1981
Ames Research Center Publications:
A Continuing Bibliography

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

Availiability sources of the different output categories are given below:

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Source

Category

NASA Report Literature:

Technical Memoranda

Formal Reports

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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.
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. Author

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, traffic control systems, and the transportation and storage of food. A communication system for emergency services is also described. A.R.H.


These bibliography lists formal NASA publications, journal articles, books, chapters of books, patents, contractor reports, and computer programs that were issued by Ames Research Center and indexed by Scientific and Technical Aerospace Reports, Limited Scientific and Technical Aerospace Reports, and International Aerospace Abstracts in 1980. 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.R.H.

TECHNOLOGY UTILIZATION OFFICE


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. A.R.H.
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.

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.

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.

A bibliography is presented for the Advanced Technology Display House. Information sources used in generating the design concepts studied are included.
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.

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 (20 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.
An experimental investigation was conducted in the Ames 12-Foot Pressure Wind Tunnel to determine the unpowered aerodynamic 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 include a single-slipstream drooped leading edge (dropped outboard of the engine nacelles), a full-slipstream 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 SLIPSTREAMS ON THIN WINGS IN THE TRANSONIC REGIME

NASA CONTRACTOR REPORTS

N81-18044# Neilsen 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.
A.R.H.

N81-18045# Neilsen Engineering and Research, Inc., Mountain View, Calif.
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.
R.C.T.

A HIGHER ORDER PANEL METHOD FOR LINEARIZED SUPERSONIC FLOW
(NASA-CR-3062; D8-48058) Avail: NTIS HC A12/MF A01 CSCL 01A
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 basic four point non-planar panel into eight triangular subpanels, and the doublet strength was made continuous at all edges by a quadratic distribution over each subpanel. Superinlaid panels were developed and tested on simple nacelle and on an airplane model having engine inlets, with excellent results.

Author


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.


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.


Data from wind tunnel tests of a powered propeller and nacelle mounted on a supercritical wing are analyzed. Installation of the nacelle significantly affected the wing flow and the flow on the upper surface of the wing is separated near the leading edge under powered conditions. Comparisons of various theories with the data indicated that the Neumann surface panel solution and the Jameson transsonic solution gave results adequate for design purposes. A modified wing design was developed (Mod 3) which reduces the wing upper surface pressure coefficients and section lift coefficients at powered conditions to levels substantially within those of the original wing without nacelle or power. A contoured wing nacelle that can be installed on the original wing without any appreciable interference to the wing upper surface pressure is described. J.D.H.


The use of self synchronizing stroboscopic Schlieren and laser interferometer systems to obtain quantitative space-time measurements of disturbed flow surfaces, streakline patterns, and the density field of two-dimensional flows that exhibit a periodic content was investigated. A large field single path stroboscopic Schlieren system was designed, constructed and successfully applied to visualize four periodic flows: near wake behind an oscillating airfoil; edge tone sound generation; 2-D planar wall jet; and axisymmetric pulsed sonic jet. This visualization technique provides an effective means of studying quasi-periodic flows in real time. The image on the viewing screen is a spatial signal average of the coherent periodic motion rather than a single realization, the high speed motion of a quasi-periodic flow can be reconstructed by recording photographs of the flow at different fixed time delays in one cycle. The preliminary design and construction of a self synchronizing stroboscopic laser interferometer with a modified Mach-Zehnder optical system is also reported. A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


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)

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 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)

CONFERENCE AND MEETING PAPERS


Examples of experiment theory correlation are presented to give an indication of the capabilities and limitations of wing design and analysis for transonic applications by potential flow theory. The examples include correlations of experimental pressure distributions with theoretical results from isolated wing codes and wing-body codes. Both conservative and nonconservative differencing as well as body and boundary layer corrections are considered. A full potential isolated wing code correlates well with data from an isolated wing test but may give poor prediction of the aerodynamic characteristics of some wing-body configurations. Potential flow wing body codes were found to improve the correlation for the wing-body configurations considered. (Author)

N81-19013*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. ADVANCED TURBOPROP INSTALLATION AERODYNAMICS c07


The expected aerodynamic effects of a proppan installed on a thick supercritical wing are summarized qualitatively. Nacelle-wing and jet interactions, slipstream incremental velocity, nonuniform inflow, and swirl loss recovery are discussed. E.D.K.


Tests have been conducted on a JT15D-1 turbofan engine both statically and at simulated forward speed in the Ames 12 x 24 Meter Wind Tunnel. Both far-field acoustic data and unsteady pressure data from transducers mounted on the fan blades were acquired. Results showed a sound power reduction of about 10 dB in the far-field acoustic levels with simulated forward speed over those measured without forward speed. Blade mounted transducer results showed rotor-turbulence interaction dominated the noise field at very low speeds while an interaction between the rotor and internal struts dominated at higher speeds. Results are presented to show the effects of varying engine rpm, changing the angle-of-attack of the engine inlet to tunnel flow and mounting an aircraft wing to simulate an installation condition on an actual aircraft. (Author)

N81-31107*# 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 C5 CL 01A

The aerodynamic phenomena associated with high angles of attack and their effects on the dynamic stability characteristics of an 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)
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-dimensional. 

(Author)
potential, isolated code correlate well with data from an isolated wing test, but may give poor predictions of the aerodynamic characteristics of some wing-body configurations. Boundary-layer correlations were found to have only moderate effects on experiment-theory correlation. Aeroelastic effects were considered important for high aspect ratio wings of low to moderate thickness, and viscous effects were minimal for typical cruise conditions, even for Reynolds' numbers as low as two million. The effect of wind-tunnel walls on experiment-theory correlations remained inconclusive. A wing-body code was used to calculate the flow field about a wing-body configuration with body-mounted engines, typical of the 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)


The flow behavior within the upper-surface boundary layer and near wake of a supercritical airfoil operating at cruise conditions is discussed. Experimental results obtained from wind-tunnel tests are presented which provide a more detailed description of the flow in these regions than was previously available. Mean streamwise velocity profiles measured by pitot-pressure-probe and laser-velocimeter techniques were found to be in excellent agreement. Other mean-flow properties obtained by the laser-velocimeter technique were the local flow angles in the viscous layers and the static pressures at the edges of the boundary layer and wake. The data set also includes measurements of the turbulence intensity and turbulent Reynolds-stress distributions as obtained by the laser-velocimeter technique. To assess the effects of the shock wave, a less extensive set of measurements was realized at a subcritical test condition. The two test conditions (Mach number at free-stream conditions = 0.72, airfoil section lift coefficient = 0.76 and Mach number of free-stream conditions = 0.5, airfoil section lift coefficient = 0.75) provide a good test for state-of-the-art prediction methods because the upper-surface-boundary layer is separated just upstream of the trailing edge in both cases.

(Author)
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.

NASA TECHNICAL MEMORANDA

X81-10006# 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

William L. Brigadier Dec. 1980 147 p refs


Notice: Available to U.S. Government Agencies and Their
Contractors.

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.

NFN 1-19131# 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 AP-
PROACHES

W. S. Hindson (National Research Council of Canada, Ottawa,
Ontario), G. H. Hardy, and R. C. Innis Mar. 1981 96 p refs
(NASA-TP-1641: A-8190) Avail: NTIS HC A05/MF A01 CSCL
01C

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, employed special electronic cockpit

NFN 1-2009# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

KINEMATIC PROPERTIES OF THE HELICOPTER IN
COORDINATED TURNS

Robert T. N. Chen and James A. Jeske Apr. 1981 41 p refs
(NASA-TP-1773: A-8399) Avail: NTIS HC A03/MF A01 CSCL
01C

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

NFN 1-1007# 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

393 p refs
HC A17/MF A01 CSCL 01C

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.

**GLOBAL OPTIMALITY OF EXTREMALS: AN EXAMPLE**

Eliezer Kreindler (Technion, Israel Inst. of Technology, Haifa) and Frank D. C. Tung (NASA Ames Research Center, Moffett Field, Calif.)

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 emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects.

**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.

**A MATHEMATICAL MODEL OF THE CH-53 HELICOPTER**


The possibilities of interactions between the propulsion and flight control systems of a three-fan subsonic VTOL aircraft was studied using non-real 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.

**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 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. M.G.


Present approaches to solving the stationary Navier-Stokes equations are of limited value; however, there does exist an equivalent representation of the problem that has significant potential in solving such problems. This is due to the fact that the equivalent representation consists of a sequence of Fredholm integral equations of the second kind, and the solving of this type of problem is very well developed. For the problem in this form, there is an excellent chance to also determine explicit error estimates, since bounded, rather than unbounded, linear operators are dealt with. A.R.H.


The introduction of independent helicopter IFR routes at hub airports was investigated in a real time air traffic control system simulation involving a piloted helicopter simulator, computer generated traffic, and air traffic controllers. The helicopter simulator was equipped to fly area navigation (RNAV) routes and microwave landing system approaches. Problems studied included: (1) pilot acceptance of the approach procedure and tracking accuracy; (2) ATC procedures for handling a mix of helicopter and fixed wing traffic; and (3) utility of the cockpit display of traffic information (CDTI) for the helicopter in the hub airport environment. Results indicate that the helicopter routes were acceptable to the subject pilots and were noninterfering with fixed wing traffic. Merging and spacing maneuvers using CDTI were successfully carried out by the pilots, but controllers had some reservations concerning the acceptability of the CDTI procedures. E.D.K.

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 optimum thrust is discontinuous and singular. M.G.


Equations describing the friction forces generated during landing operations on ships at sea were formulated. These forces depend on the platform reaction and the coefficient of friction. The platform reaction depends on the relative sink rate and the shock absorbing capability of the landing gear. The friction coefficient varies with the surface condition of the landing platform and the angle of yaw of the aircraft relative to the landing platform. Landings by VTOL aircraft, equipped with conventional oleopneumatic landing gears are discussed. Simplifications are introduced to reduce the complexity of the mathematical description of the tire and shock strut characteristics. Approximating the actual complicated force deflection characteristic of the tire by linear relationship is adequate. The internal friction forces in the shock strut are included in the landing gear model. A set of relatively simple equations was obtained by including only those tire and shock strut characteristics that contribute significantly to the generation of landing forces. A.R.H.


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 (sink 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. S.F.
CONTROL CONCEPTS
Final Report
E W Kruppa Sep 1980 514 p refs
(Contract NAS2-9196)


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 GSRA performance math model was updated and used to generated 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
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 optimal 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 those two into the controller. Assessment of the controller permits and examination and expansion of the synthesis results.

J.M.S.

N81-18419*


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-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

N81-18397*

Analytical Methods, Inc., Bellevue, Wash.

A THREE-DIMENSIONAL VISCIOUS/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 doublet 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 NAS2-9726)

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 multicyclcic 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 database 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 bases 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 the 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

N81-18798*


FORWARD VELOCITY EFFECTS ON FAN NOISE AND THE SUPPRESSION CHARACTERISTICS OF ADVANCED INLETS AS MEASURED IN THE NASAAMES 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 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, 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 caning 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.
N81-19018# Nielsen Engineering and Research, Inc., Mountain View, Calif.
Manuel E. Dillenius and Michael R. Mendenhall May 1979 53 p refs Sponsored in part by Navy
(Contract NAS2-9605)
(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 diffuser is made to expand from the primary nozzles to the diffuser exit and is represented by a distribution of vorticity on the jet boundary to provide proper entrainment. The jet downstream of the diffuser 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 diffuser exit velocity matches the specified one. Some comparisons with available data show good agreement at lower power settings. Author

N81-19096# Grumman Aerospace Corp., Bethpage, N.Y.
VTOL IN GROUND EFFECT FLOWS FOR CLOSELY SPACED JETS Final Report
(Contract NAS2-10097)
(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.

N81-19085# Douglas Aircraft Co., Inc., Long Beach, Calif.
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-152087; Pt-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, infinitesimal 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. 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 multienery 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.

N81-19111# RAND Corp., Santa Monica, Calif.
PREDICTING COST/RELIABILITY/MAINTAINABILITY OF ADVANCED GENERAL AVIATION AVIONICS EQUIPMENT Final Report
(Contract NAS2-9450)
(NASA-CR-152149; RAND/WN-10233; NASA) Avail: NTIS HC A07/MF A01 CSCL 01D
A methodology is provided for assisting NASA in estimating the cost, reliability, and maintenance (CRM) requirements for general avionics equipment operating in the 1980's. Practical problems of predicting these factors is examined. The usefulness and short comings of different approaches for modeling cost and reliability estimates are discussed together with special problems caused by the lack of historical data on the cost of maintaining general aviation avionics. Suggestions are offered on how NASA might proceed in assessing cost reliability CRM implications in the absence of reliable generalized predictive models. A.R.H.


16
The propagation of sound due to a line acoustic source in the moving stream across a semifinite 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 transforms 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 summed by the use of Pade approximants. Calculations included the pressure variation at great depth, which was considered to be a likely cause of microseismic activity, and the pressure distribution on a vertical barrier or breakwater. R.C.T.

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 a 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

APPLICATION OF VARIABLE STRUCTURE SYSTEM
THEORY TO AIRCRAFT FLIGHT CONTROL Interim Report
Anthony J. Calise, Isaac Kadushin, and Fred Kramer May 1981
42 p refs
(Contract NAG2-8) (NASA-CR-164321) Avail: NTIS HC A03/MF A01 CSCL 01C

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 examined. Examples are given of the numerical results currently being generated. A.R.H.

A NOTE ON SOUND RADIATION INTO A UNIFORMLY
FLOWING FLUID Interim Report
Toshiyuki Fukushima Mar. 1978 64 p refs

Sound radiation generated by mechanical or vibratory source arrangements and, in some instances of planar or piston types, encompasses all magnitudes of the wavelength or frequency as well as disposition of the observation site. The comparative increase in average total radiated power from infinitesimally small or point sources of periodic strength, on passing from rest to steady rectilinear motion, depends only on Mach number in the noncompact case, and a formally analogous rise in output is linked, to the presence of a steady parallel flow past a rigid plane wall in which a compact circular piston executes normal oscillations. The perspective of effects connected with such a background is flow widened by regard for an elongated or point source, the analogous problems relative to uniformly distributed forces over strips or circular areas of the plate receive attention. S.F.

A FLAP SURVEY TEST OF A COMBINED SURFACE BLOWING MODEL: FLOW MEASUREMENTS AT STATIC FLOW CONDITIONS
Toshiyuki Fukushima Mar. 1978 64 p refs
(Contract NAS2-9693) (NASA-CR-152124) Avail: NTIS HC A04/MF A01 CSCL 01A

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 outward 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.


A single ejector equipped with only one vector control jet and a diverter flap was installed close to the leading edge of the strake of 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 characteristic was present and the roughness effect of the test section walls in order to achieve the near interference of the downwash at the tail region. The experimental data indicates that, within the range of momentum coefficient examined, it can be satisfactorily corrected by the vortex jump state-dependent parameters are solved using dynamic programming. The resulting controllers exhibit "active hedging" properties.

T.M.


A simple class of discrete-time nonlinear stochastic control problems with quadratic costs for linear systems with randomly-jumping state-dependent parameters are solved using dynamic programming. The resulting controllers exhibit "active hedging" properties and results are presented to quantify the expected lift increments for Information and Decision Systems.


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 9.91 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 C141 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 used 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.


The method of vortex discretization is used to analyze the interaction of the vorticity generated by a strake, with the flow over a delta wing. The validity of the approach is first established by making comparisons with established methods for dealing with delta wings, after which compound delta planforms are discussed. An understanding of the favorable interference effects normally associated with this type of configuration is obtained and results are presented to quantify the expected lift increments resulting from the strake interaction.

Author


Author
Frequency domain methods are used to study the angles of arrival and departure for multivariable root loci. Explicit equations are obtained. For a special class of poles and zeros, some simpler equations that are generalizations of the single input/single output equations are presented.

N81-28084†/ Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 1: MODEL DESCRIPTION APPLICATION Final Report
(Contract NAS2-10294)

An attempt was made to model a high performance aircraft capable of vertical attitude takeoff and landing (VATOL). 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 model 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.

N81-28085†/ Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 2: MODEL EQUATIONS AND BASE AIRCRAFT DATA
(Contract NAS2-10294)
(NASA-CR-166129-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 01C

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 piloted 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.

N81-28086†/ Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 3: USER'S MANUAL FOR VATOL SIMULATION PROGRAM
(Contract NAS2-10294)
(NASA-CR-166129-Vol-3) Avail: NTIS HC A18/MF A01 CSCL 01C

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 VTOLLTH, 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.

(Contract NsG-2266)
(NASA-CR-166234; ASRL-TR-196-2) Avail: NTIS HC A04/MF A01 CSCL 01C

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 shear 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.

(Grant NsG-2266)
(NASA-CR-166233; ASRL-TR-196-3) Avail: NTIS HC A05/MF A01 CSCL 01C

The development and testing of a feedforward 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.

(Grant NGL-22-009-124; Contract ND0014-77-C-0224; NR Proj. 041-516)
(NASA-CR-164847; AD-A102025; LIDS-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 Bayes 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.

N81-31952‡/ Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems. ON REGULATORS WITH A PRESCRIBED DEGREE OF STABILITY M.S. Thesis
Several important aspects of the Regulator with a Prescribed Degree of Stability (RPDS) methodology and its applications are considered. The solution of the time varying RPDS problem as well as the characterization of RPDS closed loop eigenstructure properties are obtained. Based on the asymptotic behavior of RPDS root loci, a one step algorithm for designing Regulators with Prescribed Damping Ratio (RPDR) is developed. The robustness properties of RPDS are characterized in terms of the properties of the return difference and the inverse return difference matrices for the RPDS state feedback loop. This class of regulators is found to possess excellent multiloop margins with respect to stability and degree of stability properties. The ability of RPDS design to tolerate changing operating conditions and unmodelled dynamics are illustrated with a multiterminal dc/ac power system example. The output feedback realization of RPDS requires the use of Linear Quadratic Gaussian (LQG) methodology. S.F.


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)
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-prone 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)

A Flight-test investigation consisted of IFR MLS approaches at Crows Head-up display format for transport air- radar, operational pilots, and a Bell 212 helicopter. The second first flight-test investigation consisted of helicopter IFR approaches provide FAA with data for establishment of TERPS criteria. The to prove NASA with a data base to be used as a performance measure for advanced guidance and navigation concepts, and to land system (MLS) approaches. Flight-test results were utilized

F

CONFERENCE AND MEETING PAPERS

N81-19042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT TESTS OF IFR LANDING APPROACH SYSTEMS FOR HELICOPTERS


Avail: NTIS HC A17/MF A01 CSCL 01C

Joint NASA/FAA helicopter flight tests were conducted to investigate airborne radar approaches (ARA) and microwave landing system (MLS) approaches. Flight-test results were utilized to prove NASA with a data base to be used as a performance measure for advanced guidance and navigation concepts, and to provide FAA with data for establishment of TERPS criteria. The first flight-test investigation consisted of helicopter IFR approaches to offshore oil rigs in the Gulf of Mexico, using weather/mapping radar, operational pilots, and a Bell 212 helicopter. The second flight-test investigation consisted of IFR MLS approaches at Crows Landing (near the Ames Research Center), with a Bell UH-1H helicopter, using NASA, FAA, and operational industry pilots. Tests are described and results discussed. A.R.H.

N81-19043*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A HEAD-UP DISPLAY FORMAT FOR TRANSPORT AIRCRAFT APPROACH AND LANDING


Avail: NTIS HC A17/MF A01 CSCL 01C

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept in low-visibility landings of transport aircraft. 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, particularly in low-altitude transition to visual references. 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 heliports. 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 offshore oil industry. (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. Fourteen 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 glide-slope, 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 pitch technique for the steep glideslope approaches, and (2) angular guidance deviation indicator sensitivity requirements for helicopter MLS approaches to STOLports and heliports have been found to be significantly different from standard ILS sensitivities. (Author)
These equations are in a first-order, vector-matrix format, and are satisfactory, whereas ratings of adequate-but-unsatisfactory de-

both rotary-wing and fixed-wing aircraft in extreme conditions. 

For the single-pilot situation than that for the dual-pilot situation. 

tative microwave landing system approach task. Pilot rating results 

indicated the existence of a controf-display trade-off for ratings of 

higher order systems is introduced. Following this, a simple criterion 

determination for 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. (Author) 

A flight experiment was conducted using the NASA Army 

V/STOLAND UH-1H variable-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 corrobo-

rate and extend previous ground simulation results obtained in this 

program. Variations examined included stable and neutral longitudi-

dal 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-attitude 

augmentation to achieve a satisfactory system. (Author) 

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 stall angles of attack. The 
kinematic properties of the aircraft in steady coordinated turns are 
examined: in 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. 

J.F. 

A flight investigation of static stability, control 
augmentation, and flight director influences on helicopter IFR 
Research Center, Moffett Field, CA), and L. D. Corliss (U.S. Army, 
Aeromechanics Laboratory, Moffett Field, CA). In: American 
Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 
17-20, 1981, Proceedings. (A81-46603 22-D1) Washington, DC, 

A steep coordinated helical turn at extreme angles of attack with 
inherent sidlesip is of primary interest in this study. Unlike 
fixed-wing aircraft, the helicopter in a steady coordinated turn will 
Influence of sideslip on the kinematics of the 
helicopter in steady coordinated turns. R. T. N. Chen and J. A. Jeske 
(NASA, Ames Research Center, Moffett Field, CA). In: American 
Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 
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A GENERAL ALGORITHM FOR THE CONSTRUCTION OF CONTOUR PLOTS

Wayne Johnson and Fred Silva (Informatics, Inc. Palo Alto, Calif.)

An algorithm is described that performs the task of drawing equal level contours on a plane, which requires interpolation 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 pilot's control inputs after shear pin breakage, the BUCS 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


Results from wind tunnel and flight tests 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 turboprop 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 (QSRA) program. The QSRA aircraft uses an upper surface blown flap and develops a useful 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 (KV-15-TTRA) aircraft flight investigations. The TTRA is a twin rotor research aircraft capable of vertical takeoff and landing and cruise speeds of 300 knots. The turboprop V/STOL aircraft technology results are from static ground facility and wind tunnel investigations of a NASA/NAVY/Grumman full scale tilt/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. (Author)

A81-48369# Time delays in flight simulator visual displays.


It is pointed out that the effects of delays of less than 100 msec in visual displays on pilot dynamic response and system performance are of particular interest at this time because improvements in the latest computer-generated imagery (CGI) systems are expected to reduce CGI displays delays to this range. Attention is given to data which quantify the effects of display delays in the range of 0-100 msec on system stability and performance, and pilot dynamic response for a particular choice of aircraft dynamics, display, controller, and task. The conventional control system design methods are reviewed, the pilot response data presented, and data for long delays, all suggest lead filter compensation of display delay. Pilot-aircraft system crossover frequency information guides compensation filter specification. (Author)

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)

Theoretical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft; and a turboprop 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 (QSRA) program. The QSRA aircraft uses an upper surface blown flap and develops a useful 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 (KV-15-TTRA) aircraft flight investigations. The TTRA is a twin rotor research aircraft capable of vertical takeoff and landing and cruise speeds of 300 knots. The turboprop V/STOL aircraft technology results are from static ground facility and wind tunnel investigations of a NASA/NAVY/Grumman full scale tilt/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. (Author)
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.R.H.

N81-28066* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
The Influence of Unsteady Aerodynamics on Hingeless Rotor Ground Resonance
Wayne Johnson Jul. 1981 47 p refs (NASA-TM-81302; A-8635: USAUVRADCOM·TR·81·B·16) Avail: NTIS HC A03/MF A01 CSCL 01A
Calculations of the model frequency and damping for a hingeless rotor on a gimbaled support in hover are compared with measured results for two figures (differing in blade flap stiffness). Good correlation is obtained when an inflow dynamics model is used to account for the influence of the unsteady aerodynamics. The effect of the unsteady aerodynamics is significant for this rotor system. The inflow dynamics model introduces additional states corresponding to perturbations of the wake-induced velocity at the rotor disk. The calculations confirm the experimental observation that the inflow mode introduced by these additional states is measurable for one configuration but not for the other.

N81-28390* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
Performance and Analysis of a Three-Dimensional Nonorthogonal Laser Doppler Anemometer
A three dimensional laser Doppler anemometer with a nonorthogonal third axis coupled by 14 deg was designed and tested. A highly three dimensional flow field of a jet in a crossflow was surveyed to test the three dimensional capability of the instrument. Sample data are presented demonstrating the ability of the 3D LDA to resolve three orthogonal velocity components. Modifications to the optics, signal processing electronics, and data reduction methods are suggested.

E.A.K.

N81-32137* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A Full-Scale Wind Tunnel Investigation of a Helicopter Bearingless Main Rotor
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, RPM, airspeed and shaft angle. The rotor/support system was tested with the wind tunnel balance dampers installed and, subsequently, removed. Modifications to the rotor hub were tested. These included a reduction in the rotor control system stiffness and increased flexbeam structural damping. The primary objective of the test was 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.

R.C.T.

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 refs (Contract NAS2-10585)
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 include 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

N81-29923* Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics
A Note on Sound Radiation from Distributed Sources
Harold Levine May 1979 10 p refs (Grant NaG-2007)
Avail: NTIS HC A02/MF A01 CSCL 20A
The power output from a normally vibrating strip radiator is expressed in alternative general forms, one of these being chosen to refine and correct some particular estimates given by Heckl for different numerical ratios of strip width to wave length. An exact and explicit calculation is effected for sinusoidal velocity profiles when the strip width equals an integer number of half wave lengths.

Author

N81-14989* Beam Engineering, Inc., Sunnyvale, Calif.
Static Source Locations for Four Nozzles Mounted on a J-85 Engine
Leif E. Hoglund Jan. 1979 236 p refs (Contract NAS2-9399)
Avail: NASA, Ames Research Center CSCL 21E
The test nozzles included a round 17.5 in. diameter variable flap ejector (VFE) nozzle, a round 'stovepipe' nozzle, and a 104 tube suppressor nozzle operated both with and without an ejector shroud. The velocities tested ranged from 600 to 1600 fps at an approximate total temperature of 1400 R. The axial position of the noise sources during static operation was determined by jet velocity, Strouhal number, and direction of propagation. The velocity dependence was more evident for the 104 tube suppressor nozzle than for the conical nozzles tested. The results for both the VFE conical nozzle and the stovepipe conical nozzle indicate source locations to be much closer to the jet exit plane than expected. Corrections for near field effects were found to differ slightly for each nozzle tested. The corrections presented are simply the differences between the measured near field levels and the required near field levels if spherical spreading is assumed from source to far field.

Author

An Investigation of Engine Influence on Inlet Performance
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.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


Action to be taken to prepare to implement efficient, modern commuter aircraft for the 1990s is outlined. The increase in the contribution of jet fuel costs to aircraft direct operating costs (DOC) is noted as the motivation for the introduction of turboprop-powered commuter aircraft, which use 15-20% less fuel per seat mile at short stage lengths, to replace larger jet transports. Designs proposed by various manufacturers which will make use of existing technology for 19-, 30- and 50-seat aircraft capable of carrying a full payload of passengers and baggage for 800 n mi and optimized for minimum DOC over a 100-n mi stage length are presented, and the improvements in fuel usage, DOC and passenger comfort to be obtained with the use of advanced technology are pointed out. The goals and considered technologies of the dedicated small-transport aircraft technology program recommended by a commuter air transport subcommittee of the NASA Advisory Council Aeronautics Advisory Committee to speed the development of commuter technology are then presented, with attention given to efforts of analysis, design and testing of propulsion systems, structures, aerodynamics and systems intended to result in 16-24% savings in DOC and up to 40% savings in fuel. The commuter development plans of various manufacturers are also indicated.

S.C.S.


A numerical procedure for optimizing circulation control airfoils, which consists of the coupling of an optimization scheme with a viscous potential flow analysis for blowing jet, is presented. The desired airfoil is defined by a combination of three baseline shapes (cambered ellipse, and cambered ellipse with drooped and spiralled trailing edges). The coefficients of these shapes are used as design variables in the optimization process. Under the constraints of lift augmentation and lift-to-drag ratios, the optimal airfoils are found to lie between those of cambered ellipse and the drooped trailing edge, towards the latter as the angle of attack increases. Results agree qualitatively with available experimental data.


The development of a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. Particular emphasis is given to describing the reasons behind the choices and decisions involved in constructing the model. The analysis is designed to calculate rotor performance, loads and noise; helicopter vibration and gust response; flight dynamics and handling qualities; and system aeroelastic stability. It is intended for use in the design, testing and evaluation of a wide class of rotors and rotorcraft, and to be the basis for further development of rotary wing theories. The general characteristics of the geometric, structural, inertial, and aerodynamic models used for the rotorcraft components are described, including the assumptions introduced by the chosen models and the resulting capabilities and limitations. Finally, some examples from recent applications of the analysis are given.


The acoustic characteristics of circulation-controlled rotors are examined by comparing data from three full-scale rotors: a conventional rotor, the X-Wing rotor, and the Circulations Control Rotor.
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.


The Quiet Short-Haul Research Aircraft (QSRA), used to conduct a broad program of terminal area and low speed propulsive-lift flight research, is described. 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.

A81-33144* 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 A01 C5101B

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/Boeing XV-15 TRRA aircraft flight investigations. 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.


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, related component technologies, and system requirements, powerplants and component thrusters, compressor design, combustion systems, turbine efficiency, blade tip treatment concepts and shaft dynamics are discussed in detail.


The structure of the attached turbulent flow in the vicinity of a NACA 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- by 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.


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.


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 goals of the tests are (1) to investigate potential improved stalling characteristics over conventional tail-oft 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.


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)


The interference effect of closely coupled lifting surfaces was investigated. A nonsteady vortex-lattice method was applied to calculate the steady-state and nonsteady lift characteristics of configurations having interference effects. The configurations consist of low-aspect-ratio delta wings, at low and high angles of attack. Leading-edge separation and wake roll-up are simulated by a time-dependent wake-shedding procedure. For steady-state flow conditions, this numerical procedure saves a considerable amount of computer time, compared with iterative methods, and yields the same results. A better understanding of the interference effect can be gained by using the method to study the transient behavior. The nonsteady approach also offers the capability of calculating various nonsteady motions, as is demonstrated in the calculation of the longitudinal damping.

(Author)


Full-scale wind-tunnel tests, conducted to determine the effects of three different airfoil sections on the aft-fuselage drag of a low-wing aircraft, are described. The measurements indicate a maximum difference in aft fuselage drag between the three airfoils of about 0.002. Measured changes in the locations of the fuselage pressure contours with airfoil section correlated well with the changes predicted by a three-dimensional paneling code. A criterion, based on the inviscid computer code, is then proposed as an indicator for possible adverse viscous interactions at the wing-fuselage junction.

(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 + or - 1 deg, with the mean held at 0 deg when the flow was assumed to be attached and between + or - 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 (COMMIN), 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 whirr-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.

(Author)
No significant change in system damping occurred that was attributable 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.

HELICOPTER SYSTEMS OFFICE

NASA CONTRACTOR REPORTS


SIMULATION SCIENCES DIVISION

NASA CONTRACTOR REPORTS

N81-2395# 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)

N81-2395# 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)

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)

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)

X81-10216# 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)

X81-10216# 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)

Specifications for a composite rotor blade for use on the XV-15 tilt rotor aircraft are established. The outlined development specifications include: performance, design, manufacture, airworthiness qualification, and acceptance test requirements.

E.A.K.

X81-10215# Bell Helicopter Co., Fort Worth, Tex.
ENGINEERING ANALYSIS OF A COMPOSITE ROTOR BLADE FOR THE XV-15 TILT ROTOR AIRCRAFT Oct. 1979 142 p refs (Contract NAS2-10289)

X81-10215# Bell Helicopter Co., Fort Worth, Tex.
ENGINEERING ANALYSIS OF A COMPOSITE ROTOR BLADE FOR THE XV-15 TILT ROTOR AIRCRAFT Oct. 1979 142 p refs (Contract NAS2-10289)

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, producibility, 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 selected 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.
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.
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.

**A.R.H.**


**GASP - GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 3: AERODYNAMICS. PART 1: THEORETICAL DEVELOPMENT**


(Contract NAS2-9352)

HC A09/MF A01 CSCL 01C

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 angle of attack; (4) determine drag coefficient; (5) determine maximum lift coefficient and drag increment for various flap types and flap settings; and (6) determine required lift coefficient and drag coefficient in cruise flight.

**A.R.H.**


**GASP - GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 4: PROPULSION. PART 1: THEORETICAL DEVELOPMENT**


(Contract NAS2-9352)

HC A09/ME A01 CSCL 01C

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.

**A.R.H.**


**GASP - GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 5: WEIGHTS. PART 1: THEORETICAL DEVELOPMENT**


(Contract NAS2-9352)

HC A09/ME A01 CSCL 01C

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 provided.

**A.R.H.**


**GASP - GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 6: PERFORMANCE. PART 1: THEORETICAL DEVELOPMENT**


(Contract NAS2-9352)

(Contract NAS-152303-Vol-6-Pt-1) Avail: NTIS

HC A09/ME A01 CSCL 01C

Aircraft performance modeling requires consideration of propulsion, aerodynamics, and weight characteristics. Eleven subroutines used in modeling aircraft performance are presented and their interactions considered. Manuals for performance model users and programmers are included.

**A.R.H.**


**GASP - GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 7: ECONOMICS. PART 1: THEORETICAL DEVELOPMENT**

Jan. 1978 39 p refs

(Contract NAS2-9352)

(Contract NAS-152303-Vol-7-Pt-1) Avail: NTIS

HC A09/ME A01 CSCL 01C

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

X81-10001# Boeing Commercial Airplane Co., Seattle, Wash.
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

X81-10002# Boeing Commercial Airplane Co., Seattle, Wash.
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

X81-10003# Boeing Commercial Airplane Co., Seattle, Wash.
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

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.

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.
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.

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 channel per 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
The detectors were fabricated from a Ge:Ga wafer from Eagle-Pitcher with a room temperature resistivity of approximately 21%.

The activity concentrated on identifying crop and irrigation data sources for the eight states within the High Plains Aquifer and making contacts concerning the nature of these data. A mail questionnaire was developed to gather specific data not routinely reported through standard data collection channels. Input/output routines were designed for High Plains crop and irrigation data and initial statistical data on crops were input to computer files.

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 under static loadings. The tests partially verified the structural concept.

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%.

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.

New versions of LANDSAT surface data were prepared for the computer system by lake management personnel without any prior training. The characteristic spectral signatures of various algal types were also recognizable in part by the color tone produced by remote sensing.

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 under static loadings. The tests partially verified the structural concept.

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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.

N81-33117* Cornell Univ., Ithaca, N.Y. Dept. of Astronomy. MOLECULAR HYDROGEN EMISSION FROM WS1 Steven Beckwith and Ben Zuckerman (Maryland Univ.) Sep. 1981 17 p refs (Grants NsG-2412; NSF AST-76-17600) (NASA-CR-164608; CRSR-775) Avail: NTIS HC A02/MF A01 CSCL 03B The detection of emission from the v = 1 approaches 0 S(1) quadrupole transition of H2 toward the cluster of intense infrared and H2O maser sources in WS1 (north) is reported. The apparent luminosity of this line in WS1 (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 WS1. Similarity in the infrared and H2O properties of these clusters is addressed. The implications of the H2 emission for mass loss in the WS1 region is discussed and some proposed models of radiation-driven mass outflow from pre-main sequence stars are briefly considered. M.G.


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. The 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- and 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.
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 meteors 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 IFOVs’ 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 259 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

A81-19060*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. THE 1979 CLEAR AIR TURBULENCE FLIGHT PROGRAM


The flight experiments for clear air turbulence (CAT) detection and measurement concepts are described. The test were conducted over the western part of the United States during the winter season of 1979 aboard NASA’s Galileo 2 flying laboratory. A carbon dioxide pulsed Doppler lidar and an infrared radiometer were tested for the remote detection and measurement of CAT. Two microwave radiometers were evaluated for their ability to provide encounter warning and altitude avoidance information. M.G.

A81-19517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. SNOW ELECTROMAGNETIC MEASUREMENTS


An electromagnetic system is described for measuring the dielectric constant and attenuation of snow samples in the frequency range of 4 to 12 GHz. System components consists of a swept-frequency source, microwave horns, network analyzer, and XY plotter. The procedure for calibrating the effect of wetness on the snow properties is described. Equations are given that express the experimentally determined relation between attenuation per unit length and volume percent wetness at any frequency between 4 and 12 GHz. Permittivity can be calculated from the snow density, attenuation per unit length, and frequency. Some applications of the techniques are described such as runoff forecasting from mountain snowpacks. E.D.K.

A81-19004*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. A METHOD FOR DETERMINING LANDING RUNWAY LENGTH FOR A STOL AIRCRAFT


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 length by summing three segments: the touchdown-dispersion distance, the transition distance from touchdown to touchdown of brakes, and the stopping distance after brakes are applied. It is shown how the landing field length can be reduced either through improved autorotation 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.

The proposed method appears to determine a safe runway landing length for the STOL application and offers the potential for reducing runway length if great emphasis is placed on a short-runway capability. FAR Parts 25 and 121 appear conserva-

tive and suitable for the situation where no great emphasis is placed on reducing the runway length requirement. A.R.H.


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

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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.


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 Observatory (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 astronomy, extragalactic astronomy, the interstellar medium, and to the study of star formation and evolution are enumerated. C.R.


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 11,500 nm) for the purpose of estimating sea 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 sub-surface 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)


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 operational 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.


CHEMICAL RESEARCH PROJECTS OFFICE

NASA CONTRACTOR REPORTS

X81-10140 * Sierraon 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

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 Goddite 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 11D

Three weaves were evaluated: a balanced plain weave, a balanced 8-harness satin weave, and a seminidirectional crownfoot satin weave. The current state-of-the-art resin system selected was Fiberite'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.

DEVELOPMENT OF ASSEMBLY TECHNIQUES FOR FIRE RESISTANT AIRCRAFT INTERIOR PANELS Final Report Samuel C. S. Lee May 1978 87 p refs (Contract NAS2-9153)
(NASA-CR-152119; HTR-5-78) Avail: NTIS HC AO4/MF AO1 CSCL 11D
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 polycimide 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

N81-18128*# San Jose State Coll., Calif.
Donald J. Myronuk Oct. 1980 47 p refs (Grants NsG-2165; NsG-2219; AFOSR MIPR FY 1455-77: AF Proj. 3048)
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) (2.4 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. Author

N81-18197*# Utah Univ., Salt Lake City. Flammability Research Center.
FLAMMABILITY SCREENING TESTS OF RESINS Final Report
(NASA-CR-152312; UTEC-79-140) Avail: NTIS HC AO7/MF AO1 CSCL 11G
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.

N81-22119*# Idaho Univ., Moscow. Dept. of Chemical Engineering.
Roger A. Korus 28 Feb. 1981 9 p refs (Grant NsG-2367)
(NASA-CR-164194) Avail: NTIS HC AO2/MF AO1 CSCL 07C
The synthesis of high performance elastomers with the high thermal stability and chemical inertness of perfluoralkylenetriazine and a low glass transition temperature is discussed. Perfluorother triazine elastomers were proposed as potentially superior. It is concluded that the difficulties experienced in fluoroalkylenetriazine 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 other broad range elastomers.

N81-23058*# Douglas Aircraft Co., Inc. Long Beach, Calif.
STUDY TO DEVELOP IMPROVED FIRE RESISTANT AIRCRAFT PASSENGER SEAT MATERIALS Final Report, 4 Dec. 1979 - 30 Sep. 1980
(NASA-CR-152408; MDC-J4651) Avail: NTIS HC AO7/MF AO1 CSCL 01C
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

N81-24038*# Douglas Aircraft Co., Inc. Long Beach, Calif.
A. Cominsky Jan. 1981 127 p refs (Contract NAS2-10583)
(NASA-CR-161659) Avail: NTIS HC AO7/MF AO1 CSCL 01C
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.

FIRE TEST METHODOLOGY FOR AEROSPACE MATERIALS. 1: THERMAL AND SMOKE TOXICOLOGICAL ASSESSMENTS OF GRAPHITE/BISMALEIMIDE AND GRAPHITE/EPOXY SYSTEMS Final Report
(NASA-CR-166196; AHWB-03-5555-001) Avail: NTIS HC AO6/MF AO1 CSCL 11D
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.

T.M.

CONFERENCES AND MEETING PAPERS


JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


CONFERENCE AND MEETING PAPERS

A81-19061* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FIREWORTHINESS OF TRANSPORT AIRCRAFT INTERIOR SYSTEMS


Avail. NTIS HC A17/MF A01 CSCL 01C

The key materials question is addressed concerning the effect of interior systems on the survival of passengers and crew in the case of an uncontrolled transport aircraft fire. Technical opportunities are examined which are available through the modification of aircraft interior subsystem components. Modifications that may reasonably be expected to provide improvements in aircraft fire safety. Subsystem components discussed are interior panels, seats, and windows. By virtue of their role in real fire situations and as indicated by the results of large scale simulation tests, these components appear to offer the most immediate and highest payoff possible by modifying interior materials of existing aircraft. These modifications have the potential of reducing the rate of fire growth, with a consequent reduction of heat, toxic gas, and smoke emission throughout the habitable interior of an aircraft, whatever the initial source of the fire.

E.D.K.
A combustion toxicology 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.

PB91-291846* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. SPATIAL DISTRIBUTION OF VOLATILE COMPOUNDS IN GRAPHITE COMPOSITES Final Report c24 W. J. Gilwee and A. Jayarajan In American Chemical Society The 16th Natl. Symp. on Polymers in the Serv. of Man 1980 p 131-135 refs (For primary document see NB1-28146 16-23) Aval: NTIS HC A09/MF A01 CSCL 11D

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 tetraglycidylmethylenedianine. 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.
Stray radiation and the Infrared Astronomical
Telescope Project Office

CONFERENCE AND MEETING PAPERS

A81-36891
Stray radiation and the Infrared Astronomical
Satellite /IRAS/ telescope. R. J. Noll, R. Harned (Perkin-Elmer
Corp., Danbury, Conn.), R. P. Breault (Breault Research Organiza-
tion, Inc., Tucson, Ariz.), and R. Malugin (NASA, Ames Research
Center, Moffett Field, Calif.). In: Radiation scattering in optical
systems; Proceedings of the Seminar, Huntsville, Ala., September
30-October 1, 1980. (A81-36878 16-74) Bellingham, Wash., Society
refs. NASA-supported research.

Stray light control is a major consideration in the design
of infrared cryogenically cooled telescopes such as the Infrared Astro-
omical 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 exam-
ined.

A.R.H.
NASA TECHNICAL MEMORANDA

N81-16415*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUPERFLUID HELOM LEAK SEALANT STUDY
John W. Vorreiter Jan. 1981 19 p refs

Twenty-one leak specimens were fabricated in the ends of stainless steel and aluminum tubes. Eighteen of these tubes were coated with a copolymer material to seal the leak. The other three specimens were left uncoated and served as control specimens. All 21 tubes were cold shocked in liquid helium 50 times and then the leak rate was measured while the tubes were submerged in superfluid helium at 1.7 K. During the cold shocks two of the coated specimens were mechanically damaged and eliminated from the test program. Of the remaining 16 coated specimens one suffered a total coating failure and resulting high leak rate. Another three of the coated specimens suffered partial coating failures. The leak rates of the uncoated specimens were also measured and reported. The significance of various leak rates is discussed in view of the infrared astronomical satellite (IRAS) Dewar performance.

Author

N81-19871*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PIONEER: FIRST TO JUPITER, SATURN, AND BEYOND.
BIBLIOGRAPHY
1980 30 p Supplement to NASA-SP-446
(NASA-TM-81233) Avail: NTIS HC AO3/DF AF01 CSCL 03E

The reference cistons 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.

N81-21000*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SURFACE PENETRATORS FOR PLANETARY EXPLORATION: SCIENCE RATIONALE AND DEVELOPMENT PROGRAM

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.


Jane L. Fox 29 May 1981 7 p refs
(Grant NAG2-94) (NASA-CR-164329) Avail: NTIS HC AO2/MD AF01 CSCL 03B

Models of the upper atmospheres of Mars and Venus were constructed using Viking and Pioneer Venus data. The neutral densities, with the exception of NO, N(4S), N(2D) and N(2P) were taken from the measured values, along with the neutral, ion, and electron temperatures. Using solar fluxes and relevant cross sections, the production rates of ions and neutral fragments by photo and electron impact processes were computed. These production rates were combined with chemical production rates and loss along with one dimensional transport eddy diffusion, molecular and ambipolar diffusion, and thermal diffusion, to determine the densities of ions and odd nitrogen species. Preliminary calculations show that the chemistry of metastables and doubly ionized species is important in the ionospheres of Mars and Venus. Production of N(+) in metastable reactions is particularly important, and it explains the discrepancy between the measurements of earlier models. Production of CO(+) is also affected. Reactions of O(+)(-) and O(+)(2D) with N2 have important consequences for the escape rate of atomic nitrogen from the Martian atmosphere.

A.R.H.


HYBRID RECEIVER CONCEPTUAL DESIGN AND TEST REPORT Final Report
Stephen W. Klare and James J. Crawford 31 May 1978 85 p refs
(Contract NAS2-9707) (NASA-CR-152137) Avail: NTIS HC AO5/MD AF01 CSCL 178

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.


NUMERICAL SOLUTION OF TRANSODIC FULL STREAM FUNCTION EQUATIONS IN CONSERVATION FORM Final Report
Mohamed M. Hafez Oct. 1979 36 p refs
(Contract NAS2-10252)
CSCL 01A

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
(Contract NAS2-10227; Grants NSF AST-76-81874; NSF AST-78-22482)
(NASA-CR-156217) Avail: NTIS HC A02/MF A01 CSCL 20L

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.

N81-29047* Carson Alexiou Corp., Costa Mesa, Calif.
NASA Ames INFRARED DETECTOR ASSEMBLIES Final Report
15 Oct. 1979 23 p
(Contract NAS2-10138).
(NASA-CR-156215) Avail: NTIS HC A02/MF A01 CSCL 03A

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 13th power atoms/cm. A.R.H.

INFRARED ASTRONOMICAL SATELLITE (IRAS) ANALYSIS OF THE TRANSMITTANCE OF OFF-AXIS ENERGY DUE TO SCATTERING AND DIFFRACTION Final Report
(Contract NAS2-9968)
(NASA-CR-158227) Avail: NTIS HC A08/MF A01 CSCL 20F

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. L.S.

VAPOUR-LIQUID PHASE SEPARATOR PERMEABILITY RESULTS Annual Report, Fall 1980 - Sep. 1981
(Grant NCC2-64)


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, thermosmotic 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-gamma-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 emission feature is present, although it differs significantly from the opacity. On the basis of the carbon star models of Querci and Querci discussed quantitatively without the inclusion of HCN and C2H2, it is possible to associate bands at 1.04, 1.53, 1.85, 2.5, 2.7, and 7.1 microns with HCN and C2H2. The spectrum of 10 flashes/sq km/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.


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 polynatomic molecules HCN and C2H2. Since the band at 3.1 microns is known to be due to HCN and C2H2, 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 C2H2. The spectrum of 10 flashes/sq km/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.

The Shuttle Infrared Telescope Facility (SIRTF) is being designed as a 0.85 m cryogenically cooled telescope capable of a three order of magnitude improvement over currently available infrared instruments. The SIRTF requires that the image at the focal plane be stabilized to better than 0.25 arcsec with an absolute accuracy of 1.0 arcsec. Current pointing-maintained performance simulations indicate that neither of these requirements can be met without additional stabilization. The SIRTF pointing and control system will utilize gyro outputs, star field position measurements from a focal plane fine guidance sensor, and a starvable secondary mirror to provide the necessary stabilization and pointing control. The charge-coupled device fine guidance sensor tracks multiple stars simultaneously and, through the use of multitem processing algorithms in high performance microcomputer, generates three-axis position errors and gyro-drift estimates to correct the pointing-maintained gyros. A high bandwidth feedforward loop, driven directly from the pointing-maintained gyro package, controls the steering mirror in order to correct disturbances not compensated for by the pointing-maintained control system. A prototype design for the SIRTF pointing and control system is described in detail. Performance analyses made using a digital simulation of the pointing and control system as well as experimental data obtained in laboratory and field test measurements are presented.

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 rationales 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 facing 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 the Zernike coefficients and wavefront maps for the cryo corrected primary mirror.

C.R.

SPACEx SCIENCE DIVISION

NASA FORMAL REPORTS


For a fleet of 250 aircraft, the change in the ozone column is predicted to be very close to zero; in fact, the ozone overburden may actually increase as a result of a show that above 25 to 30 km the ozone abundance decreases via catalytic destruction, but at lower heights it increases, mainly as a result of coupling with odd hydrogen species. Water vapor released in the engine exhaust is predicted to cause ozone decreases; for the hypothetical engines used in the study, the total column ozone changes due to water vapor emission largely offset the predicted ozone increases due to NOx emission. The actual effect of water vapor may be less than calculated because present models do not include thermal feedback. Feedback refers to the cooling effect of additional water vapor that would tend to slow the NOx reactions which destroy ozone. T.M.

NASA TECHNICAL MEMORANDA


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

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. Fortran programs and subroutines that were developed are described and listed. A.R.H.


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 H2S2SO3 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
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 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 40/cm3. At lower densities (100 per cm3), 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)


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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. Although the observations of these large scale fields occur when perigee 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. Snettinger, 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 a Europa 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 radii. 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 blaster model.

B.J.


Optical scanner spectra are presented for ten positions in the lobes of GL 2686. 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.

(Former)


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 isothermal collapse of a rotating protostar with pressure and self-gravity is calculated by a hydrodynamic computer code that treats three space dimensions. A number of initial conditions are tested to determine the conditions under which a cloud is unstable to fragmentation. It is shown that fragmentation does not proceed to a significant extent during the first free-fall time, but that in most cases fragmentation has occurred by 1.5 to 2 times the initial free-fall time. The extent to which the density in the fragments is enhanced over that in their surroundings on this time scale depends on the initial ratio of thermal to gravitational energy, but is only weakly dependent on the type and amplitude of the perturbation and on the initial rotational energy.

B.J.


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 S 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.


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 Rosenthal's observation of an abrupt change in the velocity-gradient-luminosity relationship for BB 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)


The structure of interstellar shocks driven by supernova remnants and by expanding H II regions around early-type stars is described. Jump, intermediate, and shock interactions are examined, along with shock crossing, post-shock relaxation layers, collisional shocks, collisionless shocks, nonradiative shocks, radiative atomic shocks, and shock models of observed nebulae. 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 of shocked molecules. 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 paper reports results of an extensive set of three-dimensional hydrodynamic calculations performed to investigate the susceptibility of rotating clouds to gravitational fragmentation; only isothermal collapse sequences were considered. It is found that rotating isothermal gas clouds are unstable to fragmentation under a wide range of conditions. The degree of instability and the mode
(ring vs. blob) of fragmentation is sensitive to alpha, but insensitive to beta. The initial amplitude of a perturbation does not appear to be crucial; fragmentation should occur eventually even for low-amplitude initial NAPs.


Numerical calculations of the collapse of adiabatic clouds from uniform density and rotation initial conditions show that when restricted to axisymmetry, the clouds form either near-equilibrium spheroids or rings. Rings form in the collapse of low thermal energy clouds and have a ratio of rotational kinetic energy to the absolute value of gravitational potential energy greater than approximately 0.43. When the axisymmetric constraint is removed and an initial mass = 2 density variation is introduced, clouds either collapse to form near-equilibrium ellipsoids or else fragment into binary systems through a bar phase. Ellipsoids form in the collapse of high thermal energy clouds and have a rotational kinetic/absolute value of gravitational potential energy ratio less than approximately 0.27. The results are consistent with the critical values of the rotational kinetic/absolute value of gravitational potential energy ratio for instabilities in Maclaurin spheroids, and suggest that protostellar clouds may undergo a dynamic fragmentation in the nonisothermal collapse regime. (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, 240, 283, and 294 K. The measurements lead to a total band intensity value of 642 plus or minus 5% per cm amag, 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 km altitude. 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 subsolar, 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 39-40 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 energy sources internal to the planet rather than by equilibrium with 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)


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 1000 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 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 at altitude may be global and need not occur only in locations exhibiting unique meteorologic features. (Author)


Calculations of the distribution of stratospheric sulfur gases and of stratospheric aerosol mass have been performed 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.


Measurements of ozone and nitric oxide in a nuclear cloud 7 days after the explosion are reported. No measurable increase above ambient density of either ozone or nitric oxide was found. Results from a chemistry model of the cloud do not agree with the measurement unless 'nonstandard' assumptions are made with regard to the operating chemical processes. A number of possible explanations of the results are discussed. (Author)


A ratio spectrum of Pluto shows methane absorption bands at 6200, 7200, 7900, 8400, 8600, 8900, and 10,000 A. The heavy saturation of the 8600 band as compared to the other bands indicates a gaseous origin for the observed absorptions. A total methane abundance of 80 +/- 20 m-am is derived, and an upper limit to the total pressure of approximately .05 atm is set. The methane atmosphere would be stable if the mass of Pluto is increased 50% over its present value and its radius is 1400 km. A heavier gas would be stable if the mass of Pluto is increased 50% over its present value and its radius is 1400 km. A heavier gas may be greater.


The suprathermal electron distribution for the dayside ionosphere has been derived from data returned by the Pioneer Venus orbiter. 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' ionosphere is discussed. (Author)


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.


The possible synthesis of organic molecules by the absorption of galactic cosmic rays in an N2-CH4-H2 Titan model atmosphere has been studied. The cosmic-ray-induced ionization results in peak electron densities of 2000/cm, with NH+(+), C3H8(+), and C4H9H being among the important positive ions. Details of the ion and neutral chemistry relevant to the production of organic molecules are discussed. The potential importance of N(2D) reactions with CH4 and H2 is also demonstrated. Although the integrated production rate of organic matter due to the absorption of the cosmic ray cascade is much less than that by solar ultraviolet radiation, the production of nitrogen-bearing organic molecules by cosmic rays may be greater.

(Author)

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.


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 20 mbar level). In addition, upward of 110 km, there is evidence of large-amplitude temperature oscillations with altitude, believed to signify the presence of large-amplitude waves, perhaps thermal tides. Agreement of structure data from other Pioneer Venus experiments is generally excellent.


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 28 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.
greenhouse model of Venus' high surface temperature and to assess subtropics. It is also concluded that transient baroclinically unstable structure of the lower atmosphere can be reproduced quite closely through convective equilibrium calculations to determine the viability 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.


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 are consistent 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.

A.L.W.


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 spherically initial conditions. Every aspherical 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 5-7% but not 15-19%. It is reported 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.


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 thin 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 unacceptably low levels (1% of the galactic mass in gas).

A.L.W.
As mentioned earlier, the Jovian "mooms" probably are present in the rings of Saturn and Uranus. O.C.


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 "mooms", residing within the ring, whose semi-major axis is less than 1 km. The small visible ring grains, which are destroyed in short time 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 "mooms" proposed may be present in the rings of Saturn and Uranus.


The non-LTE radiative transfer problem for a two level atom with complete redistribution over a Doppler profile is solved for a plane parallel slab (overlying a radiating photosphere) that has a velocity field which rises symmetrically from zero at either face to a central maximum. Since the velocity gradient reverses, distant layers of the slab become coupled by radiation that jumps intervening layers. The Feautrier method is used, but an iterative variant is also employed as a check in cases where poorly conditioned matrices are encountered. Approximations are developed to explain some of the principal features. It is found that the source function S tends to have two plateaus with values near 2/3 sub 0 and 1/3 s sub 0, where s sub 0 is the photospheric continuum incident from below; the larger value lies nearer the photosphere. The upper layers sometimes exhibit a rise in S owing to interconnection by radiation to the base. It is noted that the radiation force is largest at the two faces and in the midplane. Some time profiles are found to have unusually steep absorption at rest frequency because of the low excitation in the uppermost, stationary layers.


Several random process models in the time domain are defined and discussed. Attention is given to the moving average model, the autoregressive model, and relationships between and combinations of these models. Consideration is then given to methods for investigating pulse structure, procedures of model construction, computational methods, and numerical experiments. A FORTRAN algorithm of time series analysis has been developed which is relatively stable numerically. Results of test cases are given to study the effects of adding noise and of different distributions for the pulse amplitudes. A preliminary analysis of the light curve of the quasar 3C 272 is considered as an example.


Based on an analysis of a large sample of Pioneer Venus Orbiter magnetometer data, characteristics of the magnetic fields near nightside pericenters are discussed. The observations generally indicate a weak average field of less than 10 G between 200 km and the pericenter altitude of 150 km, except when the local solar wind dynamic pressure is high. The "spicules" in the 70 degree wide solar zenith angle range, which included the midnight meridian and is centered west of it at 1 hr local time. The presence of the radial field of the neutrinosphere and the slabs and the nightside ionosphere suggest that the antiparallel magnetic fields can terminate very close to the planet.

Temperatures of galactic molecular clouds showing CO self-absorption. T. G. Phillips, G. R. Knapp, P. C. Wannier (Owens Valley Radio Observatory, Pasadena, Calif.), P. Huggins (New York University, New York, N.Y.), M. L. Werner (Institut d'Astronomie et d'Astrophysique, University of Liege, Belgium), J. D. E. Weather, P. M. Smith (California Institute of Technology), and C. R. Dermer (University of Michigan). Astrophysical Journal, Part 1, vol. 245, Apr. 15, 1981, p. 515-528. 37 refs. NSF Grant No. AST-79-19815; Grant No. NGL-0-02-207; 11th Int. Cosmic Ray Conf., p. 1-25. The CO J = 2-1 line has been observed, and in most cases, mapped in regions of high density. CO in NGC 2071, Mon R2, CRHL 161, Ring D, W49N, W51A, DR 21, and Cep AI. The CO J = 3-2 line has been observed in W3 and DR 21. The CO lines from all these sources are strongly self-absorbed. By comparing with the present results with published CO(1-0) line profiles, it is shown that large interactions between the CO lines and the collisional excitation of the CO ground state. J. D. E. Weather (Institut d'Astronomie et d'Astrophysique, University of Liege, Belgium).


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.


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 results 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.


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


A spectrum of Saturn obtained from the Kuiper Airborne Observatory exhibits an emission peak at 6.8 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 a major absorption near 3.0 microns.


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.


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 Castileman et al. (1974) suggest that there is a common source of sulfur compounds for the stratosphere of both the northern and southern hemispheres.

A81-38791 * Long wavelength carbon monoxide photodissociation. R. P. Turco (R & D Associates, Marina del Rey, CA), R. J.
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 Goddard/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 in the distant heliosphere appear to differ greatly from those observed at 1 AU, they represent the evolution expected as the interplanetary magnetic field becomes almost azimuthal. 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. 

(Author)


A theoretical fit has been made to our laboratory measurements of the 2-0 collisionally induced H2 absorption band for temperatures of 122 and 273.3 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. 

(Author)


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 (SSST emissions and nitrogen fertilizers) may be larger than expected, while perturbations due to added water vapor and chlorine (SSSTs and chlorofluoromethanes, respectively) may be smaller. 

(Author)


Mixing ratios are presented for CF2Cl2, CFCI3, 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. 

(Author)


Voyager 1 images of Titan, when normalized to remove limb darkening, reveal an axially symmetric brightness pattern with significant north-south asymmetry. This interhemispheric 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. 

(Author)


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 µg/sq cm for the surface density is calculated in the region where the waves are seen. The kinematic viscosity in the same region is approximately 170 sq cm/s and the vertical scale height of the ring is estimated to be a maximum of approximately 40 m. 

(Author)


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. 

(Author)


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 supernovae 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. 

(Author)


An objective method for deriving the components of a generalized transport tensor for a two-dimensional model is presented. Representative 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.


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(II) ions formed by the reaction of N(I) with CH4, which lead to the production of ethyl cyanide, vinyl cyanide and cyanocetylene. 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 mbar, are presented which show substantial organic nitrite and hydrogen cyanide production rates. Based on these production rates, it is expected that significant equilibrium concentrations of these compounds will be found on Titan.


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 rises steeply from the usual cool photospheric temperatures around 4,000 to 5,000 K. Even though a recent extensive survey of T Tauri stars has been completed, no clear role for rotation in producing radio emission or stellar winds has yet emerged.


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 photochemical aftereffects of the event are simulated using a comprehensive model of atmospheric trace composition. Calculations are made which indicate that up to 45% of the ozone in 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 Instit Radiotehniki, Elektroniki i Avtomatiki, Moscow, USSR). (Akademija 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. 1980, p. 256-260. 9 refs. Translation. (For abstract see issue 13, p. 2409, Accession no. A80-34132)


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, indicate HL Tau as the exciting/illuminating star for HH 30. Evidence is adduced for a highly anisotropic distribution of circumstellar obscuration around this star.


Measurements of forbidden line Ar II 6.99 micron and Pf alpha 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 measurements, 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(+).


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 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. Extensive statistical studies of the observed directional variations of the interplanetary magnetic field are necessary to test this hypothesis.

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, Ill.), J. D. Mihalov, and J. H. Wolfe (NASA, Ames Research Center, Moffett Field, CA).

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, Ill.), J. D. Mihalov, and J. H. Wolfe (NASA, Ames Research Center, Moffett Field, CA).
High-speed solar wind streams issued from specific ranges of solar longitude or evolved into a single stream at not more 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 steepwise intensity decrease then occurs for both the galactic cosmic rays and the anomalous He component. The flare-accelerated nuclei show a new aspect of solar wave propagation in the outer solar system; at about 16 to 18 AU, the intensity builds up by diffraction, reaching a peak flux level, and finally declines when the outward rate of escape becomes dominant.


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(x)-NO(x)-HO(x)-CI(x) families which are responsible for the sensitivity, are discussed. Updated calculations for SST-induced ozone alterations are compared with older predictions. For example, assuming continuous aircraft injection of NO2 at 20 km at a rate of 1 x 10 to the 9th 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.


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, H2O, CH3(+) , 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.


spectrum are modeled in accordance with the measurements of Heath and Thekaekara (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 Thekaekara 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.

STeadY AND NONSTEADY SUPersonic Turbulent
AFTERbODy fLOW

Kenneth K. Yoshikawa and Alan A. Wray
Feb. 1981 23 p refs

N81-18084* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

NUMERICAL BOUNDARY CONDITION PROCEDURES

Oct. 1981 383 p refs Symp. held at Moffett Field, Calif.,

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 N81-33895 through N81-33899.

N81-33895* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

MULTIGRID METHODS

Oct. 1981 30 p refs Symp. held at Moffett Field, Calif.,

Developments in numerical solution of certain types of partial
differential equations by rapidly converging sequences of
operations on supporting grids that range from very fine to very
coarse are presented. For individual titles, see N81-33880 through
N81-33884.

NASA TECHNICAL MEMORANDA

N81-18136* 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


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 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 both temperature and moisture
content. A qualitative explanation for these observations is
presented.

Author
PREDICTED AND EXPERIMENTAL STEADY AND UNSTEADY TRANSONIC FLOWS ABOUT A BICONVEX AIRFOIL
(NASA-TM-81262; A-8457) Avail: NTIS HC A02/MF A01 CSCL 200

Results of computer code time dependent solutions of the two dimensional compressible Navier-Stokes equations and the results of independent experiments are compared to verify the Mach number range for instabilities in the transonic flow field about a 14 percent thick biconvex airfoil at an angle of attack of 0 deg and a Reynolds number of 7 million. The experiments were conducted in a transonic, slotted wall wind tunnel. The computer code included an algebraic eddy viscosity turbulence model developed for steady flows, and all computations were made using free flight boundary conditions. All of the features documented experimentally for both steady and unsteady flows were predicted qualitatively: even with the above simplifications, the predictions were, on the whole, in good quantitative agreement with experiment. In particular, predicted time histories 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.

CORROSION OF 310 STAINLESS STEEL IN H2-H2O-H2S GAS MIXTURES: STUDIES AT CONSTANT TEMPERATURE AND FIXED OXIDATION POTENTIAL
D. Bhogeswara Rao (California Univ., Lawrence Berkeley Lab.), K. T. Jacob (California Univ., Berkeley), and Howard G. Nelson Feb. 1981 40 p refs
(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(-13) and sulfur potentials ranging from 0.19 x 10(-2) to the minus 2nd power/cu Nm and sulfur potentials ranging from 0.19 x 10(-2) to 0.19 x 10(-2) to the minus 2nd power/cu Nm. The kinetics of corrosion were determined using a thermobalance, and scanning electron microscopy, and energy dispersive X-ray analysis. Two corrosion regimes, which were dependent on sulfur potential, were identified. At high sulfur potentials (p1 less than or equal to sub S sub 2 less than or equal to sub 0 x 10(-2) to the minus 2nd power/cu Nm) the corrosion rates were high, the kinetics obeyed a linear rate equation, and the scales consisted mainly of sulfide phases similar to those observed from pure sulfidation. At low sulfur potentials (p1 less than or equal to sub S sub 2 less than or equal to sub 0 x 10(-2) to the minus 2nd power/cu Nm) the corrosion rates were low, the kinetics obeyed a parabolic rate equation, and scales consisted mainly of oxide phases. Author

NUMERICAL APPROXIMATION OF BOUNDARY CONDITIONS WITH APPLICATIONS TO INVISCID EQUATIONS OF GAS DYNAMICS
H. C. Yee Mar. 1981 87 p refs
(NASA-TM-81265; A-8480) Avail: NTIS HC A05/MF A01 CSCL 200

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 developments 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

TOPOLOGY OF THREE-DIMENSIONAL SEPARATED FLOWS
Murray Tobak and David J. Peake Apr. 1981 46 p refs
(NASA-TM-81294; A-8554) Avail: NTIS HC A03/MF A01 CSCL 01A

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.
for the case of a circular cone. With this correction, the present

**Part 2: Bodies of Revolution**

W. H. Hui and Murray Tobak (Waterloo Univ., Ontario) Apr.
1981 37 p refs Backup document for AIAA journal scheduled
HC A03/MF A01 CSCL 20D

Newtonian flow theory for unsteady flow past oscillating
bodies of revolution at very high Mach numbers is completed
by adding a centrifugal force correction to the impact pressures. 
Exact formulas for the unsteady pressure and the stability 
derivatives are obtained in closed form and are applicable to 
bodies of revolution that have arbitrary shapes, arbitrary 
thicknesses, and either sharp or blunt noses. The centrifugal 
force correction arising from the curved trajectories followed by 
the fluid particles in unsteady flow cannot be neglected even 
for the case of a circular cone. With this correction, the present 
theory is in excellent agreement with experimental results for 
sharp cones and for cones with small nose bluntness: gives 
poor agreement with the results of experiments in air for bodies 
with moderate or large nose bluntness. The pitching motions of 
slender power-law bodies of revolution are shown to be always 
dynamically stable according to Newton-Bussemann theory. 

**PART 2: BODIES OF REVOLUTION**

A discussion of the code, modifications, which involve 

**Extensions by Comparisons with Experimental Results**

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 NACA 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.**

**Author**

**NUMERICAL EXPERIMENTS IN HOMOGENEOUS TURBULENCE**

(NASA-TM-81315) Avail: NTIS HC A05/MF A01 CSCL 20D

The direct simulation methods developed by Orzag and 
Patterson (1972) for isotropic turbulence were extended to 

**homogeneous turbulence in an incompressible fluid subjected** to 

**uniform deformation or rotation. The results of simulations for** 

**irrotational strain (plane and axisymmetric), shear, rotation,** and 

**relaxation toward isotropy following axisymmetric strain are** 

**compared with linear theory and experimental data. Emissivity** is 

**placed on the shear flow because of its importance and because** of 

**the availability of accurate and detailed experimental data. The** 

**computed results are used to assess the accuracy of two** 

**popular models used in the closure of the Reynolds-stress equations. Data from a variety of the computed fields and the** 

**details of the numerical methods used in the simulation are also presented.**

**Author**

**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,** 

**measurements of increased interfacial debonding between** 

**filament and matrix. When combined moisture and temperature** 

**increased interfacial debonding and made the epoxy matrix more** 

**prone to fracture.**

**Author**

**NASA CONTRACTOR REPORTS**

**N81-11100#** Virginia Polytechnic Inst. and State Univ., Blacksburg.

**CREEP-RUPTURE OF POLYMER-MATRIX COMPOSITES**

Presented at Fourth SESA Intern. Congr. on Exptl. Mech., 
Boston, 26-30 May 1980

(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 
fraction of temperature and stress level. A.R.H.

**N81-11110#** Virginia Polytechnic Inst. and State Univ., Blacksburg, Coll. of Engineering
ACCELERATED CHARACTERIZATION OF GRAPHITE/EPoxy COMPOSITES
(Grant NsG-2038) (NASA-CR-163723: VPI-E-80-27) Avail: NTIS
HC AO3/MF A01 CSCL 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.

(Grant NsG-2112) (NASA-CR-168965: TFD-B1-01) Avail: NTIS
HC A10/MF A01 CSCL 01A
Major emphasis was on the design of shock free airfoils with applications to general aviation. Unsteady flow, transonic flow, and shock wave formation were examined.

N81-18095*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
DEVELOPMENT OF AN IMPROVED TOUGHNESS HYPER-PURE SILICA REFLECTIVE HEAT SHIELD Contractor Report, 3 Jul. 1978 - 3 Jul. 1979
E. L. Rusert, T. L. Hackett, and D. N. Drnenan Aug. 1979 93 p refs
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. Spectroscopic 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 hypurpure 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.

N81-18365*# Colorado State Univ., Fort Collins. Dept. of Physics.
VELOCITY MEASUREMENTS BY LASER RESONANCE FLUORESCENCE Final Report
C. Y. She and W. M. Fairbank, Jr. 1980 24 p refs
(Grant NsG-2287) (NASA-CR-163971) Avail: NTIS HC AO2/MF A01 CSCL 20E
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 measurements. Experiments show that single atoms and their real time diffusional 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 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.

N81-19020*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UNSTEADY TRANSONIC SMALL DISTURBANCE THEORY WITH STRONG SHOCK WAVES
HC AO2/MF A01 CSCL 01A
A theory to correct the transonic small disturbance (TSD) equation to treat strong shock waves in unsteady flow is developed. The technique involves the addition of higher order terms, which are formally of negligible magnitude, to the low frequency TSD equation. These terms are then chosen such that any shock waves in the flow have strengths approximately equal to the appropriate Rankine-Hugoniot shock strength. Two correcting approaches are investigated. The first is to derive a correction for the mean steady flow and then simply use this corrected form for oscillatory flows. The second is to derive a correction for both steady and oscillatory parts of the flow. This second development is the most satisfactory and comparisons of the present results with Euler equation results are generally favorable, particularly regarding shock location, although there are some discrepancies in the pressure distribution in the leading edge region.

N81-19081*# Battelle Columbus Labs., Ohio.
QUANTUM CHEMICAL CALCULATION OF THE EQUILIBRIUM STRUCTURES OF SMALL METAL ATOM CLUSTERS
Luis R. Kahn 27 Mar. 1981 78 p refs
(Grant NAG2-2027) (NASA-CR-164035) Avail: NTIS HC AO5/MF A01 CSCL 20H
A decomposition of the molecular energy is presented that is motivated by the atom superposition and electron delocalization physical model of chemical binding. The energy appears in physically transparent form consisting of a classical electrostatic interaction, a zero order two electron electron exchange interaction, a relaxation energy, and the atomic energies. Detailed formulae are derived in zero and first order of approximation. The formulation extends beyond first order to any chosen level of approximation leading, in principle, to the exact energy. The structure of this energy decomposition lends itself to the fullest utilization of the solutions to the atomic sub problems to simplify the calculation of the molecular energy. If nonlinear relaxation effects remain minor, the molecular energy calculation requires at most the calculation of two center, two electron integrals. This scheme thus affords the prospects of substantially reducing the computational effort required for the calculation of molecular energies.

N81-200641*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
DENSITY MEASUREMENT IN AIR WITH A SATURABLE ABSORBING SEED GAS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980
Donald Begosov Mar. 1981 44 p refs
(Grant NAG2-38) (NASA-CR-164083) Avail: NTIS HC AO3/MF A01 CSCL 04A
Rationally enhanced scattering from the iodine molecule is studied experimentally for the purpose of developing a scheme for the measurement of density in a gas dynamic flow. A study
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.


(Contract NCC2-71; Grant NSG-2038) Avail: NTIS HC A03/MF A01 CSCL 11D

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.

SUMMARY REPORT
(Contract NAS2-9381)

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 response, 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 inflight 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 end-to-end tracking system also demonstrate 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.

N81-25133† Martin Marietta Corp., Denver, Colo.

INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 1 Final Report
Clifford J. Chocol Aug. 1977 151 p refs
(Contract NAS2-9381)

(NA SA-CR-152123-Task-1-Final; MCR-76-564-Task-1-Final) Avail: NTIS HC A02/MF A01 CSCL 22B

Assessment of available IR sensor technology showed that the four aerothermodynamic conditions of interest during the entry trajectory of space shuttle can be accommodated by an aircraft flying parallel to the orbiter reentry ground track. Thermal information from the sides of the vehicle can be obtained with degraded performance (temperatures below 800 K) by flying the C-141 aircraft on the opposite side of the shuttle ground track and in the direction opposite that which is optimum for lower surface viewing. An acquisition system using a 6.25-cm aperture telescope and a single indium antimonide detector was designed to meet the acquisition requirements and interface with the 91.5-cm telescope with minimum modification. An image plane system using 600 indium antimonide detectors in two arrays which requires no modification to the existing telescope was also designed. Currently available components were used in a data handling system with interfaces with the experimenters station and the HP2100 computer.

N81-25038† Grumman Aerospace Corp., Bethpage, N.Y.

AN ALTERNATING-DIRECTION-IMPLICIT ALGORITHM FOR THE UNSTEADY POTENTIAL EQUATION IN CONSERVATION FORM.

Final Report
(Contract NAS2-10487)
(NASA-CR-166152) Avail: NTIS HC A03/MF A01 CSCL 01A

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...
Various state-of-the-art "shape- and Hamiltonian-consistent" techniques was discovered. A.R.H. of the gradients of the electronic energy was completed and some of the techniques pioneered by Komornicki for the calculation among the derivatives of the molecular integrals that extends the computation of the ECP integrals. Work on the relationships a first step towards fulfilling the increasing need to speed up formulae were modified to bring out the shell characteristics as that do not compromise the reliability of the calculations. Various aspects of the implementation of the effective core potential.


**QUANTUM CHEMICAL CALCULATION OF THE EQUILIBRIUM STRUCTURES OF SMALL METAL ATOM CLUSTERS**

Luis R. Kahn 23 Oct. 1981 33 p ref (for primary document see N81-15310 06-34)

A 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 discussed. 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.

**HEAT PUMP PROCESSES INDUCED BY LASER RADIATION**

M. Garbuny and T. Henningsen 3 Jun. 1980 43 p ref (Contract NAS-052-10078)

A carbon dioxide laser system was constructed for the demonstration of heat pump processes induced by laser radiation. The system consisted of a frequency doubling stage, a gas reaction cell with 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.

**NEAR-WALL SIMILARITY IN A PRESSURE-DRIVEN THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER**

F. J. Pierce and J. E. McAllister Sep. 1980 242 p ref (for primary document see N81-15313 06-34)

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**FLOW SIMULATIONS**


A 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 discussed. 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.

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


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.


A 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 discussed. 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.


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 gun 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...
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 aluminoborosilicate 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 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, preferable to them. L.S.


Semidiscal calculations are carried out for the quenching of excited-state fluorine atom by collinear collisions with 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 Bussemann's centrifugal force correction to impact pressures in steady flow. For airfoils of arbitrary shape, exact formulas for the unsteady pressure and stiffness and damping-in-pitch derivatives are obtained in closed form, which require only 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-Bussemann 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 gastodynamic 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 subsonic. 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 absorptivity 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 Vand-planque (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 Ballik-Ramsay (b 3 Sigma g - a 3 Pi u), Fox-Herzberg (e 3 Pi u-a 3 Pi u), and Swan (d 3 Pi u-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 3 Sigma g - d 3 Pi u, and e 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 both for 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 distances between the boundaries and the adjacent lines of the same coordinate family, i.e., stand-off distances. Second is at both inner and outer boundaries. First is arbitrary control of boundary shapes. Both viscous and inviscid spacings were used. In all cases, two important types of grid control can be exercised by the use of the Poisson equations is presented. Avail: NTIS HC A24/MF A01 CSCL 12A

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 clusters. D. L. Doering, H. Poppa (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructure Research, Moffett Field, CA), and J. T. Dickinson (Washington State University, Pullman, WA). Journal of Vacuum Science and Technology, vol. 18, Mar, 1981, p. 460-462. 10 refs. Grant No. NCA2-OR-840.811

A complete Newtonian flow theory is presented for unsteady flow past oscillating bodies of revolution at very small angles of attack up to 41.5 deg and Mach numbers of 6.8 and 9.6. 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 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.

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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 the 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 biconic 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 aerodynamic 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 inversions; (5) is simple and straightforward to program (estimated 10% modification for the update of many equilibrium reactive gas. W. C. Davy, M. J. Green (NASA, Ames Research Center, Experimental Fluid Dynamics Branch, Moffett Field, Calif.), G. S. Settles, D. R. Williams, and S. M. Bogdonoff (Princeton University, Princeton, N.J.). American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0352. 14 p. 16 refs.

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)


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 upwind difference of the streamwise terms at 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 fishtail 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/successive-line 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.

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)

The mathematical modeling of the aerodynamic response of an aircraft to arbitrary maneuvers is reviewed. Bryan's original formulation, linear aero forces, and linear aeroindicial functions, and superposition are considered. These concepts are extended into the nonlinear regime. The nonlinear generalization yields a form for the aerodynamic response that can be built up from the responses to a limited number of well defined characteristic motions, with some influence of the responses to these characteristic motions. These motions can be obtained in principle either in wind tunnel experiments or in air traffic experiments. A further generalization leads to a form accommodating the discontinuous and double valued behavior characteristics of hysteresis in the steady state aerodynamic response.

J.D.H.

A81-31121* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. SOME APPLICATIONS OF AERODYNAMIC FORMULATIONS TO PROBLEMS IN AIRCRAFT DYNAMICS c05

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Two applications of mathematical modeling to aerodynamic problems are discussed. The first application is an investigation of the capacity of a nonlinear aerodynamic mathematical model to describe the aerodynamic reactions on a wing rock in transonic flow. Flow field computational methods are used to evaluate the nonlinear, unsteady aerodynamic data in terms of characteristic motions called for by the model. Histories of unconstrained motions of the flap are generated from the full equations of motion, with the aerodynamic reactions specified by the mathematical model. In this second application, wing rock is investigated. The most recent model accommodates experimental results with wing rock by admitting the existence of aerodynamic hysteresis in the variation of the steady state rolling moment coefficient with roll angle is described.

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)

A fully implicit set of boundary conditions is developed for the solution of the parabolized Navier-Stokes equations for supersonic flows.


An examination and analysis is presented of the elevated temperature fatigue behavior of multidirectional graphite-epoxy composite 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.


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.


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 transformation 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.


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 one of 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.


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 recast grid points on the airfoil surface, i.e., the recasting 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.


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-chieneri photographs.


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 in a conformal mapping 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.


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 flows involving large regions of separation.
separated flow past a thick circular-arc airfoil in a channel. The new method is equal to or better than a version of MacCormick's hybrid method in accuracy and it converges to a steady state up to an order of magnitude faster. (Author)

A81-39068 *  

The feasibility of using a graphitic heat shield system on a solar probe going to within 4 solar radii of the center of the sun is investigated. An analysis of graphite vaporization, with commonly used vaporization coefficients, indicates that the maximum mass-loss rate from a conical shield as large as 4 m in diameter can be kept low enough to avoid interference with measurements of the solar environment. In addition to the mass-loss problem, the problem of protecting the payload from the high-temperature (up to 2300 K) primary shield must be solved. An analysis of radiation exchange between concentric disks provides a technique for designing the intermediate shielding. The technique is applied to the design of a system for the Starprobe spacecrafts, and it is found that a system with 10 shields and a payload surface temperature of 600 K will have a payload diameter of 2.45 m. Since this is 61% of the 4-m diameter of the primary shield, it is concluded that a graphitic heat-shield system is feasible for the Starprobe mission. (Author)

A81-39069 *  

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)

A81-39079 *  

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 methods, 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 262 kg and simulating entry into the Orion nominal atmosphere. The modern numerical methodology of COLTS and RASLE appear to provide an improved capability for coupled flow-field solutions. J.F.

A81-39081 *  

For the first time, candidate turbulence models are analyzed for shock-layer conditions as severe as those of a Jovian entry. The various models investigated are two standard models developed primarily by Cebechi (1970) and Kendall (1972), and two modifications of the standard models developed primarily by Bythrow and Lomax (1978) and by Nicotet (1979). The analysis is conducted within the context of a new, viscous shock-layer flow-field code, to properly isolate differences in performance among the various models. This code retains all terms in the Navier-Stokes equations necessary to describe the unique flow events, and incorporates computational features that greatly facilitate the analysis of such events. The relative superiority of the turbulence models cannot be determined from this study alone; however, insight is provided into the relative severity of the various models. In addition, attention is focused on an important research area for experimental and theoretical investigation to develop realistic turbulence models. (Author)

A81-39082 *  

Material response solutions for the forebody heat shield on the candidate 310-kg Galileo Probe are presented. A charring material ablation analysis predicts thermochromal 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)

A81-39132 *  
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. (Author)
Two tests of vestibular functioning in the rat were developed. The first test was the water maze. In the water maze the rat, taken from male Wistar rats are investigated. These activities were measured in the various hepatic cell compartiments, i.e., cytosol, mitochondria and microsomes. In addition, the levels of glycogen, total lipids, phospholipids, triglycerides, cholesterol, cholesterol esters, and the fatty acid composition of the rat livers were also examined and quantified. A similar group of ground-based rats treated in an identical manner served as 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 'backyard' 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.O.H.

OFFICE OF THE DIRECTOR OF LIFE SCIENCES

NASA TECHNICAL MEMORANDA

N81-32831*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K304: STUDIES OF SPECIFIC HEPATIC ENZYMES AND LIVER CONSTITUENTS INVOLVED IN THE CONVERSION OF CARBOHYDRATES TO LIPIDS IN RATS EXPOSED TO PROLONGED SPACE FLIGHT Final Report S. Abraham (Children's Hospital Medical Center, Oakland, Calif., H. P. Klein, C. Y. Lin (Children's Hospital Medical Center, Oakland, Calif.), C. Volkmann, of Medical and Biological Problems, Moscow), and E. G. Vetrova (Inst. of Medical and Biological Problems, Moscow) In its US Rat Expts. Flown on the Soviet Satellite Cosmos 1129 Aug. 1981 p 35-100 refs (For primary document see N81-32830 23-51) Avail: NTIS HC A19/MF A01 CSCL 06C

The effects of space flight on the activities of 26 enzymes concerned with carbohydrate and lipid metabolism in hepatic tissue taken from male Wistar rats are investigated. These activities were measured in the various hepatic cell compartments, i.e., cytosol, mitochondria and microsomes. In addition, the levels of glycogen, total lipids, phospholipids, triglycerides, cholesterol, cholesterol esters, and the fatty acid composition of the rat livers were also examined and quantified. A similar group of ground-based rats treated in an identical manner served as 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 'backyard' 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.

NASA CONTRACTOR REPORTS

N81-27778*# Utah Univ., Salt Lake City. Dept. of Psychology


Two tests of vestibular functioning in the rat were developed. The first test was the water maze. In the water maze the rat does not have the normal proprioceptive feedback from its limbs to help maintain its orientation, and must rely primarily on the sensory input from its visual and vestibular systems. By altering lighting conditions and visual cues the vestibular functioning without visual cues was assessed. Whether there was visual compensation for some vestibular dysfunction was determined. The second test measured vestibular functioning of the rat's behavior on a parallel swing. In this test the rat's postural adjustments while swinging on the swing with the otoiliths being stimulated were assessed. Less success was achieved in developing the parallel swing as a test of vestibular functioning than with the water maze. The major problem was incorrect initial assumptions of what the rat's probable behavior on the parallel swing would be.

S.F.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS


CONFERENCE AND MEETING PAPERS

N81-40381 * The effects of space flight on some rat liver enzymes regulating carbohydrate and lipid metabolism. S. Abraham, C. Y. Lin (Children's Hospital Medical Center, Bruce Lyon Memorial Research Laboratory, Oakland, CA), H. P. Klein, and C. Volkmann (NASA, Ames Research Center, Moffett Field, Calif.), C. H. Chervenka (Beckman Research Lab., Oakland, CA) In its US Rat Expts. Flown on the Soviet Satellite Cosmos 936 biolab satellite under normal space flight conditions and in centrifugales 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 glycerol of the flight centrifuged group as well as a significant increase in the ratio of palmitic to palmitoleic acid. Results thus indicate metabolic changes which may be involved in the mechanism of weight loss during weightlessness, and demonstrate the equivalence of centrifugation during space flight to terrestrial gravity.

A.L.W.
The application of methods to ameliorate desynchronization transmeridian flight studies are discussed; (3) shiftwork; (2) phase shift in which ground based light/dark alteration and arranged in the following categories: (1) human performance, to pilot performance and circadian phase alteration are cited with focus on the effects of sleep loss or disturbance and fatigue; (5) chronotherapy, in which the birthdate disturbances on sleep and psychopathology; (4) internal desynchronization which includes the effect of sleepiness and associated melatonin levels; (6) biorythm theory, in which the birthdate symptomatology: and (6) biorythm theory, in which the birthdate

development of a new method for predicting aircraft accident susceptibility is critically analyzed. Annotations are provided for most citations.


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.

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 circadian phase alteration are cited and arranged in the following categories: (1) human performance, with focus on the effects of sleep loss or disturbance and fatigue; (2) phase shift in which ground based light/dark alteration and transmeridian flight studies are discussed; (3) shiftwork; (4) internal desynchronization includes the effect of environmental factors on rhythmic stability, and of rhythm disturbances on sleep and psychopathology; (5) chronotherapy, the application of methods to ameliorate desynchronization symptomatology; and (6) biorhythm theory, in which the birthdate

based biorhythm method for predicting aircraft accident susceptibility is critically analyzed. Annotations are provided for most citations.

Authors:


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.


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 embryology 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.


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 N81-32845.
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 periosteal bone formation in tibial and humeral 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 periosteal bone formation may have ceased during space flight. Endosteal bone resorption was not affected markedly. Author

N81-32833*# 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. Mozsary (Univ. of The Pacific, San Francisco), and Emily Mory-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.

N81-32842*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENT K314: FETAL AND NEONATAL RAT BONE AND JOINT DEVELOPMENT FOLLOWING IN UTERO SPACEFLIGHT Final Report

Infant rat limb specimens from Soviet and U.S. ground-bred studies were examined by radiography, macrophotography, histologic sectioning and staining and scanning electron microscopy. A comparison was conducted between vivarium and flight-type diets suggesting that nutritional abesity may adversely affect pregnancy. Data were obtained on maturation of ossification centers, orientation of collagen fibers in bone, tendon and ligaments, joint surface texture and spatial relationships of bones of the hind limb. Computer reconstructions of the knee and hip show promise as a means of investigating the etiology of congenital hip dislocation. Author

N81-32843*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENT K315: STUDIES OF THE NASAL NUCOSA Final Report

The posterior regions of the olfactory nasal mucosa of rat, flown on Cosmos 1129 failed to reveal histopathologic lesions. These results are at variance with those of the Apollo 12 biocore experiment in which severe necrotic olfactory mucosal lesions were seen in flight animals only. In the anterior aspect of the nasal cavity of the Cosmos 1129 rats, however, focal lesions of moderate severity and variable extent were seen. These were consistent in character with that of a mild virus infection, which, it is postulated, was self-limiting. The infection was present in all groups of animals: flight, synchronous and vivarium control. Author

EXPERIMENT K-317: 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

N81-15665*# 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.
HABITATION TO NOVEL VISUAL VESTIBULAR ENVIRONMENTS WITH SPECIAL REFERENCE TO SPACE FLIGHT Final Report, 1974 - 1980
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.

A81-25666* Wayne State Univ., Detroit, Mich.
DETERMINATION OF IN VIVO MECHANICAL PROPERTIES OF LONG BONES FROM THEIR IMPEDANCE RESPONSE CURVES Final Report
(Grant NsG-2008) (NASA-CR-1644441) Avail: NTIS HC A12/MF A01 CSCL O6P

A mathematical model consisting of a uniform, linear, visco-elastic, Euler-Bernoulli beam to represent the tibia or radius of the vibrating forefoot or leg system is developed. The skin and tissue covering the bone and the skin is represented by a spring in series with the beam. The remaining skin and tissue surrounding the bone is represented by visco-elastic foundation with mass. An extensive parametric study is carried out to determine the effects of bone, bone and bone mass, height, and height, and ground reaction forces on the biomechanical response 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.

JOURNAL ARTICLES,
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, lumbar sacral 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 decohditioning in persons exposed to the weightlessness of a space environment. San Francisco, Calif.). Journal of Comparative Neurology, vol. 190, 1980, p. 733-762. 117 refs. NASA Task 199-05-02-07.

The cells of origin of the afferent connections of the amygdala in the rhesus and squirrel monkeys are determined according to the retrograde axonal transport of the enzyme horseradish peroxidase injected into various quadrants of the amygdala. Analysis of the distribution of enzyme-labeled cells reveals afferent amygdaloid connections with the ipsilateral halves of the midline nucleus paraventricularis thalami and both the parvo- and magnocellular parts of the nucleus subparafascicularis in the dorsal thalamus, all the subdivisions of the midline nucleus centralis complex, the nucleus reuniens ventralis and the nucleus interventricularis. The largest population of enzyme-labeled cells in the hypothalamus are found to lie in the middle and posterior parts of the ipsilateral, lateral hypothalamus and the ventromedial hypothalamic nucleus, with scattered cells in the supramammillary and dorsomedial nuclei and the posterior hypothalamic area, Taal's ventral tegmental area, the rostral and caudal subdivisions of the nucleus linearis in the midbrain and the dorsal raphe nucleus. The most conspicuous subcortieochephalic source of amygdalar afferent connections is observed to be the pars lateralis of the nucleus parabrachialis in the dorsolateral pontine tegmentum, with a few labeled cells differentiated from pigmented cells in the locus coeruleus. A.L.W.


The influence of work intensity on plasma volume, osmolality, vasopressin and renin activity and the interrelationships between these responses are investigated. Plasma volume, renin activity and osmotic, sodium and arginine vasopressin concentrations were measured in venous blood samples taken from healthy male subjects before and after six minutes of bicycle ergometer exercise at 100, 175 and 225 W. Plasma volume is found to decrease significantly with increasing work intensity, while increases in Na+ concentration, osmolality and vasopressin are only observed to be significant when the work intensity exceeds 40% maximal aerobic capacity and plasma renin activity increased linearly at all work levels. In addition, significant correlations are observed between plasma volume and osmolality and sodium changes, and between vasopressin and osmolality and sodium content changes. Data thus support the hypotheses that (1) vasopressin may be the primary controlling endocrine for fluid and electrolyte levels following exercise, (2) an exercise intensity greater than 40% maximal aerobic capacity is required to stimulate vasopressin release through changes in plasma osmolality, and (3) the stimulation of the renin-angiotensin system is a more general stress response. 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 injury results in 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 effect of five H1 and H2 antihistamines on the synaptosomal uptake of serotonin (5HT), noradrenaline (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 SHT uptake, had little effect on NE uptake, and no effect on DA uptake. Promethazine, diphenhydramine, metiamide, and cimetidine had no effect on SHT 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 SHT uptake at concentrations between 0.5 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 ten 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 subsequent decrease in plasma volume 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. Hyponatremia, hyposmolarity and plasma renin activity suppression are observed to continue to the end of immersion, resulting in final decreases of 15.6% in plasma volume. 17.6% 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 hindlimb skeletal muscle from rats adapted to chronic centrifugation for one year was compared with perfused tissue from 25 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 < 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 (23.8°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. INDOMETHACIN-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 immobile on the skin, a closure secured to the frame and absorbent material
located next to the skin in a cavity formed by the frame and
the closure. The absorbent material may be removed from the
device by removing the closure from the frame while the frame
is held immobile on the skin.

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

Patricia A. Brown (San Jose State Univ.) and Joan V. Danellis,
Inventors (to NASA) (San Jose State Univ.) Issued 21 Jul.
1981 8 p Filed 10 Nov. 1977 Supersedes N78-11692 (16 -
02, p 236) Sponsored by NASA
(NASA-Case-ARC-11118-1; US-Patent-4,279,906;
U.S. Patent and Trademark Office CSCL 06B

An anti-inflammatory and analgesic composition containing
indomethacin and an H sub 1 or an H sub 2 histamine receptor
antagonist in an amount sufficient to reduce gastric distress
caused by the indomethacin is described. Usable antagonists
include pyrilamine, promethazine, metiamide and cimetidine.

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

BIOSYSTEMS DIVISION

NASA TECHNICAL MEMORANDA

N81-32852 [NASA Technical Memoranda]

N81-32852 [NASA Technical Memoranda]

SIMULATED SPACEFLIGHT EFFECTS ON MATING AND
PREGNANCY OF RATS

Eric E. Sabelman (California Univ. at San Francisco), Peter V.
Chetirkin, and Robin M. Howard Sep. 1981 44 p refs
CSCL 06C

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
pasta 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

N81-19412 [NASA Technical Memoranda]

N81-19412 [NASA Technical Memoranda]

JET-DIFFUSER EJECTOR - ATTACHED NOZZLE DESIGN
Final Report

Morton Alperin and Jiunn-Jeng Wu May 1980 41 p refs
(Supported by Am. Inst. Fish Res., Fund No. 104-80-1)
Avail: NTIS HC A03/MF A01 CSCL 200

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)
those expected from rigid rotation. At radial distances beyond the orbit of Rhea at $8.8 \, R_{S}$, the dominant ions are most likely protons and the corresponding typical densities and temperatures are $0.5/\text{cu cm}$ and $1,000,000 \, \text{K}$, 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 magnetosphere since the pressure ratio beta of these plasmas approaches unity at radial distances as close to the planet as $6.5 \, R_{S}$. 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 $6.5 \, R_{S}$, will occur in the local night sector in order to relieve the plasma pressure from accretion of plasma from the rings.

A tube/film concept liquid cooling garment head cooler was developed, fabricated and delivered to NASA-ARC. The head cooler was fabricated from polyurethane film which sandwiches the transport fluid tubing and a thermally conductive fin material. The head cooler garment is sewn to form a skull cap and covered with a comfort liner. In addition, two Neonate heating garments were fabricated and supplied to NASA for further finishing and use in medical tests. The resulting garments are flexible, elastic and conforms to the head comfortably. Tests on a tube/film element of identical construction as the head cooler demonstrated good thermal effectiveness. Use of commercially available materials and development of relatively simple fabrication techniques gives the potential for a low garment cost.

Author
Faren R. Akins Oct. 1979 94 p refs
(Contract NCA2-0180-0805)
(NASA-CR-152386) Avail: NTIS HC A05/MF A01 CSCL 051

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.

N81-18655\# California Univ., Davis.
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 NCA2-0180-0805)
(NASA-CR-152382) Avail: NTIS HC A05/MF A01 CSCL 051

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.

N81-18655\# Umpqua Research Co., Myrtle Creek, Ore.
DESIGN AND FABRICATION OF A FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM Final Report
1 Nov. 1979 36 p
(Contract NAS2-9877)
(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 practices of chemically or electrochemically pretreating urine prior to distillation. T.M.

N81-18656\# 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.

A TACTILE-OUTPUT PAGING COMMUNICATION SYSTEM FOR THE DEAF-BLIND
James A. Baer Dec. 1979 71 prefs
(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


Petrographic analyses of CM matrices characterized four phyllosilicates in Murray and Murchison meteorites and Fe- and Mg-silicates 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.


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 are 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.


The Langenwicz equation was used to explore an adsorbate desorption mechanism. Calculations were performed using iterative extended Huckel on a silica model site with various small adsorbrates, e.g., H, C, NH, 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 NH 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)


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 Poit (1964), and are not inconsistent with the possibility of an intermediate resting position.


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 as high as 1.8 M are found 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.


Pioneer Venus observations are used in carrying out a study of the location 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... C.R.
The magnetic structure of Jupiter's magnetopause, as observed by the space probes Pioneer 10 and 11, is compared with terrestrial magnetopause structures from the OGO 5 mission. The Jovian magnetopause thickness, deduced from a rapid triple crossing, is found to lie in the range 3500-5200 km, while the adjoining plasma boundary layer was 5600-8400 km thick. Comparison with the terrestrial situation suggests that the dayside magnetopause thickness in both cases is a few times the ion gyroradius and that the dayside boundary layer is also of about the same width. The magnetopause normal vector and normal magnetic field component are determined for each crossing by use of minimum variance analysis. The results indicate a blunt and floppy magnetopause surface, for the most part with an insignificant normal magnetic field component. Only for three of the 14 crossings did this component exceed 1.5 times its error estimate. In two of these cases, the magnetic field tangential to the magnetopause displayed the characteristic features of a rotational discontinuity.

A. T.
A simple, microcomputer-based, interactive graphics display system has been developed for the presentation of perspective views of wire frame molecular models. The display system is based on a TERA K 8510A graphics computer system with a display unit consisting of microprocessor, television display and keyboard subsystems. 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 system, 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 gelling 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 windows 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

Considerations in the design of receivers for the detection and recognition of artificial microwave signals of extraterrestrial origin are discussed. Following a review of the objectives of SETI and the probable reception and detection characteristics of extraterrestrial signals, means for the improvement of the sensitivity, signal-to-noise ratios and online data processing capabilities of SETI receivers are indicated. The characteristics of the signals likely to be present at the output of an ultra-low-noise microwave receiver are then examined, including the system background noise, terrestrial radiations, astrophysical radiations, accidental artificial radiations of terrestrial origin, and intentional radiations produced by humans and by extraterrestrial intelligence. The classes of extraterrestrial signals likely to be detected, beacons and leakage signals, are considered, and options in the specification of gating and thresholding for a 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.


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 isogemetric helices. The energetics of recognition complexes is discussed and several models for peptide recognition are presented. G.R.


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 extrasolar planetary systems, 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.


Studies carried out within the last ten years on the nature and distribution of extraterrestrial intelligent life are reviewed. Arguments for the existence of intelligent life in the Galaxy based on the assumption that at least some of these would have engaged in colonization and for the presence of colonies of extraterrestrials in some undiscovered location in the solar system are presented, and it is noted that both these views rest on the notion that interstellar travel can be achieved at high velocities in very large vehicles, which has been questioned. Alternative suggestions concerning interstellar exploration by automated probes and the possible extended time scale and motivation for galactic colonization are pointed out. Attention is then given to arguments for the extreme smallness of one of the factors in the Drake equation used to estimate the number of communicative extraterrestrial civilizations in the Galaxy, including the frequency of single stars, the likelihood that planets with the correct initial composition and conditions for life are at the proper distance from their stars, the probability of the formation of DNA and the origin of life, and the time for the evolution of intelligence. It is concluded that it seems likely that other civilizations exist in the Galaxy, although the number and distribution of such civilizations may only be determined by the detection of one or more examples.

A.L.W.

PATENTS

N81-174325* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRESSURE CONTROL VALVE Patent
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 contains conical shaped portions which cooperate with reciprocally shaped portions of the housing to provide flow control. A filter in the air inlet removes foreign matter from the air. The bottom end of 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.
Official Gazette of the U.S. Patent and Trademark Office

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MAN-VEHICLE SYSTEMS RESEARCH DIVISION

NASA FORMAL REPORTS

N81-13835* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HEAD-UP TRANSITION BEHAVIOR OF PILOTS WITH AND WITHOUT HEAD-UP DISPLAY IN SIMULATED LOW-VISIBILITY APPROACHES
(NASA-TP-1720; A-8296: HUD-10) Avail: NTIS
HC A03/MF A01 CSCL 05H
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 it 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.

N81-13836* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COGNITIVE ISSUES IN HEAD-UP DISPLAYS
Edith Fischer and Richard F. Haines (San Jose State Univ., Calif.) Dec. 1980 32 p refs
(NASA-TP-1711; A-8246) Avail: NTIS HC A03/MF A01 CSCL 01D
The ability of pilots to recognize and act upon unexpected information, presented in either the outside world or in a head-up display (HUD), was evaluated. Eight commercial airline pilots flew 18 approaches with a flightpath-type HUD and 13 approaches with conventional instruments in a fixed-base 727 simulator. The approaches were flown under conditions of low visibility, turbulence, and wind shear. Vertical and lateral flight performance was measured for five cognitive variables: an unexpected obstacle on runway; vertical and lateral boresight type offset of the HUD; lateral ILS beam bend-type offset; and no anomaly. Mean response time to the runway obstacle was longer with HUD than without it (4.13 vs 1.75 sec), and two of the pilots did not see the obstacle at all with the HUD. None of the offsets caused any deterioration in lateral flight performance, but all caused some change in vertical tracking; all offsets seemed to magnify the environmental effects. In all conditions, both vertical and lateral tracking was better with the HUD than with the conventional instruments.
Author

N81-13837* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GUIDELINES FOR LINE-ORIENTED FLIGHT TRAINING, VOLUME I
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 LOFT scenarios, 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

N81-31162* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFORMATION TRANSFER PROBLEMS IN THE AVIATION SYSTEM
(NASA-TP-1875; A-8567) Avail: NTIS HC A03/MF A01 CSCL 17B
Problems in the transfer of information within the aviation system are discussed. Particular attention is given to voice communication problems in both intracockpit and air/ground situations. For individual titles, see N81-31163 through N81-31169.

N81-31163* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIMENSIONS OF THE INFORMATION TRANSFER PROBLEM
Charles E. Billings and William D. Reaynd In its Inform. Transfer Prob. in the Aviation System Sep. 1981 p 9-14 refs (For primary document see N81-31162 22-03)
Avai: NTIS HC A05/MF A01 CSCL 178

Several facets of the information transfer problems in aviation are described. A general analysis of these problems 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 Prob. in the Aviation System Sep. 1981 p 15-24 (For primary document see N81-31162 22-03)
Avai: 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 and Charles E. Billings In its Inform. Transfer Prob. in the Aviation System Sep. 1981 p 25-46 refs (For primary document see N81-31162 22-03)
Avai: 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 Prob. in the Aviation System Sep. 1981 p 47-61 ref (For primary document see N81-31162 22-03)
Avai: 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 Prob. in the Aviation System Sep. 1981 p 63-71 refs (For primary document see N81-31162 22-03)
Avai: 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 Prob. in the Aviation System Sep. 1981 p 85-94 . refs (For primary document see N81-31162 22-03)
Avai: 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.

N81-10021# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASP AVIATION SAFETY REPORTING SYSTEM Quarterly Report. 1 Jan. - 31 Mar. 1979

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.

N81-16022# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUMAN FACTORS OF FLIGHT-DECK AUTOMATION:
N81-16022 NASA/INDUSTRY WORKSHOP

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-8355) 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 indicators 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.
The system in terms of the degree of automation is highlighted.

The importance of understanding the individual's perception of automation in organizations is mentioned in relation to the ideas on the concept of automation, its relationship to the individual, with automation in organizations are presented with emphasis.

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 6.6 - 8.7 sec total viewing time was required to correctly extract attitude, airspeed, heading, VSI, or ADI from the IP slides and from 6.1 to 7.4 sec for the HUD slides.

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.


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 automation in organizations is highlighted.

The importance of understanding the individual's perception of the system in terms of the degree of automation is highlighted.

N81-29127* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. EFFECT OF DISPLAY UPDATE INTERVAL, UPDATE TYPE, AND BACKGROUND ON PERCEPTION OF AIRCRAFT SEPARATION ON A COCKPIT DISPLAY ON TRAFFIC INFORMATION Sharon Jago (San Jose State Univ., Calif.), Daniel Baty (San Jose State Univ., Calif.), Sharon O'Connor, and Everett Palmer June 1981. 12 p refs (NASA-TM-81171: A-8070) Avail: NTIS HC A02/MF A01 CSCL 01D

The concept of a cockpit display of traffic information (CDT) includes the integration of air traffic, navigation, and other pertinent information in a single electronic display in the cockpit. Concise display symbology was developed for use in later full-mission simulator evaluations of the CDT concept. Experimental variables used included the update interval motion of the aircraft, the update type, (that is, whether the two aircraft were updated at the same update interval or not), the background (grid pattern or no background), and encounter type (straight or curved). Only the type of encounter affected performance.


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.

NASA CONTRACTOR REPORTS


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.

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 are 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, the results of applying 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 manual control tasks are discussed.

G. Johannsen May 1979 52 p refs Partly in GERMAN and ENGLISH
(Grant NSG-2119)
(NASA-CR-164026: FB-44) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10 CSCL OSH

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)
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.

(Grant NAG-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. Randie, M. R. Murphy (NASA, Ames Research
Two experiments were conducted to examine possible decrements in performance over time on two visual tracking tasks. In Experiment 1, six subjects tracked a horizontal, sinusoidally moving target in the picture plane for 6.5 min. In Experiment 2, six subjects tracked a target sinusoidally changing focus in the depth plane between 0 and 4 D over 6.5 min. Results indicated a linearly decreasing amplitude of both pursuit eye movements (.29 deg of visual angle per minute) and accommodation (.11 D/min). These visual fatigue effects are discussed in the context of several competing explanations.

**CONFERENCE AND MEETING PAPERS**

**N81-17074#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**AN ADVANCED ELECTRONIC COCKPIT INSTRUMENTATION SYSTEM: THE COORDINATED COCKPIT DISPLAY**

D. L. Bely and M. L. Watkins in AGARD Advan. on Visualization Tech. Oct. 1980 11 p. refs Prepared in cooperation with San Jose State University Foundation, Calif. (For primary document see N81-17063 08-08)

Avail: NTIS HC A10/MF A01 CSCL 01B

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 to the cockpit designer, but the use of this flexibility would stay within the realities of the flight environment. One approach to the replacement of flight instruments is described, using three separate color CRTs. 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.

**N81-19004#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**AN EVALUATION OF HEAD-UP DISPLAYS IN CIVIL TRANSPORT OPERATIONS**


Avail: NTIS HC A17/MF A01 CSCL 01C

To determine the advantages and disadvantages of head-up displays (HUD) in civil transport approach and landing operations, an operational evaluation was conducted on the flight simulator for advanced aircraft at Ames. A non-conformal HUD concept which contained raw data and Flight Director command information, and a conformal, flight path HUD concept was designed to permit terminal area maneuvering, intercept, final approach, flare, and landing operations. Twelve B-727 line pilots (Captains) flew a series of precision and non-precision approaches under a variety of environmental and operational conditions, including wind shear, turbulence and low ceilings and visibilities. A preliminary comparison of various system and pilot performance measures as a function of display type (Flight Director HUD, Flight Path HUD, or No HUD) indicates improvements in precision and accuracy of aircraft flight path control when using the HUDs. The results also demonstrated some potentially unique advantages of a flight path HUD during non-precision approaches.

A.R.H.
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 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. The magnitude of the reflection coefficient may be sensitive to even small changes in tau in certain cases.


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.

The basic recorder can be simplified to accommodate 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. The basic recorder can be simplified to accommodate a variety of applications by adding memory to allow more data to be recorded, by changing the front end to permit measurements other than temperature to be made, and by using different batteries to realize various operating periods. Stored flight data are read out from the recorder by means of a ground read-out unit.
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 pivotably 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.

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.


The conically symmetric Navier-Stokes equations are solved by MacCormack's method for the supersonic flow past sharp cones at incidence. To provide closure for the case of turbulent flows, a scalar eddy-viscosity model based on mixing length hypotheses is used. The results are compared with available experimental data.
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)
(NASA-TM-81211; AVRADCOM-TR-80-A-14) Avail: NTIS HC A03/MF A01 CSCL 01A

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.

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


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.
Objective of retaining all terms up to third degree. The blade is systematically expanded into polynomial nonlinearities with the addition of Theodorsen’s strip theory. Equations of motion are expanded for aerodynamic forces using Greenberg’s extension from the blade’s elastic axis through its shear center and the blade is modeled as a long, slender, isotropic Hookean material. Offsets by elimination of the extension variable. The generalized equations are reduced to a set of three integro partial differential equations. The meaning of inextensionality is discussed. The equations are incorporated a pretwist. are derived via Hamilton’s principle. The application of Theodorsen’s strip theory to 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 Flowcs Williams and Hawking 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
The phenomenon of dynamic stall on oscillating airfoils is investigated by solving the governing equations by the Characteristic Box scheme. The difficulties associated with computing the first profile on a given time line, and the velocity profiles with partial flow reversal are solved. A simple calculation is performed for an external velocity distribution typical of those found near the leading edge of thin airfoils. The viability of the calculation procedure is demonstrated. M.G.

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. A.R.H.

Over the last 20 years, flight simulators have been widely accepted as training tools. Moreover, research simulators were used extensively by the fixed-wing industry: in the design, testing, and certification of new aircraft. The rotorcraft industry, however, will allow to use man-in-the-loop simulation to solve its design problems, primarily because of the difficulty of modeling complex rotorcraft for real-time simulation and because of the need for a wide-angle visual system for low-level flight. A joint U.S. Army and NASA program was initiated to provide this simulation capability for exploitation by both government and industry. The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is discussed. T.M.

**FLUID MECHANICS DIVISION**

**NASA TECHNICAL MEMORANDA**


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.


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

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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 impulsive 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 fluctuation 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 linear 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.

The moving-block analysis is a digital method of analyzing transient signals to determine modal damping and frequency. Its implementation is discussed and methods to increase the accuracy of the frequency estimate and to speed the calculation of the 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.
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. (Author)