Pi and (1) 2 Delta states of NaAr and NaXe. Calculations are performed using a self-consistent field plus configuration-interaction procedure with the core electrons replaced by an ab initio effective core potential. The potential curves obtained are found to be considerably less repulsive than the semiempirical curves of Pascale and Vandenberg (1974) and to agree well with existing experimental data, although the binding energies of those states having potential minima due to van der Waals interactions are underestimated. Emission bands are also calculated for the X 2 Sigma + -> C 2 Sigma + excimer transitions of NaAr and NaXe using the calculated transition moments and potential curves, and shown to agree well with experiment on the short-wavelength side of the maximum. A.L.W.


Electronic transition moments and their variation with internuclear separation are calculated for the Balilik-Ramsay (b 3 Sigma g -> a 3 Pi u), Fox-Herzberg (e 3 Pi g-a 3 Pi u) and Swan (d 3 Sigma g-a 3 Pi u) band systems of C2, which appear in a variety of terrestrial and astrophysical sources. Electronic wave functions of the a 3 Pi u, b 2 Sigma g -> d 3 Pi u and c 3 Pi g states of C2 are obtained by means of a self-consistent field plus configuration interaction calculation using an atomic basis of 46 Slater-type orbitals, and theoretical potential energy curves and spectroscopic constants for the four electronic states were computed. The results obtained for both the potential energy curves and electronic transition moments are found to be in good agreement with experimental data. A.L.W.


The influence of a specific surface reaction on the transport of gas-phase hydrogen through iron membranes has been investigated on the basis of model calculations. The surface reaction involves an adsorbed molecular hydrogen precursor between the gas phase and the dissociated chemisorbed state. The calculations demonstrate that the surface reaction for the H2/Fe system makes significant contributions to the time delay associated with the transient hydrogen transport through iron membranes, even under conditions where the steady-state hydrogen transport is independent of the surface reaction. These contributions to the time delay are interpreted in terms of an effective diffusivity, which is a function of the pressure on the entrance side and the thickness of the membrane. G.R.


The chemisorption of gases on well-defined, supported metal particles is a model for basic processes in heterogeneous catalysis. In this study, the chemisorption and decomposition of carbon monoxide on palladium and nickel particles was examined as a function of particle size. Particulate films with average particle sizes ranging from 1 to 10 nm were grown by vapor deposition on UVH-cleaned mica. Successive CO adsorption-desorption cycles resulted in the accumulation of carbon on the particles, which suppressed CO adsorption. The rate of carbon accumulation was strongly dependent on particle size and was higher for Ni than for Pd over the same size range. Carbon was removed from both metals by oxygen treatments at elevated temperatures. However, a mixture of CO and O2 was effective for monitoring the removal of carbon from palladium. (Author)


The hyperbolic scheme is used to efficiently generate smoothly varying grids with good step size control near the body. Although only two dimensional applications are presented, the basic concepts are shown to extend to three dimensions. R.C.T.


Results are presented from a study to define and evaluate the data base for predicting an airframe/propulsion system interference effect shown to be of considerable importance, inlet external drag. The study is focused on supersonic tactical aircraft with highly integrated jet propulsion systems, although some information is included for supersonic strategic aircraft and for transport aircraft designed for high subsonic or low supersonic cruise. The data base for inlet external drag is considered to consist of the theoretical and empirical prediction methods as well as the experimental data identified in an extensive literature search. The state of the art in the subsonic and transonic speed regimes is evaluated. The experimental data base is organized and presented in a series of tables in which the test article, the quantities measured and the ranges of test conditions covered are described for each set of data; in this way, the breadth of coverage and gaps in the existing experimental data are evident. Prediction methods are categorized by method of solution, type of inlet and speed range to which they apply, major features are given, and their accuracy is assessed by means of comparison to experimental data. Author


A method for generating boundary-fitted, curvilinear, two-dimensional grids by the use of the Poisson equations is presented. Grids of C-type and O-type were made about airfoils and other shapes, with circular, rectangular, cascade-type, and other outer boundary shapes. Both viscous and inviscid spacings were used. In all cases, two important types of grid control can be exercised at both inner and outer boundaries. First is arbitrary control of the distances between the boundaries and the adjacent lines of the same coordinate family, i.e., stand-off distances. Second is arbitrary control of the angles with which lines of the opposite coordinate family intersect the boundaries. Thus, both grid cell size (or aspect ratio) and grid cell skewness are controlled at boundaries. Reasonable cell size and shape are ensured even in cases wherein extreme boundary shapes would tend to cause skewness or poorly controlled grid spacing. An inherent feature of the Poisson equations is that lines in the interior of the grid smoothly connect the boundary points (the grid mapping functions are second order differentiable). M.G.

An implicit conservative, noniterative, finite-difference algorithm that predicts the supersonic, laminar or turbulent viscous flow about arbitrary geometries at large angles of attack is presented. The three-dimensional parabolized form of thin-layer Navier-Stokes equations are written in generalized coordinates. These equations are solved using the delta form of the Beam-Warming implicit algorithm. Flow field simulations have been obtained for a blunt bicone with windward and leeward cuts and an X-24C lifting body for both laminar and turbulent flow at various Mach numbers and angles of attack. When compared with experiment or with previous theories, these computational predictions show good agreement. (Author)


Although much progress has already been made in solving problems in aeroelastic design, many new developments are still needed before the equations for unsteady compressible viscous flow can be solved routinely. This paper describes one such development. A method for solving these equations has been devised that: (1) is second-order accurate in space and time; (2) is unconditionally stable; (3) preserves conservation form; (4) requires no block or scalar tridiagonal inversion; (5) is simple and straightforward to program; (6) is more efficient than previous methods; and (7) should easily adapt to current and future computer architectures. Computational results for laminar and turbulent flows at Re numbers from 300,000 to 3 x 10 to the 7th and at CFL numbers as high as 1000 are compared with theory and experiment. (Author)


An investigation of a two-dimensional, free turbulent shear layer reattaching on an inclined surface at Mach 2.92 and at a high Reynolds number is described. The test geometry is specifically designed to isolate the reattachment process of a high-speed separated flow. A numerical solution of the time-dependent, Reynolds-averaged, Navier-Stokes equations for the entire flow field, employing a two-equation eddy viscosity turbulence model, is presented. Detailed comparisons of prediction and experiment are made in the free shear layer at reattachment, and in the developing boundary layer downstream. These comparisons include mean surface quantities as well as mean and fluctuating flowfield quantities. Although the overall features of this complex flow field are predicted, there are several deficiencies in the numerical solution, particularly in the region downstream of reattachment. Modifications of the turbulence model to correct these deficiencies are discussed. (Author)


The requirements, constraints, design guidelines, and expected performances of heat-shield systems for a solar probe are analyzed. A multiple-stage, asymmetric, right-angle radiation cascade configuration is used as the basis for comparison. Output-to-input radiation flux ratios are first calculated for a system employing gray surfaces. Assuming that the temperature of the inner surface of the payload bus is allowed to reach 400 K, it is shown that four- and five-stage cascade systems employing graphite can approach, respectively, to within about 8.5 and 4 solar radii of the sun. The systems using slip-cast silica and tungsten are then analyzed accounting for the degradation of surface-optical performance caused by the solar wind. It is shown that two- and three-stage silica-tungsten systems can approach, respectively, to within 4 and 3 solar radii of the sun. (Author)


The energy cost of launching a projectile containing nuclear waste is two orders of magnitude lower with a mass driver than with a typical rocket system. A mass driver scheme will be feasible, however, only if ablation and deceleration are within certain
tolerable limits. It is shown that if a hemisphere-cylinder-shaped projectile protected thermally with a graphite nose is launched vertically to attain a velocity of 17 km/sec at an altitude of 40 km, the mass loss from ablation during atmospheric flight will be less than 0.1 ton, provided the radius of the projectile is under 20 cm and the projectile’s mass is of the order of 1 ton. The velocity loss from drag will vary from 0.4 to 30 km/sec, depending on the mass and radius of the projectile, the smaller velocity loss corresponding to large mass and small radius. Ablation is always within a tolerable range for schemes using a mass driver launcher to dispose of nuclear wastes outside the solar system. Deceleration can also be held in the tolerable range if the mass and diameter of the projectile are properly chosen.

C.R.


A coordinated experimental and computational investigation of the transport and interaction of the individual Reynolds stresses within a turbulent axisymmetric swirling boundary layer flowing over a stationary cylinder is described. The cylinder is instrumented with new directional surface fence skin-friction gages developed for the experiment. The longitudinal and transverse mean velocity profiles are measured with a miniature directional pressure probe. These data provided a standard on which to compare computed results employing a variety of turbulence models. The turbulence models tested range from a simple mixing length model, through a two-equation model, on to the Reynolds stress equation models. The full Reynolds stress equation models are tested with various sets of modeling coefficients for the pressure rate-of-strain correlation. It is shown that while even the simplest model shows the general features of the data, agreement with the experimental data is enhanced through the use of the more complex models. For a better prediction of the data, however, further model improvement is still required.

(Author)


Implicit methods for several fluid dynamic formulations have been developed and applied to steady-state and low-frequency transonic flows. The basic steps involved in the construction of implicit schemes include: selection of linearly stable accurate implicit difference operators, time-linearization of nonlinear terms, and approximate factorization of the implicit operators into easily solved systems of equations. The proposed schemes are found very efficient for the simpler formulations.

V.L.


A three-dimensional vortex-in-cell method has been developed for the evaluation of local flow fields due to a family of vortex filaments which employs the principles and architecture of a code developed for magnetic field evaluation in plasma simulations. The computational effort in the new method, as compared to 'vortex pushing' by direct Biot-Savart interaction, increases directly, rather than quadratically, with the number of vortex elements. The method is well suited for studying large number of vortex filaments or rings and can be used for simulating continuous vorticity.

V.L.


A fast, implicit approximate factorization algorithm for the solution of the conservative full-potential equation for transonic flow in two and three dimensions is presented. Stability in supersonic regions is maintained by the use of an upward evaluation of the density coefficient along all coordinate directions, providing an effective upward difference of the streamline tangent to any orientation of the velocity vector and thereby enhancing the reliability of the algorithm. The algorithm is shown to provide rapid convergence for the computation of certain difficult two-dimensional test cases, including cases with finitial shock patterns, demonstrating the reliability and efficiency of the procedure. Surface pressure coefficient distributions obtained by the present method are also found to be in good agreement with those computed by successive-line overrelaxation and a hybrid direct-solver/overrelaxation scheme, with significant reductions in CPU time required. A three-dimensional solution for a swept wing mounted between parallel walls is also presented which demonstrates the high convergence rate of the algorithm in three dimensions as well as two. A.L.W.

A81-31106* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. AERODYNAMIC MATHEMATICAL MODELING - BASIC CONCEPTS Murray Tobak and Lewis B. Schiff In AGARD Dyn. Stability Parameters May 1981 31 p refs (For primary document see N81-31105 22-01)

A81-31121* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. SOME APPLICATIONS OF AERODYNAMIC FORMULATIONS TO PROBLEMS IN AIRCRAFT DYNAMICS c05
N81-33868* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
A COMPARATIVE STUDY OF NONREFLECTING FAR-FIELD BOUNDARY CONDITION PROCEDURES FOR UNSTEADY TRANSSONIC FLOW COMPUTATION.
Dochan Kwak. In its Numerical Boundary Condition Procedures Oct. 1981 p 21-44 refs (For primary document see N81-33856 24-64)  
Avail: NTIS HC A17/MF A01 CSCL 12A  
Various nonreflecting far-field boundary condition procedures are compared by implementing them in the computer code LTRAN2. This code solves the implicit finite-difference representations of the small-disturbance equations for transonic flows about airfoils. The first- and second-approximate nonreflecting conditions, as proposed by Engquist and Majda, are compared with the condition derived from the full-characteristic equation. The far-field boundary conditions and the description of the algorithm for implementing these conditions in LTRAN2 are discussed. Various cases are computed and compared with results from the older, more conventional procedures. One concludes that the full-characteristic equation produces the most effective results, thus allowing the far-field boundary to be located closer to the airfoil; this decreases the computer time required to obtain the solution because fewer mesh points are required. T.M.

N81-33865* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
CHARACTERISTIC BOUNDARY CONDITIONS FOR THE EUCLID EQUATIONS.
Avail: NTIS HC A17/MF A01 CSCL 12A  
The boundary conditions are demonstrated for the quasi-one-dimensional Euler equations with the extension to two and three dimensions being straightforward. In this application an implicit finite-difference scheme is employed with the boundary conditions being applied implicitly. The boundary application uses both characteristic extrapolations and evaluations which distinguishes it from other theories. Flow fields with shocks are calculated with inflow-outflow conditions of supersonic-subsonic and subsonic-supersonic flow. T.M.

N81-33870* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
STABILITY ANALYSIS OF NUMERICAL BOUNDARY CONDITIONS AND IMPLICIT DIFFERENCE APPROXIMATIONS FOR HYPERBOLIC EQUATIONS.
Avail: NTIS HC A17/MF A01 CSCL 12A  
Implicit, noniterative, finite difference schemes were recently developed by several authors for multidimensional systems of nonlinear hyperbolic partial differential equations. When applied to linear model equations with periodic boundary conditions those schemes are unconditionally stable (A-stable). As applied in practice the algorithms often face a severe time step restriction. A major source of the difficulty is the treatment of the numerical boundary conditions. One conjecture was that unconditional stability requires implicit numerical boundary conditions. An apparent counterexample was the space time extrapolation considered by Gustafsson, Kreiss, and Sundstrom. Spatial (implicit) and space time (explicit) extrapolation using normal mode analysis for a finite and infinite number of spatial mesh intervals are examined. The results indicate that for unconditional stability with a finite number of spatial mesh intervals, the numerical boundary conditions must be implicit. Author

N81-33875* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
IMPLICIT BOUNDARY CONDITIONS FOR THE SOLUTION OF THE PARABOLIZED NAVIER-STOKES EQUATIONS FOR SUPERSONIC FLOWS.
Prepared in cooperation with Cincinnati Univ. (For primary document see N81-33856 24-64) (Contracts NCA2-OR130-301; NCA2-OR130-101)  
Avail: NTIS HC A17/MF A01 CSCL 12A  
A fully implicit set of boundary conditions is developed for the solution of the parabolized Navier-Stokes equations for supersonic flow in two dimensions. Shock fitting is employed at the shock and the body has no-slip and specified temperature conditions. A specified heat transfer condition at the wall can be handled in a similar manner. In addition, the shock location is advanced in space in a fully implicit manner by utilizing the Rankine-Hugoniot conditions along with global conservation of mass. Author

An examination and analysis is presented of the elevated temperature fatigue behavior of multidirectional graphite-epoxy laminates in terms of single lamina behavior. The laminate strength is predicted by considering the cyclic stress field in each lamina, the interlaminar stresses, and the experimentally determined temperature-effect 'shifting factors'. The initial failure of a lamina in a laminate is examined first in terms of stress redistribution, and then in terms of total failure and final laminate fracture; these analytical results are then compared with the actual fatigue behavior of T300/5208 graphite-epoxy composite laminates. In view of the agreement obtained, it is concluded that the temperature 'shifting factors' introduced here enable one to predict long-term behavior at a given temperature from short-time testing at elevated temperatures. O.C.

For the oncoming decade it is anticipated that new generations of high-capacity and high-speed computers will appear and that some
of them will be dedicated to fluid dynamics applications. An attempt is made here to examine the potential for a new generation of numerical techniques that will accompany the computer advances. Possibilities for improvement in solution techniques, grid adaptations, turbulence approximations, language constructions, and general code robustness are considered.

(Author)


A computer code has been developed that couples a fast transonic full-potential AF2 solver with both an efficient integral boundary-layer method and a viscous wedge approximation of the shock boundary-layer interaction. The efficiency of the coupled analysis methods and the method of coupling has resulted in a uniquely efficient analysis tool. The airfoil geometry is modified by the displacement thickness before the shock and the displacement thickness plus the viscous wedge thickness after the shock by considering the viscous effects as an equivalent transpiration boundary condition. The flow about conventional and supercritical airfoils under moderately strong shock situations has been calculated. Comparisons with experimental data indicate that this viscous correction method has improved the accuracy of the full-potential analysis. Furthermore, the computer time required to obtain a converged solution has been reduced.

(Author)


The applicability to practical calculations of recent theoretical developments in the stability analysis of difference approximations for initial-boundary-value problems of the hyperbolic type. For the numerical experiments, select the one-dimensional inviscid gas-dynamic equations in conservation-law form is selected. A class of implicit schemes based on linear multistep methods for ordinary differential equations is chosen and the use of space or space-time extrapolations as implicit or explicit boundary schemes is emphasized. Some numerical examples with various inflow-outflow conditions highlight the commonly discussed issues: explicit versus implicit boundary schemes, unconditionally stable schemes, and underspecification or overspecification of boundary conditions.

(Author)


A new algorithm for generating solution-adaptive grids (SAG) about airfoil configurations embedded in transonic flow is presented. The present SAG approach uses only the airfoil surface solution to recluster grid points on the airfoil surface, i.e., the reclustering problem is one dimension smaller than the flow-field calculation problem. Special controls automatically built into the elliptic grid generation procedure are then used to obtain grids with suitable interior behavior. This concept of redistributing grid points greatly simplifies the idea of solution-adaptive grids. Numerical results indicate significant improvements in accuracy for SAG grids relative to standard grids using the same number of points.

(Author)


Numerical simulations were made of two-dimensional transonic flows in diffusers, including flow separation induced by a shock or adverse pressure gradient. The mass-averaged, time-dependent, compressible Navier-Stokes equations, simplified by the thin-layer approximation, were solved using MacCormack's hybrid method. The eddy-viscosity formulation was described by the Wilcox-Rubesin's two-equation, k-omega model. Detailed comparison of the computed results with measurements showed good agreement in all cases, including one with massive separation induced by a strong shock. The computation correctly predicted the details of a distinct lambda shock pattern, closely duplicating the configuration observed experimentally in spark-schlieren photographs.

(Author)


Numerical solutions for two-dimensional, time-dependent, separated flows around bodies are obtained, using a new version of the vortex method. This method provides an efficient representation of flows involving large regions of separation. The modifications incorporated in the new version, which improve its accuracy, versatility, and computing speed, are described. The computer cost is only of the order of the 3/2 power on N, instead of N-squared, for each step with N vortices. Arbitrary shapes can be treated with a conformal mapping that is not required. Special attention is paid to the viscous character of the solution and to the accurate computation of the pressure distribution at the body surface. The vortex solution for the outer flow is coupled to an inner solution for the attached part of the boundary layer. Numerical results are presented for several bluff bodies exhibiting dependence on Reynolds number, for stationary airfoils under steady or transient conditions and for oscillating airfoils, including dynamic stalls. These results are compared with other available results, analytical or experimental, and demonstrate the enhanced reliability and accuracy of the improved method.

(Author)


An efficient implicit numerical method that solves the compressible Navier-Stokes equations in arbitrary curvilinear coordinates by the finite-volume technique is presented. An intrinsically dissipative difference scheme and a fully implicit treatment of boundary conditions, based on characteristic and conservation concepts, are used to improve stability and accuracy. Efficiency is achieved by using a diagonal form of the implicit algorithm and spatially varying time-steps. Comparisons of various schemes and methods are presented for one- and two-dimensional flows, including transonic
corresponding thermal protection requirements. (Author)

Material response solutions for the forebody heat shield on the Probe are presented. A charring material that rival the free-stream mass flux. This paper presents a comprehensive survey of the experimental work and computational research that provide technological support for the Probe's heat-shield design effort. The survey includes atmospheric modeling; both approximate and first-principle computations of flow fields and heat-shield material response; base heating; turbulence modeling; new computational techniques; experimental heating and materials studies; code validation efforts; and a set of 'consensus' first-principle flow-field solutions through the entry maneuver, with predictions of the corresponding thermal protection requirements. (Author)


The approaches of three computer flow field codes (HYVIS, COLTS, and RASLE), used to determine the Galileo Probe aerothermal environment and its effect on the design of the thermal protection system, are analyzed in order to resolve differences in their predicted results. All three codes account for the hypersonic, massively blown, radiation shock layers, characteristic of Jupiter entry. Significant differences, however, are evident in their solution procedures: the governing conservation equations, the numerical difference schemes, the governing physics (chemistry, radiation, diffusion, and turbulence models), and the basic physical data (thermodynamic, transport, chemical, and spectral properties for atomic and molecular species). Solutions are compared for two near peak heating entry conditions for a Galileo Probe baseline configuration, having an initial mass of 242 kg and simulating entry into the Orton nominal atmosphere. The modern numerical methodology of COLTS and RASLE appear to provide an improved capability for coupled flow-field solutions. J.F.


The Galileo Probe, which is scheduled to be launched in 1985 and to enter the hydrogen-helium atmosphere of Jupiter up to 1,475 days later, presents thermal protection problems that are far more difficult than those experienced in previous planetary entry missions. The high-entry speed of the Probe will cause forebody heating rates orders of magnitude faster. (Author)


Material response solutions for the forebody heat shield on the candidate 310-kg Galileo Probe are presented. A charring material ablation analysis predicts thermochemical surface recession, insulation thickness, and total required heat shield mass. Benchmark shock layer solutions provide the imposed entry heating environments on the ablating surface. Heat shield sizing results are given for a nominal entry into modeled nominal and cool-heavy Jovian atmospheres, and for two heat-shield property models. The nominally designed heat shield requires a mass of at least 126 kg and would require an additional 13 kg to survive entry into the less probable cool-heavy atmosphere. The material-property model with a 30% surface reflectance reduces these mass requirements by as much as 16%. (Author)


The relative concentrations of vapors produced from carbon phenolic composites under thermal loadings approximating those expected at peak heating during vehicle entry into the atmospheres of the outer planets have been determined. The technique of vaporizing the surface of bulk samples by laser irradiation while measuring in situ the vapor species by mass spectrometry is described. Results show that vapor composition varies with irradiance level and with depth of heating (or extent of pyrolysis). Attempts are made to compare these experimental results with the theoretical predictions from computer codes. (Author)
A Space Shuttle experiment planned to measure the surface catalytic efficiency of the baseline high-temperature reusable surface insulation (HRSI) during earth entry is described. A spray-on overcoat, with high catalytic efficiency, will be used as a comparative basis for determining the HRSI surface catalytic efficiency through surface temperature measurement. Catalytic efficiency, as well as aerothermal response of the overcoat, was evaluated, using various models made of HRSI material in arc-plasma flow environments. Agreement is obtained between the measured and computed heating rise of the coated surfaces. Computed predictions for the flight case are presented.

(Patent)

**PATENTS**

N81-13999* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**STRUCTURAL WOOD PANELS WITH IMPROVED FIRE RESISTANCE** Patent


Structural wood paneling or other molded wood compositions consisting of finely divided wood chips, flour, or strands are bound together and hot pressed with a modified novolac resin which is the cured product of a prepolymer made from an aralkyl ether or halide with a phenol and a hardening agent such as hexamethylene tetramine. The fire resistance of these articles is further improved by incorporating in the binder certain inorganic fillers, especially a mixture of ammonium oxalate and ammonium phosphate.

Official Gazette of the U.S. Patent and Trademark Office
Two tests of vestibular functioning in the rat were developed. The first test was the water maze. In the water maze the rat
was exposed to the water maze and the rat's behavior was measured. The major problem was incorrect
initial assumptions of what the rat's probable behavior on the parallel swing would be. S.F.

The effects of space flight conditions on the activities of certain enzymes regulating carbohydrate and lipid metabolism in rat liver are investigated in an attempt to account for the losses in body weight observed during space flight despite preflight caloric consumption. Liver samples were analyzed for the activities of 32 cytosolic and microsomal enzymes as well as hepatic glycogen and individual fatty acid levels for ground control rats and rats flown on board the Cosmos 936 biosatellite under normal space flight conditions and in centrifuges which were sacrificed upon recovery or 25 days after recovery. Significant decreases in the activities of glycogen phosphorylase, alpha-glycerol phosphate acyl transferase, diglyceride acyl transferase, aconitase and 6-phosphogluconate dehydrogenase and an increase in palmitoyl CoA desaturase are found in the flight stationary relative to the flight centrifuged rats upon recovery, with all enzymes showing alterations returning to normal values 25 days postflight. The flight stationary group is also observed to be characterized by more than twice the amount of liver glycogen of the controls. Both flight and synchronous control rats were sacrificed at three time intervals: R+0. 7-11 hours after recovery; R+6, after 6 days; R+6(5), after 6 days (having undergone 2-5 hour periods of fixed stress in a 'backupward' position on days 0, 3, 4, 5 and 6) and R+29, after 29 days post-flight. Although most of the enzyme activities and the amounts of liver constituents studied were unaffected by the period of weightlessness, some significant differences were observed. J.D.H.
The effects of environmental synchronizers upon circadian rhythmic stability in man and the deleterious alterations in performance and which result from changes in this stability are points of interest in a review of selected literature published between 1972 and 1980. A total of 2,084 references relevant to pilot performance and which result from changes in this stability are points of interest in a review of selected literature published between 1972 and 1980.

**NASA TECHNICAL MEMORANDA**

**N81-14600**
National Aeronautics and Space Administration.
Ames Research Center. Moffett Field, Calif.
**THE ADRENAL STEROIDOGENIC RESPONSE TO ACTH**
John P. Heybach and Joan Vernikos. Dec. 1980 17 p refs
(NASA-TM-81253; A-8416) Avail: NTIS HC A02/MF A01
CSCL 06P

The adrenal actions were stereospecific since neither the positive stereosomer of morphone, nor that of naloxone, had any effect on the adrenal response to exogenous adrenocorticotropic hormone (ACTH). The administration of human beta endorphin to phyophysectomized rats had no effect on the adrenal corticosterone concentration nor did it alter the response of the adrenal gland to ACTH. These results indicate that morphine can potentiate the action of ACTH on the adrenal by a direct, stereospecific, dose dependent mechanism that is prevented by naloxone pretreatment and which may involve competition for ACTH receptors on the corticosterone secreting cells of the adrenal cortex. **Author**

**N81-17892**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**USE OF AN ELECTRICAL RESISTANCE HYGROMETER TO MEASURE HUMAN SWEAT RATES**
Toshikazu Goga. Oct. 1980 30 p refs
CSCL 06P

The application of the resistance hygrometer as a tool to measure the localized sweat rate from the human body in both the active and passive sweat regions was studied. It was found that the physiological function of the skin membrane and fluid carrier transport phenomena from the outer skin have an indistinguishable effect on the observed findings from the instrument. The problems associated with the resistance hygrometer technique are identified and the usage of the instrument in the physiological experimentation from the engineering standpoint is evaluated. **Author**

**N81-24720**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**EFFECTS OF CIRCADIAN RHYTHM PHASE ALTERATION ON PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES: IMPLICATIONS TO PILOT PERFORMANCE (INCLUDING A PARTIALLY ANNOTATED BIBLIOGRAPHY)**
CSCL 06P

The effects of environmental synchronizers upon circadian rhythmic stability in man and the deleterious alterations in performance and which result from changes in this stability are points of interest in a review of selected literature published between 1972 and 1980. A total of 2,084 references relevant to pilot performance and which result from changes in this stability are points of interest in a review of selected literature published between 1972 and 1980. **Author**

**N81-24721**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**A 14-DAY GROUND-BASED HYPOKINESIA STUDY IN NONHUMAN PRIMATES: A COMPILATION OF RESULTS**
L. Kazarian (Wright-Patterson AFB, Ohio), C. Cann (California Univ.), M. Farfitt (Henry Ford Hospital), D. Simmons (Washington Univ.), and E. Morey-Holton. Apr. 1981 62 p refs
CSCL 06S

A 14-day ground based hypokinesia study with rhesus monkeys was conducted to determine if a spaceflight of similar duration might affect bone remodeling and calcium homeostasis. The monkeys were placed in total body casts and sacrificed either immediately upon decasting or 14 days after decasting. Changes in vertebral strength were noted and further deterioration of bone strength continued during the recovery phase. Resorption in the vertebrae increased dramatically while formation decreased. Cortical bone formation was impaired in the long bones. The immobilized animals showed a progressive decrease in total serum calcium which rebounded upon remobilization. Most mandibular parameters remained unchanged during casting except for retardation of osteon birth or maturation rate and density distribution of matrix and mineral moieties. **Author**

**N81-25855**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**US PLANT AND RADIATION DOSIMETRY EXPERIMENTS FLOWN ON THE SOVIET SATELLITE COSMOS 1129**
CSCL 06S

Experiments included: 30 young male Wistar SPF rats used for wide range physiological studies; experiments with plants, fungi, insects, and mammalian tissue cultures; radiation physics experiments; a heat convection study; a rat embryo/lymphoid experiment in which an attempt was made to breed 2 male and 5 female rats during the flight; and fertile quail eggs used to determine the effects of spaceflight on avian embryogenesis. Specimens for US experiments were initially prepared at the recovery site or in Moscow and transferred to US laboratories for complete analyses. An overview of the mission focusing on preflight, on orbit, and postflight activities pertinent to the fourteen US experiments aboard Cosmos 1129 is presented. **T.M.**

**N81-32830**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**US RAT EXPERIMENTS FLOWN ON THE SOVIET SATELLITE COSMOS 1129**
CSCL 06C

The physiological effects of an 18.5 day space flight on young male Wistar rats, on rat embryology, and on fertile quail eggs are described. For individual titles, see N81-32831 through 32845. **Author**

**N81-32832**
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**BASED BIORYTHM METHOD FOR PREDICTING AIRCRAFT ACCIDENT SUSCEPTIBILITY**
A.R.H.

**BIOMEDICAL RESEARCH DIVISION**

**NASA TECHNICAL MEMORANDA**

**N81-14600**
National Aeronautics and Space Administration.
Ames Research Center. Moffett Field, Calif.
**NALOXONE INHIBITS AND MORPHINE POTENTIATES, THE ADRENAL STEROIDOGENIC RESPONSE TO ACTH**
John P. Heybach and Joan Vernikos. Dec. 1980 17 p refs
(NASA-TM-81253; A-8416) Avail: NTIS HC A02/MF A01
CSCL 06P

The adrenal actions were stereospecific since neither the positive stereosomer of morphine, nor that of naloxone, had any effect on the adrenal response to exogenous adrenocorticotropic hormone (ACTH). The administration of human beta endorphin to phyophysectomized rats had no effect on the adrenal corticosterone concentration nor did it alter the response of the adrenal gland to ACTH. These results indicate that morphine can potentiate the action of ACTH on the adrenal by a direct, stereospecific, dose dependent mechanism that is prevented by naloxone pretreatment and which may involve competition for ACTH receptors on the corticosterone secreting cells of the adrenal cortex. **Author**
EXPERIMENT K306: QUANTITATIVE ANALYSIS OF SELECTED BONE PARAMETERS Final Report


The skeletal alterations induced by space flight were determined to be a reduced rate of perosteal bone formation in tibial and humerous diaphyses, a decreased trabecular bone volume, and an increased fat content of the bone marrow in the proximal tibial metaphysis. An increased incidence of arrest lines in flight animals suggested that perosteal bone formation may have ceased during space flight. Endosteal bone resorption was not affected markedly.

Author

N81-32835*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K306: QUANTITATIVE ANALYSIS OF SELECTED BONE PARAMETERS. SUPPLEMENT 1: EFFECTS OF WEIGHTLESSNESS ON OSTEOBLAST DIFFERENTIATION IN RAT MOLAR PERIODONTIUM Final Report

W. Eugene Roberts (Univ. of the Pacific, San Francisco), Peter G. Mozsayr (Univ. of The Pacific, San Francisco), and Emily Morey-Holton In its US Rat Expts. Flown on the Soviet Satellite Cosmos 1129 Aug. 1981 p 127-148 refs (For primary document see N81-32830 23-51) Avail: NTIS HC A19/MF A01 CSCL 06C

The morphometric analysis of periodontal ligament (PDL), the osteogenic interface between tooth and bone, is described. Immediately post-flight, PDL width and total cell number were decreased. Frequency distributions of nuclear volume revealed that presumptive preosteoblasts were particularly depressed. Decreased numbers of preosteoblasts may be an important factor in the mechanism of inhibited bone formation during weightlessness.

J.D.H.

N81-32845*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K317: BONE RESORPTION IN RATS DURING SPACEFLIGHT Final Report


Direct measurement of bone resorption in flight and synchronous control rats is described. Continuous tracer administration techniques were used, with replacement of dietary calcium with isotopically enriched Ca40 and measurement by neutron activation analysis of the Ca48 released by the skeleton. There is no large change in bone resorption in rats. Based on the time course of changes, the measured 20-25% decrease in resorption is probably secondary to a decrease in total body calcium turnover. The excretion of sodium, potassium and zinc all increase during flight, sodium and potassium to a level 4-5 times control values.

J.D.H.

NASA CONTRACTOR REPORTS

N81-15663*# San Francisco State Univ., Calif. Dept. of Biological Sciences.

EFFECTS OF CENTRIFUGATION ON GONADAL AND ADRENOCORTICAL STEROIDS IN RATS Final Report

1 Nov. 1979 - 31 Oct. 1980


Many endocrine systems are sensitive to external changes in the environment. Both the pituitary adrenal and pituitary gonadal systems are affected by stress including centrifugation stress. The effect of centrifugation on the pituitary gonadal and pituitary adrenocortical systems was examined by measuring the gonadal and adrenal steroids in the plasma and brain following different duration and intensity of centrifugation stress in rats. Two studies were completed and the results are presented. The second study was carried out to describe the developmental changes of brain, plasma and testicular testosterone and dihydrotestosterone in Sprague Dawley rats so that the effect of centrifugation stress on the pituitary gonadal system could be better evaluated in future studies.

T.M.

N81-25665*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

HABITUATION TO NOVEL VISUAL VESTIBULAR ENVIRONMENTS WITH SPECIAL REFERENCE TO SPACE FLIGHT Final Report

1974 - 1980


Author
jumping than in running, which finding could be of use in the design
of procedures to avert decohconditioning in persons exposed to
weightlessness: A.L^W.

A mathematical model consisting of a uniform, linear, visco-elastic, Euler-Bernoulli beam to represent the ulna or tibia of the vibrating forearm or leg system is developed. The skin and tissue covering the bone and bone is represented by a spring in series with the beam. The remaining skin and tissue surrounding the bone is represented by a visco-elastic foundation with mass. An extensive parametric study is carried out to determine the parametric values of the model on its impedance response. A system identification algorithm is developed and programmed on a digital computer to determine the parametric values of the model which best simulate the data obtained from an impedance test. E.D.K.

The etiology of space motion sickness and the underlying physiological mechanisms associated with spatial orientation in a space environment were investigated. Human psychophysical experiments were used as the basis for the research concerning the interaction of visual and vestibular cues in the development of motion sickness. Particular emphasis is placed on the conflict theory in terms of explaining these interactions. Research on the plasticity of the vestibulo-ocular reflex is discussed. T.M.

BOOKS AND CHAPTERS OF BOOKS


The distribution of body acceleration and associated oxygen uptake and heart rate responses are investigated in treadmill running and trampoline jumping. Accelerations in the +Gz direction were measured at the lateral ankle, lumbosacral region and forehead of eight young men during level treadmill walking and running at four speeds and trampoline jumping at four heights, together with corresponding oxygen uptake and heart rate. With increasing treadmill speed, peak acceleration at the ankle is found always to exceed that at the back and forehead, and acceleration profiles with higher frequency components than those observed during jumping are observed. Acceleration levels are found to be more uniformly distributed with increasing height in jumping, although comparable oxygen uptake and heat rates are obtained. Results indicate that the magnitude of the biomechanical stimuli is greater in trampoline jumping than in running, which finding could be of use in the design of procedures to avert decohconditioning in persons exposed to weightlessness. A.L.W.


The experimental studies on the mitochondria of insect and mammalian cells are examined with a view to an analysis of intrinsic mitochondrial senescence, and its relation to the age-related changes in other cell organelles. The fine structural and biochemical data support the concept that the mitochondria of fixed postmitotic cells may be the site of intrinsic aging because of the attack by free radicals and lipid peroxides originating in the organelles as a by-product of oxygen reduction during respiration. Although the cells have numerous mechanisms for counteracting lipid peroxidation injury, there is a slippage in the antioxidant protection. Intrinsic mitochondrial aging could thus be considered as a specific manifestation of oxygen toxicity. It is proposed that free oxygen radicals injure the cell membrane and an increasing number of the mitochondria unable to divide, probably because of damage to the lipids of the inner membrane and to mitochondrial DNA. L.S.

A study on the effects of five H1 and H2 antihistamines on the synapsosomal uptake of serotonin (5HT), norepinephrine (NE), and dopamine (DA) is presented. Brain homogenates from female rats were incubated in Krebs-Ringer phosphate buffer solution in the presence of one of three radioactive neurotransmitters, and one of the five antihistamines. Low concentrations of pyrilamine competitively inhibited 5HT uptake, had little effect on NE uptake, and no effect on DA uptake. Promethazine, diphenhydramine, metiamide, and cimetidine had no effect on 5HT or DA uptake at the same concentration. Diphenhydramine had a small inhibitory effect on NE uptake. It is concluded that pyrilamine is a selective and potent competitive inhibitor of 5HT uptake at concentrations between .05 and .5 micromolars.


The possible role of hemodilution in the early stages of water immersion in the suppression of antidiuretic hormone (vasopressin) and subsequent diuresis in man is investigated. Parameters characterizing hemodilution as well as water balance and intercompartmental fluid levels were measured before, during, and after the immersion of 10 subjects in a semireclining position in tap water up to their necks at 34.8 °C for 8 hr. Results indicate that hemodilution and the suppression of vasopressin and plasma renin activity were present by the second hour of immersion, with the early hemodilution due to a slight increase in plasma volume with no change in plasma sodium or osmotic contents, even though urine volume and osmotic excretion rates increased significantly. Hypotension, hyposmolarity, and plasma renin activity suppression are observed to continue to the end of immersion, resulting in final decreases of 15.7% in plasma volume, 18.9% in extracellular volume, 19.6% in interstitial volume and 10.7% in red cell volume. Findings suggest the transfer of hypotonic fluid into the vascular system, which contributes to vasopressin suppression observed during immersion.


Rats induced into a hypermetabolic state by exposure to chronic (7 mo) centrifugation at 4.15 g exhibited increased glucose uptake at lower plasma insulin levels than weight-matched control animals following oral glucose administration. In order to determine the insulin sensitivity of specific tissues, the effect of exogenous insulin on glucose uptake by isolated perfused livers and hindlim skeletal muscle from rats adapted to chronic centrifugation for one year was compared with perfused tissue from 2.5 mo-old noncentrifuged control animals of equal body weight. Metabolic glucose clearance by skeletal muscle from hypergravic rats did not prove significantly greater than control muscle when perfused in the absence of insulin (10.6 vs 8.1 microliters/min·g-muscle), but was twice as fast (23.0 vs 9.5) at perfusate insulin levels of 35 micro-U/ml. Conversely, glucose uptake by hypergravic livers was significantly decreased (P is less than 0.001) compared with control livers (10.3 vs 27.8) at perfusate insulin levels of 40 micro-U/ml. Results suggest that skeletal muscle rather than liver is primarily responsible for the enhanced sensitivity to insulin and the increased energy expenditure observed in rats subjected to hypergravity.


The relation of changes in plasma volume, plasma renin activity and arginine vasopressin to changes in resting blood pressure during exercise training is investigated. Resting supine, sitting, and standing systolic and fifth-phase diastolic blood pressures were measured in ten men before and after an eight-day training period on a cycle ergometer in either a hot (30.8 °C) or cool (23.6 °C) environment, and compared with plasma volume, renin and vasopressin levels, heart rates, maximal oxygen uptakes, rectal temperatures and sweat rates. Following acclimatization, resting supine and sitting diastolic pressures are observed to decrease by 6 and 9 mm Hg, respectively, while no significant changes are found in the diastolic pressures of the control group or the systolic pressures of either group. Resting plasma volume is found to increase by 12.2% in the controls and by 17.6% after acclimatization following the exercise training. Results suggest that the resting hypotension produced is not attributable to changes in resting plasma volume, renin or vasopressin, although heat acclimatization, which leads to large decreases in plasma volume and increases in vasopressin and renin activity, may be useful in the treatment of hypertension.


PATENTS

N81-14613 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INDOMETH ACIN ANTIHISTAMINE COMBINATION FOR GASTRIC ULCERATION CONTROL Patent


An anti-inflammatory and analgesic composition containing indomethacin and an H2 histamine receptor antagonist in an amount sufficient to reduce gastric distress caused by the indomethacin was developed. Usable antagonists are metiamide and cimetidine.

Official Gazette of the U.S. Patent and Trademark Office

N81-29783 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SWEAT COLLECTION CAPSULE Patent


A sweat collection capsule permitting quantitative collection of sweat is described. The device consists of a frame held immoveable on the skin, a closure secured to the frame and absorbent material
GASTRIC ULCERATION CONTROL Patent

INDOMETHACIN-ANTIHISTAMINE COMBINATION FOR GASTRIC ULCERATION CONTROL Patent

NASA TECHNICAL MEMORANDA

N81-32865* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

SIMULATED SPACEFLIGHT EFFECTS ON MATING AND PREGNANCY OF RATS

The mating of rats was studied to determine the effects of: simulated reentry stresses at known stages of pregnancy, and full flight simulation, consisting of sequential launch stresses, group housing, mating opportunity, diet, simulated reentry, and postreentry isolation of male and female rats. Uterine contents, adrenal mass and abdominal fat as a proportion of body mass, duration of pregnancy, and number and sex of offspring were studied. It is found that: (1) parturition following full flight simulation was delayed relative to that of controls; (2) litter size was reduced and resorptions increased compared with previous matings in the same group of animals; and (3) abdominal fat was highly elevated in animals that were fed the Soviet paste diet. It is suggested that the combined effects of diet, stress, spacecraft environment, and weightlessness decreased the probability of mating or of viable pregnancies in the Cosmos 1129 flight and control animals. E.A.K.

NASA CONTRACTOR REPORTS


JET-DIFFUSER EJECTOR - ATTACHED NOZZLE DESIGN Final Report

Attached primary nozzles were developed to replace the detached nozzles of jet-diffuser ejectors. Slotted primary nozzles located at the inlet lip and injecting fluid normal to the thrust axis, and rotating the fluid into the thrust direction using the Coanda Effect were investigated. Experiments indicated excessive skin friction or momentum cancellation due to impingement of opposing jets resulted in performance degradation. This indicated a desirability for location and orientation of the injection point at positions removed from the immediate vicinity of the inlet surface, and at an acute angle with respect to the thrust axis. Various nozzle designs were tested over a range of positions and orientations. The problems of aircraft integration of the ejector, and internal and external nozzle losses were also considered and a geometry for the attached nozzles was selected. The effect of leaks, protrusions, and asymmetries in the ejector surfaces was examined. The results indicated a relative insensitivity to all surface irregularities, except for large protrusions at the throat of the ejector. J.M.S.
on hemolysis and appears to normalize the hemolytic rate in the early postflight period. (Author)


The design details and rationale for a versatile, long-range, long-life telemetry data acquisition system for heart rates and body temperatures at multiple locations from free-ranging animals are presented. The design comprises an implantable transmitter for short to medium range transmission, a receiver retransmitter collar to be worn for long-range transmission, and a signal conditioner interface circuit to assist in signal discrimination and demodulation of receiver or tape-recorded audio outputs. Implanted electrodes are used to obtain an ECG, from which R-wave characteristics are selected to trigger a short RF pulse. Pulses carrying heart rate information are interrupted periodically by a series of pulse interval modulated RF pulses conveying temperature information sensed at desired locations by thermistors. Pulse duration and pulse sequencing are used to discriminate between heart rate and temperature pulses as well as radio frequency interference. The implanted transmitter may be used alone for medium and short-range tracking, or with a receiver-transmitter collar that employs commercial tracking equipment for transmissions of up to 12 km. A system prototype has been tested on a dog.


The considered LSFE program focuses on Spacelab life sciences missions planned for the 1984-1985 time frame. Life Sciences Spacelab payloads, launched at approximately 18-months intervals, will enable scientists to test hypotheses from such disciplines as vestibular physiology, developmental biology, biochemistry, cell biology, plant physiology, and a variety of other life sciences. An overview is presented of the LSFE program that will take advantage of the unique opportunities for biological experimentation possible on Spacelab, Program structure, schedules, and status are considered along with questions of program selection, and the science investigator working groups. A description is presented of the life sciences laboratory equipment program, taking into account the general purpose work station, the research animal holding facility, and the plant growth unit.

G.R.


The modular Research Animal Holding Facility (RAHF) developed by NASA is described. Besides providing general housing for various animal species, the RAHF is designed to minimize disturbance of the specimens caused by vehicle and mission operations. The RAHF system offers life-sustaining capabilities, such as food, water, and waste removal, as well as environmental control. Modularity of construction to accommodate a variety of small animals and associated instrumentation ensures continued use of RAHF as the sophistication of experiments increases on subsequent missions.

C.R.

PATENTS


A subcutaneous electrode structure suitable for a chronic implant and for taking a low noise electrocardiogram of an active animal, comprises a thin inflexible, smooth disc of stainless steel having a diameter of 5 to 30 mm, which is secured in place to the animal being monitored. The disc electrode, a radially directed slot extending from in the periphery of the disc to approximately 1/3 of the diameter. Electrical connection is made to the disc by means of a flexible lead wire that extends longitudinally of the slot and is woven through apertures in the disc and held at the terminal end by means of a spot welded tab. Within the slot, an electrically insulative sleeve, such as silicone rubber, is placed over the wire. The wire with the sleeve mounted thereon is captured in the plane of the disc and within the slot by means of crimping tabs extending laterally of the slot and over the insulative wire. The marginal lip of the slot area is apertured and an electrically insulative potting material such as silicone rubber, is potted in place overlaying the wire slot region and through the apertures.

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EXTRATERRESTRIAL RESEARCH DIVISION

NASA TECHNICAL MEMORANDA


(A81-34050: AD-A096079: U-of-Iowa-80-12) Avail: NTIS HC A04/M F01 CSCL 03/2

The solar wind plasma analyzer on board Pioneer 2 provides first observations of low-energy positive ions in the magnetosphere of Saturn. Measurable intensities of ions within the energy-per-unit charge (E/Q) range 100 eV to 8 keV are present over the planetocentric radial distance range about 4 to 15 R sub S in the dayside magnetosphere. The plasmas are found to be rigidly corotating with the planet out to distances of at least 10 R sub S. At radial distances beyond 10 R sub S the bulk flows appear to be in the corotation direction but with lesser speeds than
those expected from rigid rotation. At radial distances beyond the orbit of Rhea at 8.8 R sub S, the dominant ions are most likely protons and the corresponding typical densities and temperatures are 0.8/cu cm and 1,000,000 K, respectively, with substantial fluctuations. It is concluded that the most likely source of these plasmas in the photodissociation of water frost on the surface of the ring material with subsequent ionization of the products and radially outward diffusion. The presence of this plasma torus is expected to have a large influence on the dynamics of Saturn’s magnetospheric since the pressure ratio beta of these plasmas approaches unity at radial distances close to the planet as 6.5 R sub S. On the basis of these observational evidences it is anticipated that quasi-periodic outward flows of plasma, accompanied with a reconfiguration of the magnetosphere beyond about 6.5 R sub S, will occur in the local night sector in an attempt to relieve the plasma pressure from accretion of plasma from the rings. 

Author

NASA CONTRACTOR REPORTS

N81-18650*# California Univ., Davis.
PRELIMINARY REPORT ON SMALL GROUP FACTORS IN LONG DURATION SPACE FLIGHTS: REVIEW AND DIRECTIONS FOR FUTURE RESEARCH
Albert A. Harrison Sep. 1979 93 prefs
(Contract NCA2-OR180-803) Avail: NTIS HC A05/MF A01 CSCL 065

The behavioral, psychological, and sociological aspects of space travel, particularly with emphasis on longer duration missions, are discussed along with the biomedical aspects of space flight. These factors may strongly interact with the various psycho-social factors and as such they stand as an immensely important area of concern in and of themselves. A foundation for understanding weightlessness related medical problems through a discussion of the history of symptoms reported specific details on the major areas of concern and approaches to their investigation are presented. Also, discussion is given to the possibility of various countermeasures. Some indication of the effects of various biomedical changes in performance are also covered.

T.M.

N81-18651*# Santa Clara Univ., Calif.
PERFORMANCE CONSIDERATIONS IN LONG-TERM SPACEFLIGHT
Faren R. Akins Sep. 1979 93 prefs
(Contract NCA2-OR180-805) Avail: NTIS HC A05/MF A01 CSCL 065

Group dynamics, sociological and psychological factors are examined. Crew composition and compatibility are studied. Group dynamics analysis includes: leadership: cohesiveness: conformity: and conflict.

S.F.

N81-18653*# Santa Clara Univ., Calif.
PRELIMINARY REPORT: BIOMEDICAL CONSIDERATIONS FOR FUTURE MANNED SPACE FLIGHTS
Faren Ray Akins 1 Oct. 1978 93 p refs
(Contract NCA2-OR180-805) Avail: NTIS HC A05/MF A01 CSCL 065

The behavioral, psychological, and sociological aspects of space travel, particularly with emphasis on longer duration missions, are discussed along with the biomedical aspects of space flight. These factors may strongly interact with the various psycho-social factors and as such they stand as an immensely important area of concern in and of themselves. A foundation for understanding weightlessness related medical problems through a discussion of the history of symptoms reported specific details on the major areas of concern and approaches to their investigation are presented. Also, discussion is given to the possibility of various countermeasures. Some indication of the effects of various biomedical changes in performance are also covered.

T.M.
Based on previous experience with crew selection, three important avenues of consideration for future missions are discussed: technical qualifications and expertise; medical fitness and ability to tolerate the various conditions of space; and psychological considerations including personality structure, motivation, intelligence, leadership potential, group compatibility, etc. Primary emphasis was given to the psychological considerations.

T.M.

N81-18665# Life Systems, Inc., Cleveland, Ohio.
PRELIMINARY REPORT ON SOCIAL PSYCHOLOGICAL FACTORS IN LONG DURATION SPACE FLIGHTS: REVIEW AND DIRECTIONS FOR FUTURE RESEARCH
Albert A. Harrison Sep. 1978 99 p refs
(Contract NAS2-9677)
(NASA-CR-152226) Avail: NTIS HC A03/MF A01 CSCL 06K

Group dynamics, sociological and psychological factors are examined. Crew composition and compatibility are studied. Group dynamics analysis includes: leadership; cohesiveness; conformity; and conflict.

S.F.

N81-18665# Umpqua Research Co., Myrtle Creek, Ore.
DESIGN AND FABRICATION OF A FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM Final Report
1 Nov. 1979 38 p
(Contract NASS-9577)
(NASA-CR-152226) Avail: NTIS HC A03/MF A01 CSCL 06K

The integrated system was tested to determine the performance characteristics and limitations of the dual catalyst concept. The primary objective of the dual catalyst concept is to remove ammonia and other noxious substances in the gas phase and thereby eliminate the need for and current practice of chemically or electrochemically pretreating urine prior to distillation.

T.M.

N81-18666# Life Systems, Inc., Cleveland, Ohio.
FAULT DIAGNOSTIC INSTRUMENTATION DESIGN FOR ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS Final Report
(Contract NAS2-10050)
(NASA-CR-152309; LSI-TR-361-5) Avail: NTIS HC A04/MF A01 CSCL 06K

As a development phase moves toward flight hardware, the system availability becomes an important design aspect which requires high reliability and maintainability. As part of continuous development efforts, a program to evaluate, design, and demonstrate advanced instrumentation fault diagnostics was successfully completed. Fault tolerance designs for reliability and other instrumentation capabilities to increase maintainability were evaluated and studied.

T.M.

N81-21261# SRI International Corp., Menlo Park, Calif.
A TACTILE-OUTPUT PAGING COMMUNICATION SYSTEM FOR THE DEAF-BLIND
James A. Baer Dec. 1979 71 p refs
(Contract NAS2-8711)
(NASA-CR-152332) Avail: NTIS HC A04/MF A01 CSCL 17B

A radio frequency paging communication system that has coded vibrotactile outputs suitable for use by deaf-blind people was developed. In concept, the system consists of a base station transmitting and receiving unit and many on-body transmitting and receiving units. The completed system has seven operating modes: fire alarm; time signal; repeated single character Morse code; manual Morse code; emergency aid request; operational status test; and message acknowledge. The on-body units can be addressed in three ways: all units; a group of units; or an individual unit. All the functions developed were integrated into a single package that can be worn on the user's wrist. The control portion of the on-body unit is implemented by a microcomputer. The microcomputer is packaged in a custom-designed hybrid circuit to reduce its physical size.

J.M.S.
A polyester yarn of type 56 Dacron and a urethane coating system were selected. The relationships between yarn and weave parameters which lead to an optimum fabric construction for the 8 psi elbow joint are defined. A.R.H.

**JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS**

A81-10679 * Carbonaceous chondrites. II - Carbonaceous chondrite phyllosilicates and light element geochemistry as indicators of parent body processes and surface conditions. T. E. Bunch and S. Chang (NASA, Ames Research Center, Moffett Field, Calif.). Geochimica et Cosmochimica Acta, vol. 44, Oct. 1980, p. 1543-1577. 111 refs. Petrographic analyses of CM matrices characterized four phyllosilicates in Murray and Murchison meteorites and Fe- and Mg-serpentines in Nogoya. All phyllosilicates and bulk matrices show enrichment of K relative to Na when compared with bulk meteorites; the loss of Na and some Cl, and the addition of H2O, CO2, and water-soluble organics during alteration indicates a partially open system. Synthesis of soluble organic materials may have occurred in CM matrices before aqueous alteration of the precursory phases. Nogoya was 95% altered and has a bulk C content of 5.2%, higher than any meteorite; also, it has the lowest measured C:13/C:12 ratio of any carbonaceous chondrite except for Karoonda. A.T.

A81-14654 * Plasmas in Saturn's magnetosphere. L. A. Frank, B. G. Bursik, K. L. Ackerson (Iowa, University, Iowa City, Iowa), J. H. Wolfe, and J. D. Mihalov (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). Journal of Geophysical Research, vol. 85, Nov. 1, 1980, p. 5695-5708. 27 refs. Grant No. NGL-16-001-002. Passage of Pioneer 11 through Saturn's magnetosphere revealed a third magnetosphere with a high plasma abundance. The dominant ion species appears to be oxygen. The plasma is located in a large torus about Saturn, including the orbits of Dione and Tethys. The plasma is rigidly corotating with the planet to distances of at least 10 Saturn radii. Bulk flows appear to move in the corotation direction, but at speeds lower than those expected from rigid corotation. The ions appear to be the ionization products of water frost on the surface of the ring material. V.P.

A81-18465 * Behavior of molecules on interstellar grains. Application of the Langevin equation and iterative extended Hückel. S. Aronowitz and S. Chang (NASA, Ames Research Center, Extraterrestrial Research Div., Moffett Field, Calif.). Astrophysical Journal, Part 1, vol. 242, Nov. 15, 1980, p. 149-164. 26 refs. NASA Order A-51416-B. The Langevin equation was used to explore an adsorbate desorption mechanism. Calculations were performed using iterative extended Hückel on a silica model site with various small adsorbates, e.g., H, CH, OH, NO, CO. It was found that barriers to free traversal from one site to another are substantial (about 3-10 eV). A bootstrap desorption mechanism for some molecules in the process of forming at a site also became apparent from the calculations. The desorption mechanisms appear to be somewhat balanced by a counterforce - the attraction of sites for the newly desorbed molecule. The order of attraction to a silica grain site for the diatomic molecules considered was OH greater than CH greater than CO greater than NO, when these entities were sufficiently distant. The nature of the silica grain and that of the 'cold' desorption mechanism, when considered together, suggest that the abundance of very small grains might be less common than anticipated. (Author)

A81-10672 * The visual accommodation response during concurrent mental activity. F. V. Malmstrom (Southern California, University, Los Angeles, Calif.), R. J. Randle (NASA, Ames Research Center, Moffett Field, Calif.), J. S. Bendix (Amherst College, Amherst, Mass.), and R. J. Weber (Oklahoma State University, Stillwater, Okla.). Perception and Psychophysics, vol. 28, no. 5, Nov. 1980, p. 440-448. 30 refs. NASA-USAF-supported research; NSF Grant No. 74-20208. The direction and magnitude of the human visual accommodation response during concurrent mental activity are investigated. Subject focusing responses to targets at distances of 0.0 D, 3.0 D and an intermediate distance were monitored by means of an optometer during the performance of a backwards counting task and a visual imagery task (thinking near and thinking far). In both experiments a shift in accommodation towards the visual far point is observed particularly for the near target, which increases with the duration of the task. The results can be interpreted in terms of both the capacity model of Kahneman (1973) and the autonomic arousal model of Hess and Pott (1964), and are not inconsistent with the possibility of an intermediate resting position. A.L.W.

A81-24967 * Formate esters of 1,2-ethanediol - Major decomposition products of p-dioxane during storage. D. Jewett and J. G. Lawless (NASA, Ames Research Center, Moffett Field, Calif.). Bulletin of Environmental Contamination and Toxicology, vol. 25, 1980, p. 118-121. 12 refs. Research done on detecting the contaminants of p-dioxane that cause a positive response for highly reactive acyl groups is discussed. Attention is given to the fact that the positive hydroxamate response might indicate an unsuspected hazard. It is found that all acyl groups transferred are formyl groups, and the mono- and diformates of 1,2-ethanediol are identified as major sources of this activity. It is also found that the formate esters are formed by way of peroxide intermediates. Concentrations of the formate ester group are high, 1.8 M, in partially consumed bottles of dioxane but not in other common ethers stored under similar conditions. Attention is called to the possibility that the exposure to the glycol formates is probably much wider than expected. It is noted that by purging containers of dioxane with nitrogen each time they are opened and storing them in the cold away from light can prevent both the economic loss and possible health hazard caused by contamination with peroxide and formate ester. C.R.

A81-26779 * The solar wind interaction with Venus - Pioneer Venus observations of bow shock location and structure. J. A. Slavin, R. C. Elphic, C. T. Russell (California, University, Los Angeles, Calif.), F. L. Scarf (TRW Defense and Space Systems Group, Redondo Beach, Calif.), J. H. Wolfe, J. D. Mihalov (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.), D. S. Intriligator (Southern California, University, Los Angeles, Calif.), L. H. Brace, H. A. Taylor, Jr., and R. E. Daniell, Jr. (NASA, Goddard Space Flight Center, Laboratory for Planetary Atmospheres, Greenbelt, Md.). Journal of Geophysical Research, vol. 85, Dec. 30, 1980, p. 7625-7641. 88 refs. Contract No. NASA-9491. Pioneer Venus observations are used in carrying out a study of the configuration and structure of the Venus bow shock. The trace of the shock in the solar wind aberrated terminator plane is almost circular at an altitude of 1.38 Venus radii independent of interplanetary magnetic field orientation with an extrapolated subsolar height of 0.38 Venus radii. Gas dynamic relations and scaling of the terrestrial analogue are used in determining the effective impenetrable obstacle altitude from the mean shock surface with the conclusion that it lies beneath the observed height of the ionopause. The short-term variability in shock position is similar to that found at the earth; over the long-term bow shock, altitude varies by up to approximately 35% in phase with the solar cycle for reasons other than changing solar wind Mach number. In contrast to ionopause position, which is shown to be well determined by external pressure measurements, it is found that bow shock altitude is only weakly dependent on ionopause height and solar wind dynamic pressure...

The dynamics of the Venus ionosphere relates to the variations in the solar wind and the ionosheath magnetic fields as demonstrated by the electron density and temperature measurements of the Pioneer Venus orbiter electron probe. The mean ionopause height increases from 330 km at the subsolar point to 700 km at the dusk terminator, and to 1000 km at the dawn terminator: the dayside ionopause expands and contracts with solar wind pressure variations. Extreme spatial irregularities in the shape of holes, horizontally stratified layers, and detached plasma clouds are observed in the nightside ionosphere. The ion pickup on the dayside is described in terms of solar wind discontinuities inducing a wavelike pattern at the ionopause which is penetrated by the ionosheath plasma and magnetic fields which remove the plasma in the form of detached plasma clouds.

A. T.


The data from seven gas analyzer measurements obtained from Pioneer Venus and the Venera 11 and 12 spacecraft are compared, and the chemical composition of the atmosphere from approximately 700 km to the surface is examined. In and near the clouds, the CO mixing ratio is a few ten ppm, and the CO mixing ratio is 20-30 ppm. The existence of COS in the lower part of the atmosphere is doubtful, and its mixing ratio at higher altitudes does not exceed a few ppm. SO2 may exist below the clouds at a mixing ratio of about 100 ppm, whereas in the clouds, it is less than 10 ppm. A discrepancy in the data still exists for the measurement of the water vapor abundance.

A. T.


A gas chromatograph mounted in the Pioneer Venus sounder probe measured the chemical composition of the atmosphere of Venus at three altitudes. Ne, N2, O2, Ar, CO, H2O, SO2, and CO2 were measured, and upper limits set for H2, COS, H2S, CH4, Kr, N2O, C2H4, CH4, and C3H8. Simulation studies have provided indirect evidence for sulfuric acid-like droplets and support the possibility of water vapor at altitudes of 42 and 24 km. The paper discusses the implications of these results for the origin, evolution, and present state of Venus' atmosphere.

Valinomycin and its analogs: ion transport across membranes. Ion binding energies and conformations with the central ions Li+, Na+, K+, Rb+, and Cs+ are investigated as part of a study of the specific preference of valinomycin for potassium and the mechanisms of carrier-mediated ion transport across membranes. Ion binding energies and conformational potential energies are calculated taking into account polarization energy formulas and repulsive energy between the central ion and the ligand atoms for conformations representing various stages in ion capture and release for each of the two ring chiralities of valinomycin and its analogs. Results allow the prediction of the chirality and conformation most likely to be observed for a given analog, and may be used to synthesize analogs with a desired rigidity or flexibility. The binding energies with the alkali metal cations are found to decrease with increasing ion size, and to be smaller than the corresponding ion hydration energies. It is pointed out that the observed potassium preference may be explainable in terms of differences between binding and hydration energies. Binding energies are also noted to depend on ligand conformation.

A. L. W.
A simple, microcomputer-based, interactive graphics display system has been developed for the presentation of perspectives views of wire frame molecular models. The display system is based on a TERAK 8510A graphics computer system with a display unit consisting of microprocessor, television display and keyboard subsystem. The operating system includes a screen editor, file manager, PASCAL and BASIC compilers and command options for linking and executing programs. The graphics program, written in USCD PASCAL, involves the centering of the coordinate systems, the transformation of centered model coordinates into homogeneous coordinates, the construction of a viewing transformation matrix to operate on the coordinates, clipping invisible points, perspective transformation and scaling to screen coordinates; commands available include ZOOM, ROTATE, RESET, and CHANGEVIEW. Data file structure was chosen to minimize the amount of disk storage space. Despite the inherent slowness of the system, its low cost and flexibility suggests general applicability.

A. L. W.

A description is presented of the results of studies of the water and salt transport properties of PVA membranes, taking into account radiation crosslinked PVA membranes, diffusive salt permeability through PVA membranes, and heat treated PVA membranes. The experimental findings support an occurrence of independent water, and salt permeation processes. It is suggested that the salt permeation is governed by a solution-diffusion transport mechanism. The preparation of thin skinned, asymmetric PVA membranes is also discussed. The employed method has a certain similarity to the classical phase inversion method, which is widely applied in the casting of asymmetric reverse osmosis membranes. Instead of using a gelatin bath composed of a nonsolvent for the membrane material and miscible with the solvent from which the membrane is cast, a 'complexing' bath is used, which is a solution of a complexing agent in water.

G. R.

Major changes in the solar wind before, during and after the Pioneer 10 and 11 missions' encounter with the Jovian magnetosphere are considered. A numerical simulation of the multiple corotating interaction region (CIR) evolutions from one spacecraft to its sister spacecraft is shown to have confirmed the suggestion by Smith et al. (1978) that Jupiter's magnetosphere was compressed by interplanetary CIRs during three out of four of the observed events. The MHD simulation presented suggests that the Jupiter magnetosphere reacts to solar wind rarefactions by expanding. A pair of previously unexplained magnetopause crossings of the Pioneer 11 outbound pass may be due to a delayed reexpansion of the Jupiter magnetosphere from a compression that occurred during the inbound pass.

O. C.

The structures and C-13 contents of individual hydrocarbons extracted from bat guano found in the Carlsbad region of New Mexico are analyzed in order to elucidate details of the carbon flow in the plant-insect-bat ecosystem. Carbon isotopic analyses indicate that equivalent numbers of plants with C3 and C4 photosynthetic pathways occupy the feeding area of the bats, which supports alfalfa and cotton as well as native plants. The molecular composition of the guano is consistent with an origin in two distinct populations of insects with different feeding habits, one of which may graze predominantly on crops. It is also pointed out that isotopic analyses of more ancient guano deposits may be useful in characterizing prevalent vegetation and climate of earlier periods.

A. L. W.

Isotopic measurements of individual geothermal hydrocarbons that are, as a group, of higher molecular weight than methane are reported. It is believed in light of this data that the principal source of hydrocarbons in four geothermal areas in western North America is the thermal decomposition of sedimentary or groundwater organic matter.

O. C.

Plasma-polymerized tetrafluoroethylene (PPTFE) coated potassium bromide IR window are shown to possess better resistance to moisture than either ethylene or chlorotrifluoroethylene. The PPTFE-coated windows tolerated an upper limit relative humidity of about 80% at 297 K, without visible damage to either window or coating, over a period of 24 hours. Elemental analysis of the bulk, and photoelectron spectroscopy of the coating surface, showed that PPTFE coatings deposited downstream of the internal plasma reactor electrodes contained less atmospheric oxygen than coatings deposited between the electrodes; perhaps accounting for the improved moisture resistance.

O. C.

CONFERENCE AND MEETING PAPERS

A search strategy is proposed for the detection of signals of extraterrestrial intelligent origin. It constitutes an exploration of a well defined volume of search space in the microwave region of the
The development of ideas on CETI within the international community over the past five years is reviewed, and the outlook for future CETI activities is discussed. The growth of review sessions on CETI held annually by the International Academy of Astronautics (IAA) is considered, with particular attention given to the issue of radio frequency allocation for the search for extraterrestrial intelligence. CETI activities outside the IAA are then examined, including the Viking search for life on Mars, Project Orion for the detection of extraterrestrial planets, SETI programs undertaken in the U.S. and Soviet Union, and the development of multispectral spectrum analyzers and signal processors. The expected future development of CETI strategies, techniques and instrumentation as well as popular and scientific interest in SETI are discussed, and it is noted that the IAA sessions remain the only regular international forum for the exchange of data on all aspects of CETI.

A.L.W.

**PATENTS**


A control valve is provided which is adapted to be connected between a pressure source, such as a vacuum pump, and a pressure vessel so as to control the pressure in the vessel. The valve comprises a housing having a longitudinal bore which is connected between the pump and vessel, and a transversely movable valve body which controls the air flow through an air inlet in the housing. The valve body is screwed into the valve housing control knob formed integrally with the valve body and controls translation of the valve body, and the opening and closing of the valve.

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A.L.W.


Studies carried out within the last ten years on the nature and distribution of extraterrestrial intelligent life are reviewed. Arguments for the nonexistence of intelligent life in the future are discussed. The assumption that some classes of extraterrestrial signals are likely to be detected, beacons and leakage signals, are considered, and options in the specification of gating and thresholding for high-spectral resolution, high-time-resolution signal discriminator are indicated. Possible tests for the nonhuman origin of a received signal are also pointed out.

A.L.W.

A81-42227*  Modelling of DNA-protein recognition. R. Rein, R. Garduno, S. Colombano, S. Nir, K. Haydock (Roswell Park Memorial Institute, Buffalo; New York State University, Amherst, NY), and R. D. MacElroy (NASA, Ames Research Center, Moffett Field, CA; Roswell Park Memorial Institute, Buffalo; New York State University, Amherst, NY). In: Biomolecular structure, conformation, function and evolution. Volume 2 - Physico-chemical and theoretical studies. Oxford and New York, Pergamon Press, 1980, p. 387-395. 21 refs. Grants No. NCAR-GR-635-701; No. NSG-7305.  Computer model-building procedures using stereochemical principles together with theoretical energy calculations appear to be, at this stage, the most promising route toward the elucidation of DNA-protein binding schemes and recognition principles. A review of models and bonding principles is conducted and approaches to modeling are considered, taking into account possible di-hydrogen-bonding schemes between a peptide and a base (or a base pair) of a double-stranded nucleic acid in the major groove, aspects of computer graphic modeling, and a search for isogeometric helices. The energetics of recognition complexes is discussed and several models for peptide DNA recognition are presented.

G.R.
MAN-VEHICLE SYSTEMS RESEARCH DIVISION

NASA FORMAL REPORTS


To quantify head-up transition behavior with and without a flightpath type head-up display, eight rated B-727 pilots each flew 31 manual and coupled approaches in a simulator with B-727 dynamics and collimated model board external scene. Data were also obtained on the roll played by the head-up display in the coupled-to-manual transition. Various wind shears, low visibilities, and ceilings were tested along with unexpected misalignment between the runway and head-up display symbology. The symbolic format used was a conformal scene. Every pilot except one stayed head-up, flying with the display after descending below the ceiling. Without the display and as altitude decreased, the number of lookups from the instrument panel decreased and the duration of each one increased. No large differences in mean number or duration of transitions up or down were found during the head-up display runs comparing the no-misalignment with the lateral instrument landing system offset misalignment runs. The head-up display led to fewer transitions after the pilot made a decision to land or execute a missed approach. Without the display, pilots generally waited until they had descended below the ceiling to look outside the first time, but with its several pilots looked down at their panel at relatively high altitudes (if they looked down at all). Manual takeover of control was rapid and smooth both with and without the display which permitted smoother engine power changes. E.D.K.


Line-Oriented Flight Training (LOFT) is a developing training technology which synthesizes high-fidelity aircraft simulation and high-fidelity line-operations simulation to provide realistic, dynamic pilot training in a simulated line environment. LOFT is an augmentation of existing pilot training which concentrates upon command, leadership, and resource management skills. This report, based on an NASA/Industry workshop held in January, 1981, is designed to serve as a handbook for LOFT users. In addition to providing background information, guidelines are presented for designing, conducting, real-time LOFT operations, pilot debriefing, and instructor qualification and training. The final chapter addressed other uses of LOFT and line-operations (or full-mission) simulation. Author


Problems in the transfer of information within the aviation system are discussed. Two communications problems in both cockpit and air-ground situations. For individual titles, see N81-31163 through N81-31169. Author


Problems in the transfer of information within the aviation system are discussed. Two communications problems in both cockpit and air-ground situations. For individual titles, see N81-31163 through N81-31169. Author
Charles E. Billings and William D. Reynard In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 9-14 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

Several facets of the information transfer problems in aviation are described. A general analysis of these problem are given and the implications of some proposed solutions discussed. It is concluded that information transfer problems are responsible for many potentially serious human errors in aviation operations.

R.C.T.

N81-31164# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER IN THE SURFACE COMPONENT OF THE SYSTEM: PROBLEMS ASSOCIATED WITH BRIEFING OF RELIEF CONTROLLERS

Ralph L. Grayson In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 15-24 (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

The types of human error associated with briefing of relief in air traffic control operations are described. The factors associated with these errors are examined.

R.C.T.

N81-31165# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER IN THE SURFACE COMPONENT OF THE SYSTEM: COORDINATION PROBLEMS IN AIR TRAFFIC CONTROL

Ralph L. Grayson In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 25-46 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

The significance of coordination in the air traffic control system is discussed. An attempt is made to determine the circumstances that appear to encourage coordination failures as well as examine the human and system factors involved in these failures. Possible means of reducing the rate of such failures are also considered.

R.C.T.

N81-31166# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER BETWEEN AIR TRAFFIC CONTROL AND AIRCRAFT: COMMUNICATION PROBLEMS IN FLIGHT OPERATIONS

Ralph L. Grayson and Charles E. Billings In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 47-61 ref (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

Problems in communications between flightcrews and air traffic controllers were investigated as part of an analysis of information transfer problems in the national aviation system. Particular attention was given to problems in oral communication between pilots and controllers.

R.C.T.

N81-31167# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER WITHIN THE COCKPIT: PROBLEMS IN INTRACOCKPIT COMMUNICATIONS

H. Clayton Foushee and Karen L. Manos In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 63-71 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

The role of communication patterns among cockpit crew members is discussed. Emphasis is placed on information transfer problems which include: messages that are untimely; messages that are not received or understood; and less common, messages that are not transferred because of equipment failure.

R.C.T.

N81-31169# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFORMATION TRANSFER PROBLEM SUMMARY AND COMMENTS

Charles E. Billings and Ed S. Cheaney In its Inform. Transfer Probl. in the Aviation System Sep. 1981 p 85-94. refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 178

An attempt is made to illuminate the problems associated with deficiencies in the information transfer process of both intracockpit and air/ground communications. Possible steps are suggested as a means of enhancing the flow of information in the aviation system.

R.C.T.

NASA TECHNICAL MEMORANDA

N81-10021# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.


Avail: NTIS HC A03/MF A01 CSCL QIC

A comprehensive study of near midair collisions in terminal airspace, derived from the ASRS database is presented. A selection of controller and pilot reports on airport perimeter security, unauthorized takeoffs and landings, and on winter operations is presented. A sampling of typical Alert Bulletins and their responses is presented.

T.M.

N81-16984# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HUMAN FACTORS OF FLIGHT-DECK AUTOMATION: NASA/INDUSTRY WORKSHOP


(NASA-TM-81260: A-8432) Avail: NTIS HC A03/MF A01 CSCL 01C

The scope of automation, the benefits of automation, and automation-induced problems were discussed at a workshop held to determine whether those functions previously performed manually on the flight deck of commercial aircraft should always be automated in view of various human factors. Issues which require research for resolution were identified. The research questions developed are presented.

A.R.H.

N81-16994# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE USE OF TOTAL SIMULATOR TRAINING IN TRANSITIONING AIR-CARRIER PILOTS: A FIELD EVALUATION


(NASA-TM-81250: A-8411) Avail: NTIS HC A03/MF A01 CSCL 051

A field study was conducted in which the performance of air carrier transitioning pilots who had landing training in a landing maneuver approved simulator was compared with the performance of pilots who had landing training in the aircraft. Forty-eight trainees transitioning to the B-727 aircraft and eighty-seven trainees transitioning to the DC-10 were included in the study. The study results in terms of both objectively measured performance indicants and observer and check-pilot ratings did not demonstrate a clear distinction between the two training groups. The results suggest that, for these highly skilled transitioning pilots, a separate training module in the aircraft may be of dubious value.

T.M.
PRELIMINARY STUDY OF HEAD-UP ASSESSMENT TECHNIQUES. 1: VIEWING DURATION OF INSTRUMENT PANEL AND HUD SYMBOLOGY USING A RECALL METHODOLOGY


Eight commercial pilots were shown 50 colored, high fidelity slides of a standard instrument panel (IP) with the needle positions of each instrument varying from slide to slide and then 50 slides of a head-up display (HUD) symbology format which contained an equivalent amount of flight-related information as the instrument panel slides. All stimuli were presented under controlled, static viewing conditions that allowed the measurement of the speed and accuracy with which one randomly selected flight parameter on each slide could be read. The subject did not know which parameter would be requested and, therefore, had to remember the total set of information in order to answer the question correctly. The results showed that from 6.8 - 7.9 sec total viewing time was required to correctly extract altitude, airspeed, heading, VSI, or ADI from the IP slides and from 6.1 to 7.4 sec for the HUD slides. T.M.

A PRELIMINARY STUDY OF HEAD-UP DISPLAY ASSESSMENT TECHNIQUES. 2: HUD SYMBOLOGY AND PANEL INFORMATION SEARCH TIME


Twelve commercial pilots were shown 50 high-fidelity slides of a standard aircraft instrument panel with the airspeed, altitude, ADI, VSI, and RMI needles in various realistic orientations. Fifty slides showing an integrated head-up display (HUD) symbology containing an equivalent number of flight parameters as above (with flight path replacing VSI) were also shown. Each subject was told what flight parameter to search for just before each slide was exposed and was given as long as needed (12 sec maximum) to respond by verbalizing the parameter's displayed value. The results for the 100-percent correct data indicated that: there was no significant difference in mean reaction time (averaged across all five flight parameters) between the instrument panel and HUD slides; and a statistically significant difference in mean reaction time was found in responding to different flight parameters. T.M.

AUTOMATION IN ORGANIZATIONS: ETERNAL CONFLICT


Some ideas on and insights into the problems associated with automation in organizations are presented with emphasis on the concept of automation, its relationship to the individual, and its impact on system performance. An analogy is drawn, based on an American folk hero, to emphasize the extent of the problems encountered when dealing with automation within an organization. A model is proposed to focus attention on a set of appropriate dimensions. The function allocation process is periodically reinitialized. Valid results were demonstrated off line using existing data from simulated landing approaches involving regulation of flight director and airspeed. Changes were detectable in pilot gain and lead compensation. Also, a switch from tracking pitch attitude to tracking flight director could be inferred. The report describes the piloting technique measurement procedure and results obtained. Recommendations are given for eventual implementation in a real time simulator environment, and several improvements are suggested for enhanced results. A.R.H.

NASA AVIATION SAFETY REPORTING SYSTEM Quarterly Report


Problems in briefing of relief by air traffic controllers are discussed, including problems that arise when duty positions are changed by controllers. Altimeter reading and setting errors as factors in aviation safety are discussed, including problems associated with altitude-including instruments. A sample of reports from pilots and controllers is included, covering the topics of ATIS broadcasts an clearance readback problems. A selection of Alert Bulletins, with their responses, is included. S.F.

NASA CONTRACTOR REPORTS

X81-10161*# Systems Technology. Inc., Mountain View, Calif. DEVELOPMENT OF A CTOL PILOTING TECHNIQUE MEASUREMENT SCHEME FOR A REAL TIME SIMULATOR ENVIRONMENT


The approach used in a study conducted to develop a practical scheme for measuring CTOL piloting technique in a real time simulator environment consisted of performing a running least squares fit of pilot generated simulator data to a function representing an assumed form of piloting technique. To obtain variations in the pilot element, the least squares algorithm was periodically reinitialized. Valid results were demonstrated off line using existing data from simulated landing approaches involving regulation of flight director and airspeed. Changes were detectable in pilot gain and lead compensation. Also, a switch from tracking pitch attitude to tracking flight director could be inferred. The report describes the piloting technique measurement procedure and results obtained. Recommendations are given for eventual implementation in a real time simulator environment, and several improvements are suggested for enhanced results. A.R.H.

X81-10162*# Systems Technology, Inc., Mountain View, Calif. A PILOT CONTROL STRATEGY IDENTIFICATION
A technique for measuring a pilot's control strategy is described. The technique, called the Non-Intrusive Pilot Identification Program (NIPIP), estimates the pilot's input-output describing function and combined pilot-vehicle performance parameters such as crossover frequency, and phase margin by using a time domain model of the pilot and a least squares identification algorithm. NIPIP functions is realtime and uses a sliding time window to maintain freshness in the data: thus time-varying characteristics in the pilot's control strategy can be measured. The results of a performance evaluation of NIPIP to a realtime ground-based simulation of two competing concepts of head-up displays (HUD) for use in conventional takeoff and landing are given. Differences in the pilot's control strategy used for the two HUDs and the head-down display are quantified in terms of differences in the pilot's describing functions are combined pilot-vehicle measurements. Conclusions based on the performed evaluation and application of NIPIP are presented and some recommendations on how NIPIP could be used in other man-machine control tasks are discussed.

M.G.

**NB1-17718**
Forschungsinstitut fuer Anthropotechnik, Mecklenburg (West Germany). Forschungsgesellschaft fuer Angewandte Naturwissenschaften e. V.

**MONITORING AND DECISION MAKING BY PEOPLE IN MAN MACHINE SYSTEMS [UBERWACHUNGS- UND ENTSCHEIDUNGSVERHALTEN DES MENSCHEN IN MENSCH-MASCHINE-SYSTEMEN]**
G. Johannsen May 1979 52 p ref Partly in GERMAN and ENGLISH

(Grant NSG-2119)
(NASA-CR-164028; GB-44) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10

The analysis of human monitoring and decision making behavior as well as its modeling are described. Classic and optimal control theoretical, monitoring models are surveyed. The relationship between attention allocation and eye movements is discussed. As an example of applications, the evaluation of predictor displays by means of the optimal control model is examined. Fault detection involving continuous signals and decision making behavior of a human operator engaged in fault diagnosis during different operation and maintenance situations are illustrated. Computer aided decision making is considered as a queueing problem. It is shown to what extent computer aids can be based on the state of human activity as measured by psychophysiological quantities. Finally, management information systems for different application areas are mentioned. The possibilities of mathematical modeling of human behavior in complex man machine systems are also critically assessed.

Author (ESA)

**NB1-22037**
Battelle Columbus Labs., Mountain View, Calif. POTENTIAL EFFECTS OF THE INTRODUCTION OF THE DISCRETE ADDRESS BEACON SYSTEM DATA LINK ON AIR/GROUND INFORMATION TRANSFER PROBLEMS

Ralph L. Grayson 30 Mar. 1981 47 p ref

(Contract NAS2-10060)
(NASA-CR-166165) Avail: NTIS HC A03/MF A01

This study of Aviation Safety Reporting System reports suggests that benefits should accrue from implementation of discrete address beacon system data link. The phase enhanced terminal information system service is expected to provide better terminal information than present systems by improving currency and accuracy. In the exchange of air traffic control messages, discrete address insures that only the intended recipient receives and acts on a specific message. Visual displays and printer copy of messages should mitigate many of the reported problems associated with voice communications. The problems that remain unaffected include error in addressing the intended recipient and messages whose content is wrong but are otherwise correct as to format and reasonableness.

Author

**NB1-22695**
Battelle Columbus Labs., Mountain View, Calif. FATIGUE AND ASSOCIATED PERFORMANCE DECREMENTS IN AIR TRANSPORT OPERATIONS

E. Gene Lyman and Harry W. Orlady 31 Mar. 1981 36 p refs

(Contract NAS2-10060)
(NASA-CR-166167) Avail: NTIS HC A03/MF A01

A study of safety reports was conducted to examine the hypothesis that fatigue and associated performance decrements occur in air transport operations, and that these are associated with some combination of factors: circadian desynchronosis, duty time; pre-duty activity; sleep: work scheduling; workload; and environmental deprivation. The findings are based on a selected sample of reported incidents in which the reporter associated fatigue with the occurrence. In comparing the fatigue reports with a control set, significant performance decrements were found to exist related to time-of-day, awareness and attention to duty, less significantly, final phases of flights. The majority of the fatigue incidents involved such unsafe events as altitude deviations, takeoffs and landing without clearance, and the like. Considerations of duty and sleep are the major factors in the reported fatigue conditions.

S.F.

**NB1-27063**
Battelle Columbus Labs., Ohio.

A STUDY OF ASRS REPORTS INVOLVING GENERAL AVIATION AND WEATHER ENCOUNTERS Interim Report

Thomas H. Rockwell (Ohio State Univ.), Darrell E. Roach (Ohio State Univ.), and Walter C. Griffin (Ohio State Univ.) 26 Jun. 1981 57 p

(Contract NAS2-10060)
(NASA-CR-166212) Avail: NTIS HC A04/MF A01

Consideration is given to the nature and characteristics of problems involving dissemination of weather information, use of this information by pilots, its adequacy for the purpose intended, the ability of the air traffic control system to cope with weather related incidents and to the various aspects of pilot behavior, aircraft equipment, and NAVAIDS affecting flights in which weather emergencies were involved.
figures. It is concluded from the study that skill and training deficiencies of general aviation pilots are not major factors in weather related occurrences, nor is lack of aircraft equipment. Major problem causes are identified with timely and easily interpreted weather information, judgement and attitude factors of pilots, and the functioning of the air traffic control system.

E.D.K.

N81-29108*# Battelle Columbus Labs., Ohio.  
(NASA-CR-166230) Avail: NTIS HC A04/MF A01 CSCL 01C.  
Some 258 reports from more than 23,000 documents in the files of the Aviation Safety Reporting System (ASRS) were found to be to the hazard of flight into terrain with no prior awareness by the crew of impending disaster. Examination of the reports indicate that human error was a casual factor in 84% of the incidents in which some threat of terrain conflict was experienced. Approximately two-thirds of the human errors were attributed to controllers, the most common discrepancy being a radar vector below the Minimum Vector Altitude (MVA). Errors by pilots were of a much diverse nature and include a few instances of gross deviations from their assigned altitudes. The ground proximity warning system and the minimum safe altitude warning equipment were the initial recovery factor in some 18 serious incidents and were apparently the sole warning in six reported instances which otherwise would most probably have ended in disaster.  
A.R.H.

N81-29110*# Battelle Columbus Labs., Ohio.  
**ATC CONTINGENCY OPERATIONS IN THE EN-ROUTE FLIGHT REGIME** Interim Report  
E. Gene Lyman 15 Apr. 1981 24 p refs (Contract NAS2-10060)  
(NASA-CR-166231) Avail: NTIS HC A02/MF A01 CSCL 17G  
Air traffic control (ATC) operations were examined to learn what factors of controller performance should be given consideration in the design and development of future automation systems enhancing ATC. Contingencies were of two types: those constraining airspace usage or traffic flow (i.e., weather); and those related to system and equipment usage (i.e., radar/radio status). Examination of controller response to contingencies and workload pressures showed differing effects on controller allocations of effort among the three primary functions of planning, monitoring, and information transfer. Automation advancements oriented towards aiding the controller in performing monitoring tasks may offer the most substantial safety benefit.  
S.F.

N81-30106*# Battelle Columbus Labs., Mountain View, Calif.  
**OPERATIONAL PROBLEMS EXPERIENCED BY SINGLE PILOTS IN INSTRUMENT METEOROLOGICAL CONDITIONS** Interim Report  
Stacy Weisslogel 5 Aug. 1981 74 p refs (Contract NAS2-10060)  
(NASA-CR-166236) Avail: NTIS HC A04/MF A01 CSCL 17G  
The development and implementation of a search strategy to extract pertinent reports from the Aviation Safety Reporting System-2 (ASRS-2) database are described. For any particular occurrence to be pertinent to the study, it must have satisfied the following conditions: the aircraft must be of the type usually flown by a single pilot; operation on an IFR flight plan in instrument meteorological conditions; pilot experienced an operational problem. The occurrences consist of reports by the pilot about his own performance, by the pilot about the system performance, or by an air traffic controller about a pilot’s performance.  
T.M.

William B. Rouse Aug. 1981 28 p refs (Grant NsG-2119)  
(NASA-CR-164729: T-106) Avail: NTIS HC A03/MF A01 CSCL 05H  
The role of the pilot and crew for future aircraft is discussed. Fifteen formal experimental studies and the development of a variety of models of human behavior based on queueing history, pattern recognition methods, control theory, fuzzy set theory, and artificial intelligence concepts are presented.  
L.F.M.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

The types and formats of information most suitable to be displayed in a cockpit display of traffic information (CDTI) are investigated. Twenty three airline pilots and 13 instrumented general aviation pilots were asked to select from sets of symbols of various complexities incorporating various levels of information that would contain all information necessary for monitoring the traffic situation, detecting errors, maintaining separation and merging. Display features selected by a significant number of pilots were then evaluated for their capabilities in helping pilots to assess the lateral or vertical separation between their own and another aircraft in a dynamic simulation. It is found that while some of the features initially chosen by the pilots, such as flightpath predictors, aided the pilots in perceiving the traffic situation correctly, others, such as ground speed and climb/descend arrows and relative altitude encoding of symbols for other aircraft, did not contribute to improved performance speed or accuracy.  
A.L.W.

The influence of various display symbologies in a cockpit display of traffic information (CDTI) on pilot perception of horizontal aircraft separation is investigated. In a series of nine experiments using different combinations of display symbology, information update rate, display viewing time and encounter geometry, subjects were asked to predict whether an intruder aircraft would pass in front of or behind their own aircraft. It is found that displayed history did not improve task performance, although it was desired by the pilots when no other display of aircraft turn rate was available, and that pilots made fewer errors when they had predictive information. Variations in the rate of updating information from 0.1 to 4 sec and viewing times from 1 to 16 sec are not observed to affect performance. It is concluded that the present task, which may arise in a collision avoidance situation, would require an onboard computer to make a prediction of relative aircraft position and display it on the CDTI.  
A.L.W.

A81-42133 * Visual fatigue - The need for an integrated model, F. V. Malmstrom (Southern California, University, Los Angeles, CA), R. J. Randle, M. R. Murphy (NASA, Ames Research
AN ADVANCED ELECTRONIC COCKPIT INSTRUMENTATION SYSTEM: THE COORDINATED COCKPIT DISPLAY


Cathode ray tube (CRT) and computer technologies have reached the stage where current flight and engine instruments can economically be replaced by computer controlled CRT displays. This provides a tremendous opportunity for flexibility in the cockpit design. However, the use of this flexibility will have to be within the capabilities of the flight environment. One approach is the replacement of flight instruments is described, using three separate visual displays - each CRT displays information pertinent to one of the three orthogonal projections of the aircraft flight situation. Three airline pilots made a preliminary assessment of this display set. Comments, rankings, and ratings show that, in general, the pilots accepted the concept of pictorial flight displays. E.D.K.


This paper describes some of the results of a human factors study of energy management during descent using standard aircraft displays. Discussions with pilots highlighted the practical constraints involved and the techniques (algorithms) used to accomplish the descent. The advantages and disadvantages of these algorithms are examined with respect to workload and their sensitivity to disturbances. Vertical navigation and flight performance computers are discussed in terms of the information needed for effective pilot monitoring and takeover.

M.G.
A solid-state, digital, temperature recorder has been developed for use in space experiments. The recorder is completely self-contained and includes a temperature sensor: all necessary electronics for signal conditioning, processing, storing, control, and timing; and a battery power supply. No electrical interfacing with the particular spacecraft on which the unit is used is required. The recorder is small, light, and sturdy, and has no moving parts. It uses only biocompatible materials and has passed vibration and shock spaceflight qualification tests. The unit is capable of storing 2048 10° to +45°C, 8-bit temperature measurements taken at intervals selectable by factors of 2 from 1.875 to 240 min; data can be retained for at least 6 months.


A method of fluid-structure coupling which provides symmetrical matrix equations of standard form solved by existing finite element computer programs is presented. The method postulates that the uncoupled vibration modes of the fluid or the structure be calculated before the coupled analysis. A numerical solution of vibration modes in an axisymmetric container demonstrated that a static approximation to higher order fluid modes can improve the accuracy of dynamic response computations using modal methods. A.T.
In a macro-fluid exchange, a hollow needle, such as a syringe needle, is provided for penetrating the fluid conduit of the animal. The syringe needle is coupled to a plenum chamber having an inlet and outlet port. The plenum chamber is coupled to the syringe needle via the intermediary of a standard quick disconnect coupling fitting. The plenum chamber is carried at the end of a drive rod which is coupled to a micrometer drive head. The micrometer drive head is slidably and pivotally coupled to a pedestal for adjusting the height and angle of inclination of the needle relative to a reference base support. The needle is positioned adjacent to the incised trachea or a blood vessel of a small animal and the micrometer drive head is operated for penetrating the fluid conduit of the animal.
CONFERENCE AND MEETING PAPERS


The three-dimensional leeward separation about a 5 deg semi-angle cone at an 11 deg angle of attack was investigated in flight, in the wind tunnel, and by numerical computations. The test conditions were Mach numbers of 0.6, 1.5, and 1.8 at Reynolds numbers between 7 and 10 million based on free-stream conditions and a 30-inch wetted length or surface. The surface conditions measured included mean static and fluctuating pressures; skin friction magnitudes and separation line positions were obtained using obstacle blocks. The mean static pressures from flight and wind tunnel were in good agreement. The computed results gave the same distributions, but were slightly more positive in magnitude. The experimentally measured primary and secondary separation line locations compared closely with computed results. There were substantial differences in level and in trend between the surface root-mean-square pressure fluctuations obtained in flight and in the wind tunnel, due, it is thought, to a relatively high acoustic disturbance level in the tunnel compared with the quiescent conditions in flight. (Author)


The nonlinear modified equation approach is taken in this paper to analyze the generalized Lax-Wendroff explicit scheme approximation to the unsteady one- and two-dimensional equations of gas dynamics. Three important applications of the method are demonstrated. The nonlinear modified equation analysis is used to (1) generate higher order accurate schemes, (2) obtain more accurate estimates of the discretization error for nonlinear systems of partial differential equations, and (3) generate an adaptive mesh procedure for the unsteady gas dynamic equations. Results are obtained for all three areas. For the adaptive mesh procedure, mesh point requirements for equal resolution of discontinuities were reduced by a factor of five for a 1-D shock tube problem solved by the explicit MacCormack scheme. (Author)


A parabolized Navier-Stokes code capable of predicting steady viscous supersonic flows with cross-flow separation is applied to three-dimensional arbitrary geometries at high angles of attack. The numerical procedure, which is implicit, noniterative, and of second-order accuracy in the marching direction, has been used to compute complicated flow fields containing a relatively thick sonic layer and regions of strong viscous-inviscid interaction. A consistent and accurate procedure has also been developed to provide the necessary starting data through time-wise integration of the equations of motion near the nose-tip region of the body. Numerical results, obtained from the present method compare well with experiment for both the surface pressures and heat transfer. (Author)
A CONSERVATIVE IMPLICIT FINITE DIFFERENCE ALGORITHM FOR THE UNSTEADY TRANSONIC FULL POTENTIAL EQUATION

Joseph L. Steger (Flow Simulations, Inc., Sunnyvale, Calif.) and Francis X. Caradonna (Army Aviation Research and Development Command, St. Louis, Mo.) Oct. 1980 40 p refs
(Contract NAS2-10417)

An implicit finite difference procedure is developed to solve the unsteady full potential equation in conservation law form. Computational efficiency is maintained by use of approximate factorization techniques. The numerical algorithm is first order in time and second order in space. A circulation model and difference equations are developed for lifting airfoils in unsteady flow; however, thin airfoil body boundary conditions have been used with stretching functions to simplify the development of the numerical algorithm.

US ARMY REMOTELY PILOTED VEHICLE SUPPORTING TECHNOLOGY PROGRAM

(NASA-TM-81263; A-8450; USAAVRADCOM-TR-81-A-12) Avail: NTIS HC A02/MF A01 CSCL 01C

Essential technology programs that lead to the full-scale engineering development of the Aquila Remotely Piloted Vehicle system for U.S. Army are described. The Aquila system uses a small recoverable and reusable RPV to provide target acquisition, designation, and aerial reconnaissance mission support for artillery and smart munitions. Developments that will provide growth capabilities to the Aquila RPV system, as well as future RPV mission concepts being considered by the U.S. Army are presented.

LOGIC ANALYSIS OF COMPLEX SYSTEMS BY CHARACTERIZING FAILURE PHENOMENA TO ACHIEVE DIAGNOSIS AND FAULT-ISOLATION

Presented at the Joint Intern. Meeting of CORS and ORSA, Toronto, 3-6 May 1981 Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.
(NASA-TM-81291; USAAVRADCOM-TR-81-A-12; A-8561) Avail: NTIS HC A02/MF A01 CSCL 14D

A recent result shows that, for a certain class of systems, the interdependency among the elements of such a system together with the elements constitutes a mathematical structure a partially ordered set. It is called a loop free logic model of the system. On the basis of an intrinsic property of the mathematical structure, a characterization of system component failure in terms of maximal subsets of bad test signals of the system was obtained. Also, as a consequence, information concerning the total number of failure components in the system was deduced. Detailed examples are given to show how to restructure real systems containing loops into loop free models for which the result is applicable.
AEROMECHANICS LABORATORY

NASA TECHNICAL MEMORANDA

N81-11012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC ROTOR NOISE: THEORETICAL AND EXPERIMENTAL COMPARISONS

Two complementary methods of describing the high-speed rotor noise problem are discussed. The first method uses the second-order transonic potential equation to define and characterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second employs the Ffowcs Williams and Hawkings equation to successfully calculate the acoustic far field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9. Author

N81-19101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ROLE OF THE RESEARCH SIMULATOR IN THE SYSTEMS DEVELOPMENT OF ROTORCRAFT

The application of the research simulator to future rotorcraft systems development, design, development, product improvement evaluations, and safety analysis is examined. Current simulation capabilities for fixed-wing aircraft are reviewed and the requirements of a rotorcraft simulator are defined. The visual system components, vertical motion simulator, cab, and computation system for a research simulator under development are described. M.G.

NASA CONTRACTOR REPORTS

FLAP-LAG-TORSIONAL DYNAMIC MODELLING OF ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT. INCLUDING THE EFFECT OF CUBIC NONLINEARITIES
(Grant NAG2-38)
(NASA-CR-164293) Avail: NTIS HC A03/MF A01 CSCL 01C

The differential equations of motion, and boundary conditions, describing the flap-lag/torsional motion of a flexible rotor blade with a precone angle and a variable pitch angle, which incorporates a pretwist, are derived via Hamilton’s principle. The equations of motion are reduced to a set of three integro partial differential equations for a hingeless blade by eliminating the extension variable. Aerodynamic forces are modeled using Greenberg’s extension of Theodorsen’s strip theory. The equations of motion are expanded into polynomial nonlinearities to evaluate the motion of the system. E.A.K.

N81-23433*# Stanford Univ., Calif. Dept. of Aeronautics and Acoustics.
APPLICATION OF HOLOGRAPHY TO THE STUDY OF HELICOPTER ROTOR FLOW FIELDS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980
Donald Bagannoff 29 May 1981 37 p. refs
(Grant NAG2-45)
(NASA-CR-164293) Avail: NTIS HC A03/MF A01 CSCL 01C

The feasibility of an experiment which is intended to measure the acoustic field about a model helicopter rotor using holographic interferometry is considered. The numerical simulation used to study the experiment is described as well as the measurement technique itself. Data generated by the simulation are presented and prospects for both determining the density field from these data, and for actually obtaining such data in practice are assessed. A few significant problems which may be expected to arise are indicated and discussed. Author

CONFERENCE AND MEETING PAPERS

N81-12924# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.
TRANSONIC ROTOR NOISE - THEORETICAL AND EXPERIMENTAL COMPARISONS
(AD-A090806: Rept-22) Avail: NTIS HC A03/MF A01 CSCL 01C

Two complementary methods of describing the high-speed rotor noise problem are discussed. The first method uses the second-order transonic potential equation to define and characterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second
The phenomenon of dynamic stall on airfoils is investigated by solving the governing equations. The system development of rotorcraft is discussed. The role of the research simulator in the systems development of rotorcraft is presented. The evolution of unsteady boundary layers on oscillating airfoils is investigated by solving the governing equations. The essential results of a comprehensive review of existing unsteady turbulent boundary-layer experiments are presented. Different types of unsteady flow facilities are described, and the related unsteady turbulent boundary-layer experiments are cataloged and discussed. The measurements that were obtained in the various experiments are described, and a complete list of experimental results is presented. All the experiments that employ the Fowcs Williams and Hawking's equation to successfully calculate the acoustic far-field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9.

N81-33146* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE PHENOMENON OF DYNAMIC STALL


The general features of dynamic stall on oscillating airfoils are explained in terms of the vortex shedding phenomenon, and the important differences between static stall, light dynamic stall, and deep stall are described. An overview of experimentation and prediction techniques is given. M.G.

N81-20202* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPUTATION OF UNSTEADY TURBULENT BOUNDARY LAYERS WITH FLOW REVERSAL AND EVALUATION OF TWO SEPARATE TURBULENCE MODELS


A procedure which solves the governing boundary layer equations within Keller's box method was developed for calculating unsteady laminar flows with flow reversal. This method is extended to turbulent boundary layers with flow reversal. Test cases are used to investigate the proposition that unsteady turbulent boundary layers also remain free of singularities. Turbulent flow calculations are performed. The governing equations for both models are solved. As in laminar flows, the unsteady turbulent boundary layers are free from singularities, but there is a clear indication of rapid thickening of the boundary layer with increasing flow reversal. Predictions of both turbulence models are the same for all practical purposes.

N81-23982* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A REVIEW OF UNSTEADY TURBULENT BOUNDARY-LAYER EXPERIMENTS


The essential results of a comprehensive review of existing unsteady turbulent boundary-layer experiments are presented. Different types of unsteady flow facilities are described, and the related unsteady turbulent boundary-layer experiments are cataloged and discussed. The measurements that were obtained in the various experiments are described, and a complete list of experimental results is presented. All the experiments that

FLUID MECHANICS DIVISION

NASA TECHNICAL MEMORANDA

N81-20384* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DYNAMIC BEHAVIOR OF AN UNSTEADY TURBULENT BOUNDARY LAYER


Experiments on an unsteady turbulent boundary layer are reported in which the upstream portion of the flow is steady (in the mean) and in the downstream region, the boundary layer sees a linearly decreasing free stream velocity. This velocity gradient oscillates in time, at frequencies ranging from zero to approximately the bursting frequency. For the small amplitude, the mean velocity and mean turbulence intensity profiles are unaffected by the oscillations. The amplitude of the periodic velocity component, although as much as 70% greater than that in the free stream for very low frequencies, becomes equal to that in the free stream at higher frequencies. At high frequencies, both the boundary layer thickness and the Reynolds stress distribution across the boundary layer become frozen. The behavior at higher amplitude is quite similar. At sufficiently high frequencies, the boundary layer thickness remains frozen at the mean value over the oscillation cycle, even though flow reverses near the wall during a part of the cycle. A.R.H.
measured instantaneous values of velocity, turbulence intensity, or turbulent shear stress are identified, and the availability of digital data is indicated. The results of the experiments are analyzed, and several significant trends are identified. An assessment of the available data is presented, delineating gaps in the existing data, and indicating where new or extended information is needed. Guidelines for future experiments are included.

N81-33167* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PREDICTION OF BLADE-VORTEX INTERACTION NOISE FROM MEASURED BLADE PRESSURE

The impulse nature of noise due to the interaction of a rotor blade with a tip vortex is studied. The time signature of this noise is calculated theoretically based on the measured blade surface pressure fluctuations of an operational load survey rotor in slow descending flight and is compared with the simultaneous microphone measurement. Particularly, the physical understanding of the characteristic features of a waveform is extensively studied in order to understand the generating mechanism and to identify the important parameters. The interaction trajectory of a tip vortex on an acoustic platform is shown to be a very important parameter for the impulsive shape of the noise. The unsteady nature of the pressure distribution at the very leading edge is also important to the pulse shape. The theoretical model using noncompact line acoustics predicts the general shape of interaction impulse pretty well except for peak amplitude which requires more continuous information along the span at the leading edge.

CONFERENCE AND MEETING PAPERS

N81-12071* Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

STABILITY OF NONUNIFORM ROTOR BLADES IN HOVER USING A MIXED FORMULATION

A mixed formulation for calculating static equilibrium and stability eigenvalues of nonuniform rotor blades in hover is presented. The static equilibrium equations are nonlinear and are solved by an accurate and efficient collocation method. The linearized perturbation equations are solved by a one step, second-order integration scheme. The numerical results correlate very well with published results from a nearly identical stability analysis based on a displacement formulation. Slight differences in the results are traced to terms in the equations that relate moments to derivatives of rotations. With the present ordering scheme, in which terms of the order of squares of rotations are neglected with respect to unity, it is not possible to achieve completely equivalent models based on mixed and displacement formulations. A study of the one step methods reveals that a second order Taylor expansion is necessary to achieve good convergence for nonuniform rotating blades. Numerical results for a hypothetical nonuniform blade, including the nonlinear static equilibrium solution, were obtained with no more effort or computer time than that required for a uniform blade with the present analysis.

ROTORCRAFT DYNAMICS DIVISION

N81-11033* Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

EXPERIMENTAL AND ANALYTICAL STUDIES OF A MODEL HELICOPTER ROTOR IN HOVER

The present study is a benchmark test to aid the development of various rotor performance codes. The study involves simultaneous blade pressure measurements and tip vortex surveys. Measurements were made for a wide range of tip Mach numbers including the transonic flow regime. The measured tip vortex strength and geometry permit effective blade loading predictions when used as input to a prescribed wake lifting surface code. It is also shown that with proper inflow and boundary layer modeling, the supercritical flow regime can be accurately predicted.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


It is noted that the general fluid dynamic problem of unsteady separation at most practical Reynolds numbers remains unsolved and that no completely reliable prediction techniques exist at the present time. The modern design engineer must therefore draw from a combination of approximate theories, empirical correlations of data, and finite difference programs based on uncertain physical modeling of turbulence. An attempt is made to describe the basic features of several representative classes of problems for which unsteady effects produce strong or unusual changes in the separation characteristics of the flow. The analysis concerns itself largely with external flow, and emphasis is placed on the physical phenomena involved.

CONFERENCE AND MEETING PAPERS

N81-12071* Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

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moving-block function are described. Computer-generated data are used to examine the capability of the method to analyze modes closely spaced in frequency. It is shown that accuracy is constrained at both small and large block sizes, and that the best results are achieved with a block size 1/4 to 1/2 of the signal length. The method's performance can be improved by using increased signal length or Hanning of the data; however, the computational burden will be increased in either case. A special case of the problem of two closely spaced modes is treated where one acts as a forced-response contaminant. In this case the method's accuracy is dramatically increased by selection of the block size to correctly locate the contaminant frequency's side lobes. A short discussion of the effects that actual data will have on the major results of the study is included.