NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Bibliography 39-16

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Foreword

JPL Bibliography 39-16 describes and indexes the formalized technical reporting, released January through December 1974, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Five classes of publications are included:

(1) Technical Reports (32-series), in which the information is complete for a specific accomplishment and is intended for a wide audience.

(2) Technical Memorandums (33-series), in which the information is complete for a specific accomplishment but is intended for a limited audience to satisfy unique requirements.

(3) Articles from the bimonthly *Deep Space Network (DSN) Progress Report* (42-series). Each collection of articles in this new class of publication beginning with 42-20 presents a periodical survey of current accomplishments by the Deep Space Network. Formerly, each collection of articles was published as a separate volume of Technical Report 32-1526. The last of the 32-1526 volumes (Volume XIX) is indexed in this bibliography.

(4) Special Publications (43-series), a new class of publication, in which the information is complete for a specific accomplishment and is presented in a special format to emphasize its unique character and direction.

(5) Articles published in the open literature.

The publications are indexed by: (1) author, (2) subject, and (3) publication type and number. A descriptive entry appears under the name of each author of each publication; an abstract is included with the entry for the primary (first-listed) author. Unless designated otherwise, all publications listed are unclassified.

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relative photoionization efficiency curves of H_2^+ and HO_2^+, are the same from 804 to 764 Å. Below 764 Å production of the $a\ ^4\Pi_u$ metastable electronic state of O_2^+ leads to the formation of HO_2^+ by the reaction $O_2^+(a\ ^4\Pi_u) + H_2 \rightarrow HO_2^+ + H$.

A006 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

ALLEN, J. E.

A007 Support of the Mariner 10 Television Enhancement Experiment

J. E. Allen

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 165–168, December 15, 1974

This article describes the support provided by DSN Operations for the Mariner Venus/Mercury 1973 Television Enhancement Experiment that was conducted during the second Mercury encounter. The experiment included antenna arraying at the Goldstone Deep Space Stations (DSSs 12, 13, and 14) and signal combining at DSS 14 of the spacecraft's uncoded 117.6-kbps high-rate telemetry data. In addition, analog recordings of symbol-synchronizer assembly outputs were made at DSSs 14 and 43 during the encounter-pass view-period overlap for later processing and correlation at JPL to improve the video data beyond the quality that could be obtained from a single recording.

ALLEN, W., III

A008 The Availability of Local Aerial Photography in Southern California

W. Allen III, B. Sledge, C. K. Paul, and A. J. Landini (City of Los Angeles)

Special Publication 43-14, December 1, 1974

Aerial photography's potential as a primary data source for planning projects is increasingly being realized by local agencies. This report attempts to delineate a few of the major photography and photogrammetric suppliers and users located in Southern California. Also noted are recent trends in aerial photographic coverage of the Los Angeles basin area as well as the uses made of that imagery.

ALSBERG, H.

A009 TEM Data Retrieval for Computer Electron Micrograph Processing

H. Alsberg, R. E. Hartman, and R. Nathan

Seminar Proceedings on Optical Instrumentation in Medicine II, Vol. 43, pp. 235–241, Chicago, November 1973

As a part of the broad program in biological image processing being pursued at JPL, the development of an integrated electron microscope/computer system has been undertaken. The ultimate goal of this project is the recovery of useful information concerning the structure of biological systems. A major part of the effort in this program has been directed toward the development of a satisfactory electron microscope/computer interface system for the recovery and analysis of the information contained in the electron image. This article describes the current state of the development of this system.

ANDERSON, J. D.

A010 Geodetic and Dynamical Properties of Planets

J. D. Anderson

EOS, Vol. 55, No. 5, pp. 515–523, May 1974

The purpose of this article is to discuss the sources of planetary data and to present a general review of the current knowledge of planetary dynamics and geodesy. The scope of the article is limited to Mercury, Venus, Mars, and the four major planets. Future expectations in some areas are discussed briefly.

A011 Transformation Between Orbital Parameters in Different Coordinate Systems of the General Relativistic Schwarzschild Problem

R. M. Georgevic and J. D. Anderson

J. Franklin Inst., Vol. 296, No. 4, pp. 275–286, October 1973

For abstract, see Georgevic, R. M.

A012 Gravity Results From Pioneer 10 Doppler Data

J. D. Anderson, G. W. Null, and S. K. Wong

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3661–3664, September 1, 1974

Two-way doppler data received from Pioneer 10 during its encounter with Jupiter have been analyzed, and preliminary results have been obtained on the mass and the gravity field of Jupiter and on the masses of the four Galilean satellites. The ratios of the masses of the satellites to the mass of Jupiter are $(4.696 \pm 0.06) \times 10^{-5}$ for Io, $(2.565 \pm 0.06) \times 10^{-5}$ for Europa, $(7.845 \pm 0.08) \times 10^{-5}$ for Ganymede, and $(5.603 \pm 0.17) \times 10^{-5}$ for Callisto (all error estimates presented in this paper are standard errors; those for Pioneer 10 represent our evaluation of the real errors as distinguished from formal errors). The ratio of the mass of the Sun to the mass of the Jupiter system is 1047.342 ± 0.02, which is in good agreement with recent determinations from the motions of asteroids.

The second- and fourth-degree zonal harmonic coefficients in the gravity field of Jupiter are $J_2 = (1.4720 \pm 0.0040) \times 10^{-2}$ and $J_4 = (-6.5 \pm 1.5) \times 10^{-4}$, based on an equatorial planetary radius of 71,400 km, and the derived dynamical oblateness f is 0.0647 ± 0.0001 at the same radius. Any differences in the equatorial principal moments of inertia are bounded by $(B - A)/MR^2 < 4 \times 10^{-6}$. A similar bound on the third-degree zonal harmonic coefficient ($J_3 < 1.5 \times 10^{-4}$) is less precise because of a strong correlation with the location of Jupiter's rotation axis. Data from Pioneer 11 should weaken this correlation considerably, and better resolution in the overall gravitational field should result. The Pioneer 10 data are consistent with the assumption that Jupiter is in hydrostatic equilibrium at all levels.

A013 Testing Relativistic Gravity Theories Using Radio Tracking Data From Planetary Orbiting Spacecraft

J. F. Jordan, W. G. Melbourne, and J. D. Anderson

Space Research XIII, pp. 83–92, Akademie-Verlag, Berlin, 1973

For abstract, see Jordan, J. F.

ANDERSON, T. O.

A014 DSN Progress Report for November–December 1973: NCS Standard Computer Interface Hardware, Its Timing and Timing Control Logic

T. O. Anderson

Technical Report 32-1526, Vol. XIX, pp. 152–160, February 15, 1974

This article describes the Network Control System standard computer interface hardware, including the interface cable, the line drivers, line receivers and line terminating network. It presents in considerable detail the time specifications of the interface timing control signals for continuous data transfer as well as for asynchronous byte transfer. A set of control logic which complies with these timing specifications has been designed for and successfully checked out in connection with the star switch controller. This control logic, which includes synchronization and noise filter operations, is described in detail. Transfer rates for variable cable lengths are listed.

A015 The Star Switch Controller Used in the Network Control System

T. O. Anderson

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 82–86, June 15, 1974

This article describes the Star Switch Controller used in the Network Control System (NCS). The NCS requirements are first discussed as are different design philosophies for multi-computer hardware interface systems. The technique adopted is then presented and the functional characteristics discussed.

ANSELMO, V. J.

A016 Quantitative Imagery in the Bio-Medical Sciences—II. Infrared Photography as a Diagnostic Tool for the Burn Wound

V. J. Anselmo and B. E. Zawacki (University of Southern California Medical Center)

Proceedings of the Society of Photo-optical Instrumentation Engineers, San Diego, California, August 27–29, 1973, Vol. 40, pp. 181–188

About 30 years ago, burn physicians began to realize that the depth of a burn injury, not superficial appearance, was of prime importance. Thus, there evolved a two-category burn description, partial-thickness and full-thickness. Spontaneous skin repair occurs in partial-thickness burns but not in full-thickness burns. Developments over the past few years have indicated that early primary excision of the full-thickness burn reduces the risk of infection, fibrosis, and loss of function. However, in many cases it is very difficult or impossible to differentiate clinically between full- and partial-thickness burns until 3 to 4 weeks after injury. This paper presents evidence for the use of infrared photography, enhanced in some cases by image processing, in accelerating burn diagnosis by weeks to allow early primary excision of a full-thickness wound.

ANSPAUGH, B. E.

A017 Uncertainties in Predicting Solar Panel Power Output

B. E. Anspaugh

Technical Memorandum 33-673, April 15, 1974

This memorandum examines the problem of calculating solar-panel power output at launch and during a space mission. It also examines the major sources of uncertainty and error in predicting the postlaunch electrical performance of the panel. A general discussion of error analysis is given and examples of uncertainty calculations are included. A general method of calculating the effect on the panel of various degrading environments is presented, with references supplied for specific methods. A technique for sizing a solar panel for a required mission power profile is developed.

A018 Proton Irradiation of Conventional and Lithium Solar Cells: 11–37 MeV

B. E. Anspaugh and J. R. Carter (TRW Systems)

Proceedings of the IEEE Tenth Photovoltaic Specialists Conference, Palo Alto, California, November 13–15, 1973, pp. 366–372

Conventional n/p and lithium solar cells were irradiated with 11–37 MeV protons. The energy dependence of the solar cell degradation, calculated from electrical parameters and lifetime measurements is shown to be very slight. Damage coefficients for the n/p cells are calculated. Annealing characteristics of both the lithium cells and the n/p cells are presented.

ARENZ, R. J.

A019 Effect of Crosslinking Density on Biaxial Relaxation of SBR by Using Reduced Variables

R. J. Arenz

J. Polym. Sci., Pt. A-2: Polym. Phys., Vol. 12, No. 1, pp. 131–143, January 1974

Use of reduced variables to account for the effect of crosslinking density ν_e in a styrene–butadiene rubber (SBR) system is demonstrated for general biaxial stress states. Recently published results from stress relaxation tests on five SBR vulcanizates crosslinked to different degrees by tetramethylthiuram disulfide were superposed by using ν_e as a reduction variable. The equilibrium shear modulus G_e calculated from the master relaxation curve at long reduced times was in satisfactory agreement with other results for SBR. The time-axis shifts were related in a linear logarithmic manner to the crosslinking density but had a slope slightly less than values previously reported for elastomer systems.

ARNOLD, J. R.

A020 Some Correlations Between Measurements by the Apollo Gamma-Ray Spectrometer and Other Lunar Observations

J. I. Trombka (Goddard Spaceflight Center), J. R. Arnold (University of California, San Diego), R. C. Reedy (University of California, San Diego), L. E. Peterson (University of California, San Diego), and A. E. Metzger

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2847–2853

For abstract, see Trombka, J. I.

A021 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

For abstract, see Harrington, T. M.

ASBRIDGE, J. R.

A022 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

ASSEFI, T.

A023 Two-Dimensional Signal Processing With Application to Image Restoration

T. Assefi

Technical Report 32-1596, September 1, 1974

This report presents a recursive technique for modeling and estimating a two-dimensional signal contaminated by noise. A two-dimensional signal is assumed to be an undistorted picture, where the noise introduces the distortion. Both the signal and the noise are assumed to be wide-sense stationary processes with known statistics. Thus, to estimate the two-dimensional signal is to enhance the picture.

The picture representing the two-dimensional signal is converted to one dimension by scanning the image horizontally one line at a time. The scanner output becomes a nonstationary random process due to the periodic nature of the scanner operation. Procedures to obtain a dynamical model corresponding to the autocorrelation function of the scanner output are derived. Utilizing the model, a discrete Kalman estimator is designed to enhance the image.

AUMANN, H. H.

A024 Determination of Particle Sizes in Saturn's Rings From Their Eclipse Cooling and Heating Curves

H. H. Aumann and H. H. Kieffer (University of California, Los Angeles)

Astrophys. J., Vol. 186, No. 1, Pt. 1, pp. 305–311, November 15, 1973

A method is developed to estimate mean particle sizes in Saturn's rings from eclipse cooling and heating curves, and applied to interpret recent ground-based observation of Saturn's rings at 10 and 20 μ.

BACK, L. H.

B001 Explosive Propulsion Applications

Y. Nakamura, G. Varsi, and L. H. Back

Technical Memorandum 33-675, April 1, 1974

For abstract, see Nakamura, Y.

B002 Detonation Propulsion for High Pressure Environments

L. H. Back and G. Varsi

AIAA J., Vol. 12, No. 8, pp. 1123–1130, August 1974

One limitation encountered by chemical rocket propulsion in high-pressure planetary atmospheres is illustrated by the conflict between the dependence of specific impulse on the ratio of chamber pressure to ambient pressure and the dependence of the motor structural design on the difference between the pressures. This article proposes to resolve the difficulty by employing detonating propellant in which the high pressures necessary for efficient propulsion are developed over a short time and need not be contained statically. Experimental results are presented to substantiate this claim of relatively high performance, together with an analytical development that approximately describes the flow dynamics.

BAHADUR, A.

B003 DSN Progress Report for November–December 1973: Analysis of Staffing and Training Policies for a DSN Tracking Station

A. Bahadur and P. Gottlieb

Technical Report 32-1526, Vol. XIX, pp. 207–220, February 15, 1974

This article presents a method for analyzing the effects of training and staffing policies, and for selecting optimum policies which minimize the expenditures for training and salaries while maximizing the performance of a deep space station. Two models have been developed which represent increasing levels of sophistication.

The first model characterizes steady-state behavior under the optimization of training, average capability, and crew size. The second, which is the dynamic model, optimizes the operating policy over a sequence of time segments. Each segment is characterized by a performance requirement (dependent on the phase of the mission), turnover, and training allocation with a corresponding change in average capability. With inputs such as required minimum station performance, training availability, current crew capability, and expected turnover, the output of the model will be the change in average crew capability, the percentage of time allocated for training, and the corresponding minimum cash expenditure for salaries and training.

BAME, S. J.

B004 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

BAMFORD, R. M.

B005 A Shock Spectra and Impedance Method To Determine a Bound for Spacecraft Structural Loads

R. M. Bamford and M. R. Trubert

Technical Memorandum 33-694, September 1, 1974

This memorandum describes a method to determine a bound for structural loads of a spacecraft mounted on a launch vehicle. The method utilizes the interface shock spectra and the relative impedance of the spacecraft and launch vehicle. The method is developed for single-degree-of-freedom models and then generalized to multidegree-of-freedom models.

BARBOUR, B. H.

B006 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

BATELAAN, P. D.

B007 S/X-Band Experiment: Zero Delay Device Antenna Location

C. T. Stelzried, T. Y. Otoshi, and P. D. Batelaan

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 64–68, April 15, 1974

For abstract, see Stelzried, C. T.

B008 S/X-Band Experiment: Zero Delay Device Z Correction

P. D. Batelaan

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 78–83, April 15, 1974

This article describes a new dual-frequency (S/X-band) zero-delay device (ZDD) which was required for the Mariner Venus/Mercury 1973 S/X-band experiment at the Mars Deep Space Station. To properly utilize the zero calibration provided by the ZDD, an evaluation of the Z term in the ranging equations must be made. An equation for this term is derived, and values are determined for several configurations.

B009 S/X Experiment: DSS 14 S/X Ground System Ranging Tests

T. Y. Otoshi and P. D. Batelaan

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 90–100, August 15, 1974

For abstract, see Otoshi, T. Y.

BATHKER, D. A.

B010 DSN Progress Report for November–December 1973: Dual Carrier Preparations for Viking

D. A. Bathker and D. W. Brown

Technical Report 32-1526, Vol. XIX, pp. 186–192, February 15, 1974

While simultaneous transmission of two S-band carriers from a single deep space station is no longer a committed operating mode for Viking Mars 1975 Project support, the program of investigation and abatement of noise bursts and intermodulation interference has continued through the first three calendar quarters of 1973. At the Mars Deep Space Station, internal waveguide and external antenna work yielded major reductions in both types of interference. Supporting investigations were also conducted at JPL and at the Venus Deep Space Station during this period. This article presents conclusions and recommendations for future work.

B011 A Dual Hybrid Mode Feedhorn for DSN Antenna Performance Enhancement

R. F. Thomas and D. A. Bathker

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 101–108, August 15, 1974

For abstract, see Thomas, R. F.

B012 Low-Noise Microwave Receiving Systems in a Worldwide Network of Large Antennas

M. S. Reid, R. C. Clauss, D. A. Bathker, and C. T. Stelzried

Proc. IEEE, Vol. 61, No. 9, pp. 1330–1335, September 1973

For abstract, see Reid, M. S.

BAUMAN, A. J.

B013 Fluorometric Search for Porphyrins in Apollo 15 Exhaust-Contaminated Surface Fines and Deep Drill Cores and Apollo 16 Surface Fines

J. H. Rho, A. J. Bauman, and E. A. Cohen

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 2, pp. 2261–2265

For abstract, see Rho, J. H.

BECKENBACH, E. S.

B014 Picture Analysis Applied to Biomedicine

D. A. O'Handley, E. S. Beckenbach, K. R. Castleman, R. H. Selzer, and R. J. Wall

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 417–432, December 1973

For abstract, see O'Handley, D. A.

BECKMAN, J. C.

B015 Exploring Jupiter and Its Satellites With an Orbiter

J. C. Beckman, J. R. Hyde, and S. I. Rasool (NASA Office of Space Sciences)

Astronaut. Aeronaut., Vol. 12, No. 9, pp. 24–35, September 1974

The long-standing and still growing interest in exploring Jupiter and its satellite system makes a wide-ranging orbiter the logical sequel to the initial Pioneer and Mariner flybys. This article discusses possible Mariner Jupiter Orbiter missions for 1981 or 1982 launch. It describes the mission design factors, a baseline spacecraft, major science objectives, and various orbit and trajectory strategies using satellite-gravity-assist techniques.

BEER, R.

B016 Abundance and Rotational Temperature of Telluric Methane as Determined From the $2\nu_3$ Band

J. S. Margolis, J. V. Martonchik, R. Beer, and R. H. Norton

J. Atmos. Sci., Vol. 31, No. 3, pp. 823–827, April 1974

For abstract, see Margolis, J. S.

BEJCZY, A. K.

B017 Robot Arm Dynamics and Control

A. K. Bejczy

Technical Memorandum 33-669, February 15, 1974

This memorandum treats two central topics related to the dynamical aspects of the control problem of the six-degrees-of-freedom JPL Robot Research Project manipulator: (1) variations in total inertia and gravity loads at the joint outputs, and (2) relative importance of gravity and acceleration-generated reaction torques or forces versus inertia torques or forces. The relation between the dynamical state equations in explicit terms and servoing the manipulator is briefly discussed in the framework of state-variable feedback control which also forms the basis of adaptive manipulator control.

The main result of this memorandum is the construction of a set of greatly simplified state equations which describe total inertia and gravity load variations at the output of the six joints with an average error of less than 5%. Included is a simplification of the general matrix algorithm for manipulator dynamics.

BELL, P. M.

B018 Visible and Near-Infra-Red Transmission and Reflectance Measurements of the Luna 20 Soil

J. B. Adams (Fairleigh Dickinson University, Virgin Islands), P. M. Bell (Carnegie Institution of Washington), J. E. Conel, H. K. Mao (Carnegie Institution of Washington), T. B. McCord (Massachusetts Institute of Technology), and D. B. Nash

Geochim. Cosmochim. Acta, Vol. 37, No. 4, pp. 731–743, April 1973

For abstract, see Adams, J. B.

BELLMAN, R.

B019 Invariant Imbedding and Radiation Dosimetry: IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab

R. Bellman (University of Southern California), A. L. Fymat, S. Ueno (University of Southern California), and R. Vasudevan (University of Southern California)

Math. Biosci., Vol. 20, Nos. 3/4, pp. 315–325, April 1974

Considering a homogeneous, isotropically scattering target slab of optical thickness x, containing an internal, plane emitting source, the present paper aims to deter-

mine the distribution of the internal emitting source by measuring the angular distribution of the intensity of radiation emergent from the slab. First, a system of differential recurrence relations for the intensity of finite-order scattered radiation emergent from the top is deduced. In other words, a Cauchy system for determining the finite-order emergent intensity is expressed in terms of a source function in the diffuse radiation field and the Fredholm resolvent. Then, the quasilinearization technique is used to solve the inverse problem of determining characteristics of the internal source by measuring the radiation field emergent from the top. This method will be employed in future computations relating to realistic situations in the radiation diagnosis and therapy.

BELTON, M. J. S.

B020 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

B021 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

BENDER, D. F.

B022 A Survey of Possible Missions to the Periodic Comets in the Interval 1974–2010

D. F. Bender

Technical Memorandum 33-684, April 15, 1974

In order to survey the mission possibilities for short-period comets, two catalogs are developed. The first presents physical and pertinent orbital characteristics for 65 short-period comets. Since missions for short-period comets are for the most part expected to utilize arrivals near perihelion at a time when the comet is comparatively active, the second catalog contains the predicted perihelia for each of the 65 comets between 1974 and 2010. Included is enough geometry to indicate feasibility of Earth-based observation and sighting within 100 days of perihelion.

Mission selection criteria and trajectory requirements are discussed with the aim of providing the background for categorizing the possibilities. The comets are then divided essentially on the basis of size and activity into three groups of interest from the data in the first catalog: primary, secondary, and low interest. The perihelia are separated into satisfactory and not satisfactory, essentially on the basis of Earth–comet distance. Three tables of targets for missions to the short-period comets are presented according to interest group. A fourth table lists chronologically the 51 perihelia for which a comet is predicted to pass within .75 AU of the Earth.

BERMAN, A. L.

B023 Tracking Operations During the Pioneer 10 Encounter

A. L. Berman

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 190–195, April 15, 1974

Tracking operations during critical mission phases have become increasingly complex due to more sophisticated mission objectives and expanded tracking capability within the DSN. This article describes tracking operations during the Pioneer 10 Jupiter encounter phase with special attention paid to the role of the newly installed digital-controlled oscillator.

B024 Tracking Operations During the Mariner 10 Venus Encounter

A. L. Berman and G. L. Spradlin

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 95–107, June 15, 1974

Tracking operations during the Mariner Venus/Mercury 1973 (Mariner 10) Venus encounter phase were strongly impacted by the first critical-phase usage of the Block IV S- and X-band receivers, the relatively new digitally controlled oscillators, and the large uncertainties associ-

ated with the Venusian atmosphere. This article describes the pre-encounter planning and subsequent analysis of tracking operations during the Mariner 10 Venus encounter phase.

B025 Tracking Operations During the Mariner 10 Mercury Encounter

A. L. Berman and G. L. Spradlin

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 202–211, August 15, 1974

Tracking operations during the Mariner Venus/Mercury 1973 Mercury encounter were quite smooth and highly successful. Contributing factors included a lack of any substantial Mercurian atmosphere and, hence, signal refraction, relatively small gravitational perturbation of the spacecraft by Mercury, and a great deal more experience with the Block IV S- and X-band receivers and the digitally controlled oscillators. This article describes the pre-encounter planning and subsequent analysis of tracking operations during the Mercury encounter phase.

B026 A New Angular Tropospheric Refraction Model

A. L. Berman and S. T. Rockwell

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 144–164, December 15, 1974

As part of an effort to obtain a new angular tropospheric refraction model for use within the DSN, an empirical model has been constructed which very accurately reflects precise optical refraction data. The model is a single analytic function, is finite over the entire domain of elevation angle, and is highly accurate over large ranges of pressure and temperature.

BERMAN, P. A.

B027 Lithium-Doped Solar Cell Pilot Line Fabrication and Test Programs

P. A. Berman and R. K. Yasui

Technical Memorandum 33-677, October 1, 1974

Results of a previous JPL lithium-doped solar cell program indicated that such cells can exhibit high efficiencies and radiation tolerance. This memorandum presents the results of an additional effort to determine the technology readiness of lithium-doped silicon solar cells with respect to use in space programs. This effort was comprised of a pilot line-fabrication program and an evaluation of the pilot line cells after exposure to environments representative of those presently imposed on state-of-the-art, nonlithium-doped silicon solar cells. A summary of the results is presented. It is concluded that further process improvements are required, particularly with respect to the P/N junction diffusion and the electrical contacting technique (including solder coating). It is also concluded that lithium-doped cells can be fabricated to exhibit high efficiencies, uniform cell-to-cell recovery characteristics after exposure to 1-MeV electrons, and good stability in most environments investigated (the only exception being the thermal shock environment).

BIERMAN, G. J.

B028 Sequential Square Root Filtering and Smoothing of Discrete Linear Systems

G. J. Bierman

Automatica, Vol. 10, No. 2, pp. 147–158, March 1974

Square-root information estimation algorithms are immensely important estimation analysis tools that are not sufficiently well understood nor adequately exploited. In an endeavor to rectify this state of affairs an expository derivation of the square-root information filter/smoother is given. It is based on the recursive least-squares method and is easier to grasp, interpret, and generalize than are the dynamic programming arguments previously used. Backward smoothing algorithms, both square-root and covariance recursions, are derived as direct consequences of the method. A comparison of smoothing algorithms indicates that those presented in this article are the most efficient. Partitioning the results to separate bias parameters provides further computational economies and reduction of storage requirements.

The principal objective of this article is to inspire greater utilization of square-root estimation algorithms. Arguments supporting this thesis are the new least-squares filter/smoother derivations, enhanced numerical accuracy, reduced computation, and lower storage requirements.

B029 A Square-Root Data Array Solution of the Continuous–Discrete Filtering Problem

G. J. Bierman

IEEE Trans. Automat. Contr., Vol. AC-18, No. 6, pp. 675–676, December 1973

The Dyer–McReynolds discrete square-root filtering algorithm is extended to accommodate continuous dynamics. Differential equations are given to represent the time evolution of the filter data array. These equations are nonlinear, but it is shown that the nonlinearities act to enhance the stability of the solution.

B030 The Treatment of Bias in the Square-Root Information Filter/Smoother

G. J. Bierman

Proceedings of the 1973 IEEE Conference on Decision and Control, San Diego, California, December 5–7, 1973, pp. 632–639

The Dyer–McReynolds square root information filter is rederived, using recursive least-squares arguments. The result is applied to a system composed partly of biases. The filter "sensitivity" matrix, "computed" covariance, and "consider" covariance for this augmented system are reviewed. A new computationally attractive representation for the smoothed estimates, in terms of a smoothed "sensitivity" matrix and a smoothed "computed" covariance, is presented.

BIGGS, J. R.

B031 Mariner Venus/Mercury 1973: A Strategy of Cost Control

J. R. Biggs (NASA Office of Space Science) and W. J. Downhower

Astronaut. Aeronaut., Vol. 12, No. 6, pp. 48–53, June 1974

The Mariner Venus/Mercury 1973 (MVM'73) spacecraft proved a notable success both in space and on the ground as a development project. The MVM'73 Project kept within its originally established goals for schedule, performance, and cost. Underlying this development success was the availability of Mariner technology; but meeting the goals demanded management determination, planning, and discipline to make optimum use of state-of-the-art technology. This article on the development points out management approaches and techniques that kept schedules and controlled costs, the intent being to stimulate thought about how to do the same with future spacecraft and payloads.

BILLINGS, R.

B032 DSN Progress Report for November–December 1973: Computer Program Copy–Verify and Load Check System

R. Billings

Technical Report 32-1526, Vol. XIX, pp. 193–195, February 15, 1974

This article presents the computer-program copy–verify and load–check system which consists of two programs, the Mag Tape Copy Routine and the Mag Tape Load–Check Loader Program. The system assures the integrity of a DSN program tape at two critical points—reproduction and loading. The Mag Tape Copy Routine verifies the tape as it is being copied, and the Mag Tape Load–Check Loader Program interacts with parts of the Mag Tape Copy Routine to check the validity of a load in progress.

BIRD, E. F.

B033 GCF Wideband Switch Subassembly—Application Techniques

E. F. Bird

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 129–133, August 15, 1974

This article discusses application techniques used in the development of the wideband switch subassembly (WBSS). The WBSS is a part of the Ground Communications Facility's wideband subsystem located in the Central Communications Terminal at JPL. It is used to support Mariner Venus/Mercury 1973 and Viking Mars 1975 operations. The WBSS is a complex switching unit that provides for simple control by the operator for effecting the many interconnect configurations of various data sets, coded multiplexers/demultiplexers, and JPL computer systems.

BLACKWELL, R. J.

B034 Automated Firearms Identification System (AFIDS): Phase I

R. J. Blackwell and E. P. Framan

Special Publication 43-8, July 1, 1974

This report, prepared for the NASA Applications Technology Office, examines items critical to the future development of an automated firearms identification system (AFIDS), with the following specific results: (1) Types of objective data, that can be utilized to help establish a more factual basis for determining identity and nonidentity between pairs of fired bullets, have been identified. (2) A simulation study has indicated that randomly produced lines, similar in nature to the individual striations on a fired bullet, can be modeled and that random sequences, when compared to each other, have predictable relationships. (3) A schematic diagram of the general concept for AFIDS has been developed and individual elements of this system have been briefly tested for feasibility. Future implementation of such a proposed system will depend on such factors as speed, utility, projected total cost, and user requirements for growth. The success of the proposed system, when operational, would depend heavily on existing firearms examiners.

BOETTGER, H. G.

B035 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

BOOTH, R. W. D.

B036 Preliminary S-Band Noise Temperature Statistics at DSS 14 for 1971 and 1972

R. W. D. Booth, M. S. Reid, and T. J. Cullen

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 84–91, April 15, 1974

This article reports on the continuing effort to statistically characterize microwave weather-induced parameters as part of an overall effort to optimize the spacecraft-to-ground communications link. The article considers S-band 1971 and 1972 weather project data only. The statistics of interest are distribution tables for each year, distribution tables for each quarter, and tables of average excess noise temperature duration.

BORN, G. H.

B037 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

The primary purpose of the Mariner Mars 1971 (MM'71) Optical Navigation Demonstration was to prove the feasibility of using a combination of spacecraft-based optical data and Earth-based doppler data to perform near-real-time approach navigation for the MM'71 mission. The optical data consisted of Mariner 9 television photographs of Mars' natural satellites Phobos and Deimos against a star background.

The objectives of the demonstration were successfully carried out, and this memorandum documents the important findings, conclusions, and recommendations resulting therefrom. The memorandum is divided into two parts: a formal summary section and a section of appended publications and papers giving additional details on the primary and secondary objectives of the demonstration. The appendixes describe instrument calibration and performance as well as navigation and science results obtained by processing TV data of Mars' natural satellites, Mars' landmarks, and Mars' lit limb taken during both the approach phase and the orbital phase of the MM'71 mission.

B038 The Determination of the Satellite Orbit of Mariner 9

G. H. Born, E. J. Christensen, A. J. Ferrari, J. F. Jordan, and S. J. Reinbold

Celest. Mech., Vol. 9, No. 3, pp. 395–414, May 1974

This article presents a comprehensive analysis of the Mars orbital phase of the Mariner Mars 1971 spacecraft trajectory as determined from Earth-based radio data. Both the method and accuracy of the orbit determination process are reviewed. Analysis is presented to show the effects of Mars-gravity-model and node-in-the-plane-of-the-sky errors on the accuracy of orbit determination. In addition, the long term evolution of the orbit from insertion through the first 500 revolutions is presented and decomposed into effects from the Mars gravity field, n-body perturbations, and solar radiation pressure. Since the orbit period is nearly commensurable with the Mars rotational period, the orbit experiences significant resonance perturbations. The primary perturbation is in-track with a maximum amplitude of 1000 km and a wavelength of 39 spacecraft revolutions.

B039 Mars Physical Parameters as Determined From Mariner 9 Observations of the Natural Satellites and Doppler Tracking

G. H. Born

J. Geophys. Res., Vol. 79, No. 32, pp. 4837–4844, November 10, 1974

Spherical harmonic coefficients of the Mars gravity field to degree 6, mass, spin-axis direction, and the orbits of Phobos and Deimos were determined from radio and optical data obtained by the Mariner Mars 1971 (Mariner 9) spacecraft. The optical data consist of 62 TV photographs of Phobos and Deimos. The radio data are in the form of apoapsis state vectors obtained from 195 one-revolution fits of the doppler data. A first-order analytical theory was used to model the motion of both the satellites and the spacecraft. However, the resonance arising from the fact that the orbital period of Mariner 9 was very close to 1/2 day necessitated development of a partial second-order theory to model the long-period perturbations by even-order tesseral harmonics.

Results for the spherical harmonic coefficients are in good agreement with those previously published from Mariner 9 doppler data. The value obtained for the gravitational constant of Mars (42,828.1 ± 0.5 km^3/s^2) is in excellent agreement with prior determinations from Mariner flyby trajectories. The direction of Mars' rotational pole relative to the Earth's mean equinox and equator of 1950 is given by α = 317.3 ± 0.1 deg, δ = 52.7 ± 0.1 deg. The longitudes for Phobos and Deimos at the time of Mariner 9 Mars orbit insertion were found to be 0.2 deg less and 0.3 deg greater, respectively, than the longitudes predicted for this epoch by A. T. Sinclair (1972) on the basis of a recent processing of Earth-based data obtained for the satellites during 1877–1969.

B040 Viewing Phobos and Deimos for Navigating Mariner 9

T. C. Duxbury, G. H. Born, and N. Jerath

J. Spacecraft Rockets, Vol. 11, No. 4, pp. 215–222, April 1974

For abstract, see Duxbury, T. C.

BORNCAMP, F.

B041 Results of the Tau/Mu Alternate Ranging Demonstration

B. D. Mulhall, F. Borncamp, and D. E. Johnson

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 27–31, June 15, 1974

For abstract, see Mulhall, B. D.

BRECKENRIDGE, W. G.

B042 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

For abstract, see Born, G. H.

BRIDGE, H. S.

B043 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

BRIGGS, G. A.

B044 Mariner 9 Observations of the Mars North Polar Hood

G. A. Briggs and C. B. Leovy (University of Washington)

Bull. Am. Meteorol. Soc., Vol. 55, No. 4, pp. 278–296, April 1974

Mariner Mars 1971 photographs showing variations in the behavior of the Mars atmosphere over 21 consecutive days during northern winter are displayed. The photographs show the north-polar cloud hood to be highly variable from day to day, with variations suggestive of the development, motion, and decay of baroclinic waves. Lee wave clouds apparently composed primarily of water ice, convective cloud lines inferred to consist of CO_2 ice, and dust clouds all occur frequently in the active region between latitudes 40 and 60 deg N. The wave clouds show that persistent surface westerlies and strong westerly shear occur in this region.

BROUCKE, R. A.

B045 Ten Subroutines for the Manipulation of Chebyshev Series [C1]

R. A. Broucke

Commun. ACM (Association for Computing Machinery, Inc.), Vol. 16, No. 4, pp. 254–256, April 1973

This article presents ten subroutines which deal with the manipulation of Chebyshev series. The operations performed are the construction of the Chebyshev approximation of functions, the evaluation of the series or its derivative, the integration or differentiation, and the construction of negative or fractional powers of such a series. The subroutines are written in ANSI Fortran, and have been extensively tested.

BROWN, D. W.

B046 DSN Progress Report for November–December 1973: Dual Carrier Preparations for Viking

D. A. Bathker and D. W. Brown

Technical Report 32-1526, Vol. XIX, pp. 186–192, February 15, 1974

For abstract, see Bathker, D. A.

BROWNLEE, G. R.

B047 Viking Mars Lander 1975 Dynamic Test Model/ Orbiter Developmental Test Model Forced Vibration Test: Summary Report

J. Fortenberry and G. R. Brownlee

Technical Memorandum 33-689, November 15, 1974

For abstract, see Fortenberry, J.

BRYAN, A. I.

B048 DSN Progress Report for November–December 1973: Summary Report on the Mariner Venus/ Mercury 1973 Spacecraft/Deep Space Network Test Program

A. I. Bryan

Technical Report 32-1526, Vol. XIX, pp. 25–30, February 15, 1974

The DSN/Mariner Venus/Mercury 1973 (MVM'73) spacecraft compatibility test program consisted of three phases of testing. Subsystem design, system design, and system verification tests were performed at JPL and Cape Canaveral. Preliminary-design tests, initiated in late 1971, preceded the formal compatibility test program that culminated in final verification of DSN/MVM'73 spacecraft compatibility on October 23, 1973. This article describes the tests and test results that provided the basis for establishment and continuous verification of DSN/MVM'73 spacecraft compatibility.

B049 Helios Prototype Spacecraft Deep Space Network Compatibility Test Summary

A. I. Bryan

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 22–36, October 15, 1974

The Helios Prototype Model Spacecraft/DSN compatibility test program consisted of three phases of subsystem-design, system-design, and system-verification tests-which were performed at JPL and Cape Canaveral. Subsystem design tests were initiated on the Engineering Model in early 1972 and the program culminated in verification of Helios Spacecraft/DSN compatibility on August 2, 1974. This article describes the tests and test results that provided the basis for establishment of telecommunications system design compatibility and verification.

B050 Summary Report on the Deep Space Network/ Viking Flight Project Telecommunications Compatibility

A. I. Bryan

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 9–34, December 15, 1974

The Viking Flight Project/DSN Telecommunications Compatibility Test Program consists of three phases: subsystem design, system design, and system verification tests to be performed at JPL and at the Air Force Eastern Test Range/Kennedy Space Center complexes. Subsystem design tests were performed with the Viking Orbiter and the Viking Lander during 1973. System design compatibility tests were performed with the Viking Orbiter, Viking Lander, and a multiple Viking spacecraft configuration during the summer of 1974. This article describes the system design tests and test results that provided the basis for the establishment of telecommunications system design compatibility between the DSN and the Viking Lander, Viking Orbiter, and a simulated DSN/multiple spacecraft configuration for the Mars planetary orbital operations.

BUCHANAN, H. R.

B051 DSN Progress Report for November–December 1973: Variable S-Band High-Power Tuner

H. R. Buchanan

Technical Report 32-1526, Vol. XIX, pp. 176–178, February 15, 1974

This article reports progress in the development of a variable, high-power waveguide tuner that can be remotely controlled. Satisfactory operation at a 400-kW power level is the goal.

BUNCE, R. C.

B052 S-Band/X-Band Doppler Two-Way Nonlinear Jitter Analysis Using Simplified Series-Expansion Techniques

R. C. Bunce

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 190–196, August 15, 1974

Using a simplified, nonlinear approach by Yuen, together with simplified series expressions to obtain the nonlinear values for Alpha, Gamma, and Sigma, a full program was developed to output estimated two-way jitter in degrees as a function of ground and spacecraft signal-level margin above design point. Required modified (hyperbolic) Bessel functions were calculated individually with the defining series, rather than by recursion, to reduce the error. When the series was no longer feasible, results were replaced by linear approximation, well into the "linear range." As an experiment, and to establish feasibility of the entire model, programming was done entirely on a table calculator (four card-sides; about 1700 steps).

BURKE, J. M.

B053 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

BUTMAN, S.

B054 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

This article describes the motivation for, and development and initial testing of, a scaled-time telemetry test capability. The immediate need for this capability is to establish the sequential decoding performance of the data decoder assembly for Helios and Pioneer, and the tests have been aimed at evaluating the suitability of the scaled phase-locked loop (PLL) for this task. The relevant parameters of limiter suppression, phase jitter variance, and phase jitter autocorrelation have been measured, and no discrepancy was found between the ×16-scaled PLL and the 12-Hz loop of the DSN receiver. Comparative sequential decoding tests have also been performed for 128-bit/s data; no discrepancy was found between scaled and unscaled performance at any modulation index, either near-optimum or high (70 deg), where the carrier reference noise is dominant.

B055 The Ultimate Limits of Binary Coding for a Wideband Gaussian Channel

S. Butman and R. J. McEliece

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 78–80, August 15, 1974

This article presents, in graphical form, the theoretical relationship between the bit signal-to-noise ratio, the bit error probability, and the bandwidth expansion factor for binary-coded telemetry on a wideband Gaussian channel.

BUTTRILL, S. E., JR.

B056 Photoionization and Ion Cyclotron Resonance Studies of the Reaction of Vibrationally Excited $C_2H_2^+$ Ions With H_2

S. E. Buttrill, Jr., J. K. Kim, W. T. Huntress, Jr., P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 61, No. 5, pp. 2122–2128, September 1, 1974

The reaction $C_2H_2^+ + H_2 \rightarrow C_2H_3^+ + H$ has been studied using ion cyclotron resonance and photoionization mass spectrometric techniques. At thermal kinetic energies, the cross section for the reaction is near zero for ground state reactants but increases rapidly with increasing vibrational energy in the $C_2H_2^+$ ions. The ratio of the cross sections for ions in the $\nu_2 = 1$ and $\nu_2 = 2$ states is approximately 1:2, respectively. Some reaction is observed at photoionization energies below the threshold for formation of $\nu_2 = 1$ ions owing to reaction of thermally excited ions and neutrals. For the distribution of vibrational energies in $C_2H_2^+$ ions formed by electron impact at 15 eV, the rate constant for the reaction is $6.3 \pm 1.8 \times 10^{-11}$ cm^3/s. Exchange of hydrogen atoms in nonreactive collisions between $C_2H_2^+$ ions and D_2 molecules has also been observed. An upper limit of $\Delta H_f(C_2H_3^+) = 267$ kcal/mole is obtained.

CALLAHAN, P. S.

C001 Interpretation of Columnar Content Measurements of the Solar-Wind Turbulence

P. S. Callahan

Astrophys. J., Vol. 187, No. 1, Pt. 1, pp. 185–190, January 1, 1974

The temporal spectrum of measurements of the integrated electron columnar content between the Earth and a distant source is considered. The relation between this spectrum and the three-dimensional wave-number spectrum of the solar-wind density is derived under the assumption that the correlation scale is the smallest scale of interest. The specific case of round-trip measurements to a spacecraft is investigated for a power-law solar-wind density spectrum. The resulting spectrum has a power-law envelope one power less steep than the solar-wind density spectrum with several deep minima superposed.

CAMERON, R. E.

C002 Microbial Abundance and Thermoluminescence of Antarctic Dry Valley Soils

J. D. Ingham, R. E. Cameron, and D. D. Lawson

Soil Sci., Vol. 117, No. 1, pp. 46–57, January 1974

For abstract, see Ingham, J. D.

CANNON, W. A.

C003 Surface Properties of the Orgueil Meteorite: Implications for the Early History of Solar System Volatiles

F. P. Fanale and W. A. Cannon

Geochim. Cosmochim. Acta, Vol. 38, No. 3, pp. 453–470, March 1974

For abstract, see Fanale, F. P.

C004 Exchange of Adsorbed H_2O and CO_2 Between the Regolith and Atmosphere of Mars Caused by Changes in Surface Insolation

F. P. Fanale and W. A. Cannon

J. Geophys. Res., Vol. 79, No. 24, pp. 3397–3402, August 20, 1974

For abstract, see Fanale, F. P.

CAPPS, J. W.

C005 Real-Time High-Rate Telemetry Support of Mariner 10 Operations

J. T. Hatch and J. W. Capps

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 125–131, October 15, 1974

For abstract, see Hatch, J. T.

CARON, L. G.

C006 Low-Temperature Thermostatics of Face-Centered-Cubic Metallic Hydrogen

L. G. Caron

Phys. Rev., Pt. B: Solid State, Vol. 9, No. 12, pp. 5025–5038, June 15, 1974

The higher symmetry face-centered-cubic phase of metallic hydrogen is investigated at low temperature in the density region $0.1 < r_s < 1.5$. This study concentrates on the thermostatic properties with special attention given to electronic screening and the quantum nature of the proton motion. The electron–proton and proton–proton interactions are treated perturbatively using a variant of the Singwi dielectric function, while the proton motion is handled via the self-consistent harmonic approximation. This phase of metallic hydrogen is found not to be as much of a quantum solid as might be expected from the light proton mass. Nuclear magnetism is absent. The phonon spectrum is, however, considerably affected by screening and large proton motion. The zero-point vibrational energy is smaller than all previous estimates. So is the superconducting critical temperature as compared to the estimate of Schneider although it still remains in the 100 K range at low density. The face-centered-cubic structure is found to become unstable at $r_s \geq 1.5$, which is compatible with Brovman's phase-stability study. The crystalline-defect formation energies are found to be just a few times the Debye energy. This implies an important contribution of defects to melting at the lower particle densities.

CARTER, J. R.

C007 Proton Irradiation of Conventional and Lithium Solar Cells: 11–37 MeV

B. E. Anspaugh and J. R. Carter (TRW Systems)

Proceedings of the IEEE Tenth Photovoltaic Specialists Conference, Palo Alto, California, November 13–15, 1973, pp. 366–372

For abstract, see Anspaugh, B. E.

CASTLEMAN, K. R.

C008 Picture Analysis Applied to Biomedicine

D. A. O'Handley, E. S. Beckenbach, K. R. Castleman, R. H. Selzer, and R. J. Wall

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 417–432, December 1973

For abstract, see O'Handley, D. A.

CERINI, D. J.

C009 NaK–Nitrogen Liquid Metal MHD Converter Tests at 30 kW

D. J. Cerini

AIAA J., Vol. 12, No. 1, pp. 78–83, January 1974

A NaK–nitrogen liquid metal magnetohydrodynamic converter was operated over a range of nozzle inlet pressures of 100 to 165 N/cm^2, NaK flowrates of 46 to 72 kg/s, and nitrogen flowrates of 2.4 to 3.8 kg/s. The converter was operated as an eight-phase linear induction generator with two of the eight phases providing magnetic field compensation to minimize electrical end losses at the generator channel inlet and exit. Each of the eight phases was connected to a separately controlled capacitor bank for magnetization reactive power and a separately controlled load bank for dissipation of the output power. Generator operation was obtained with average winding currents and voltages up to 80 A and 500 V, respectively, with estimated channel magnetic fields up to 0.4 T over the range of frequencies of 270–470 Hz. The output power of the converter was varied from −6 to 31 kW. At maximum output, the winding losses, fluid friction losses, and fluid ohmic losses were estimated to be 18, 21, and 49 kW, respectively, for a sum of 119 kW extracted from the fluid corresponding to net and gross efficiencies of 31/119 = 0.26 and (31 + 18)/119 = 0.41, respectively.

C010 On-Board Hydrogen Generator for a Partial Hydrogen Injection Internal Combustion Engine

J. Houseman and D. J. Cerini

Paper 740600, SAE West Coast Meeting, Anaheim, Calif., August 12–16, 1974

For abstract, see Houseman, J.

CHAHINE, M. T.

C011 Remote Sounding of Cloudy Atmospheres. I. The Single Cloud Layer

M. T. Chahine

J. Atmos. Sci., Vol. 31, No. 1, pp. 233–243, January 1974

The relaxation method for the inverse solution of the radiative-transfer equation is applied in a dual-frequency scheme for the determination of complete vertical temperature profiles in cloudy atmospheres from radiance observations alone, without any additional information related to the expected solutions. The dual-frequency principle employs to advantage a property in the Planck function of the dependence of intensity on frequency. This property leads to the formulation of a new convergence criterion for the selection of cloud-sounding frequencies to be used for reconstructing the clear column radiance from observations made in the presence of a broken cloud layer in all fields of view.

The principle is applied to the case of observations in two adjacent or partially overlapping fields of view and to the case of observations in a single field of view. The solutions are illustrated by numerical examples in the dual-frequency ranges of the 4.3 and 15 μm CO_2 bands of the terrestrial atmosphere. The resulting profiles can possess the same degree of vertical resolution permitted under cloudless conditions.

CHAN, K. W.

C012 Plasmaspheric Hiss Intensity Variations During Magnetic Storms

E. J. Smith, A. M. A. Frandsen, B. T. Tsurutani, R. M. Thorne (University of California, Los Angeles), and K. W. Chan (University of California, Los Angeles)

J. Geophys. Res., Space Physics, Vol. 79, No. 16, pp. 2507–2510, June 1, 1974

For abstract, see Smith, E. J.

CHAN, S. I.

C013 Metallic Fe Phases in Apollo 16 Fines: Their Origin and Characteristics as Revealed by Electron Spin Resonance Studies

F.-D. Tsay, S. L. Manatt, D. H. Live (California Institute of Technology), and S. I. Chan (California Institute of Technology)

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2751–2761

For abstract, see Tsay, F.-D.

CHANEY, W. D.

C014 DSN Tracking System Predictions

W. D. Chaney and O. B. Shows (Philco-Ford Corporation)

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 11–14, October 15, 1974

The Deep Space Network Tracking System predictions include angles, frequencies, and ranges for use by the deep space stations in the acquisition and tracking of spacecraft. These predictions are also used to validate

the radio metric data generated by the deep space stations.

CHAO, C. C.

C015 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

C016 Short Baseline QVLBI Doppler Demonstrations—Part II

C. C. Chao, R. A. Preston, and H. E. Nance

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 20–26, April 15, 1974

This article describes the continuation of the short baseline quasi-very-long-baseline interferometry (QVLBI) demonstrations, which are designed to examine the stability of the current doppler frequency system. A total of six passes of simultaneous two-way and three-way doppler data from Pioneer 10 were obtained at the Pioneer Deep Space Station and the Mars Deep Space Station. Results indicate that the short-term (minute), medium-term (hour), and long-term (month) stabilities of the new rubidium frequency standard (HP 5065A) are 8 parts in 10^{13}, 1.3 parts in 10^{13}, and 1.9 parts in 10^{12}, respectively. The relative drift rate between the two systems, the Pioneer Deep Space Station and the Mars Deep Space Station, is around 6 mHz/month. This indicates that the long-term stability of the current frequency system exceeds our limit level and makes the coming QVLBI Mariner Venus/Mercury 1973 Project demonstration very difficult.

C017 Report of the Two-Station Doppler (VLBI) Demonstration Conducted With Mariner 9

B. D. Mulhall, C. C. Chao, D. E. Johnson, and J. W. Zielenbach

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 27–40, April 15, 1974

For abstract, see Mulhall, B. D.

C018 An Evaluation of QVLBI OD Analysis of Pioneer 10 Encounter Data in the Presence of Unmodeled Satellite Accelerations

B. D. O'Reilly and C. C. Chao

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 66–77, August 15, 1974

For abstract, see O'Reilly, B. D.

CHAPMAN, B. H.

C019 Goldstone DSCC Energy Distribution Model

B. H. Chapman

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 132–152, October 15, 1974

In expectation of increases in cost and decreases in supply of currently available energy forms, the DSN is studying the installation of systems which will provide reliable energy for the Goldstone Deep Space Communications Complex in stable amounts and at stable cost. One of the main factors in improving the economic viability of such an installation is the efficiency with which the useful energy forms resulting from the conversion of the stable energy form to be provided can be distributed to the consumers.

The aim of the general distribution model presented in this article is to provide a method for the optimal design of a network for the distribution of several different types of energy to users and for the optimal operation of such a network when installed. When such a network is operational the consumers' demand for energy can be ascertained by real-time sampling, but during the design phase these energy demands are known only stochastically. The initial model describes the case of known constant demand and will form the basis of a subsequent model of the stochastic demand case. An algorithm to be used in the solution of this model problem is also outlined.

CHASE, S. C., JR.

C020 Preliminary Infrared Radiometry of Venus From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), and G. Neugebauer (California Institute of Technology)

Science, Vol. 183, No. 4131, pp. 1291–1292, March 29, 1974

This paper presents the intensity of emission at 45 μm, measured with high spatial resolution along a single crossing of the Venus disk. On the average, the observed darkening toward the limb varies nearly linearly with the cosine of the emission angle. The brightness temperature, extrapolated to normal emission, is 255 K. The limb

darkening curve, interpreted in a linear approximation, implies that the atmosphere is quite opaque, with an absorption coefficient of 0.24/km. Changes in curvature present in the limb darkening curve suggest the existence of thermal inhomogeneities with scale comparable to that of the dark markings shown by ultraviolet images.

C021 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

The infrared radiometer on the Mariner Venus/Mercury 1973 spacecraft measured the thermal emission from Mercury with a spatial resolution element as small as 40 km in a broad wavelength band centered at 45 μm. The minimum brightness temperature (near local midnight) in these near-equatorial scans was 100 K. Along the track observed, the temperature declined steadily from local sunset to near midnight, behaving as would be expected for a homogeneous, porous material with a thermal inertia of 0.0017 cal cm^{-2} $s^{-1/2}$ K^{-1}, a value only slightly larger than that of the Moon. From near midnight to dawn, however, the temperature fluctuated over a range of about 10 K, implying the presence of regions having thermal inertia as high as 0.003 cal cm^{-2} $s^{-1/2}$ K^{-1}.

CHEN, C. J.

C022 Manganese Laser Using Manganese Chloride as Lasant

C. J. Chen

Appl. Phys. Lett., Vol. 24, No. 10, pp. 499–500, May 15, 1974

A manganese vapor laser utilizing manganese chloride as a lasant has been observed and investigated. Lasing is attained by means of two consecutive electrical discharges. The maximum laser output is obtained at a vapor pressure of about 3 torr, a temperature of 680°C, and a time delay between electrical discharges of 150 μs. The maximum energy density is 1.3 μJ cm^{-3}.

C023 Lead Laser Using Lead Chloride as a Lasant

C. J. Chen

J. Appl. Phys., Vol. 45, No. 10, pp. 4663–4664, October 1974

A lead-vapor laser utilizing lead chloride as a lasant has been investigated. Lasing is attained by means of two consecutive electrical discharges. The maximum output is obtained at a vapor pressure of about 0.3 torr at a temperature of 500°C, a time delay between electrical discharges of 150 μs, and an output mirror transmittance of 80%. The maximum energy density and power density are 4 μJ cm^{-3} and 160 W cm^{-3}, respectively.

CHEN, J. C.

C024 Development and Correlation: Viking Orbiter Analytical Dynamic Model With Modal Test

B. K. Wada, J. A. Garba, and J. C. Chen

Technical Memorandum 33-690, June 1, 1974

For abstract, see Wada, B. K.

CHERNOFF, R. C.

C025 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

For abstract, see Butman, S.

C026 DSN Progress Report for November–December 1973: A No-Load Calorimeter

R. C. Chernoff

Technical Report 32-1526, Vol. XIX, pp. 179–185, February 15, 1974

This article presents a description and analysis of a novel RF calorimeter. The device combines the conservation-of-energy principle with the dc-substitution idea to eliminate the need for RF and/or dc loads, thereby providing highly accurate "on-line" measurements of RF power at low cost. Breadboard test data are reported.

CHOATE, R.

C027 Unmanned Surface Traverses of Mars and Moon: Science Objectives, Payloads, Operations

L. D. Jaffe and R. Choate (TRW Systems Group)

J. Spacecraft Rockets, Vol. 11, No. 6, pp. 353–354, June 1974

For abstract, see Jaffe, L. D.

CHRISTENSEN, E. J.

C028 The Determination of the Satellite Orbit of Mariner 9

G. H. Born, E. J. Christensen, A. J. Ferrari, J. F. Jordan, and S. J. Reinbold

Celest. Mech., Vol. 9, No. 3, pp. 395–414, May 1974

For abstract, see Born, G. H.

CHUTJIAN, A.

C029 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of N_2O

R. I. Hall, A. Chutjian, and S. Trajmar

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 12, pp. L365–L368, December 1973

For abstract, see Hall, R. I.

CLAUSS, R. C.

C030 DSN Progress Report for November–December 1973: Low-Noise Receivers: Microwave Maser Development

R. C. Clauss and E. Wiebe

Technical Report 32-1526, Vol. XIX, pp. 93–99, February 15, 1974

Two S-band maser systems with equivalent input noise temperatures of 2.1 K have been supplied to the DSN. These masers will be used on the 64-m-diameter antennas at the Mars Deep Space Station and the Ballima Deep Space Station to meet special requirements of the Mariner Venus/Mercury 1973 mission. The masers use a new shortened and cooled signal-input transmission line to reduce noise and are equipped with super-conducting magnets to provide the best possible stability performance.

C031 Low-Noise Receivers: Microwave Maser Development

R. C. Clauss

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 41–44, June 15, 1974

A new multijunction, cryogenically coolable, X-band circulator has been developed and tested. Isolation exceeding 20 dB per junction and insertion loss less than 0.2 dB per junction between 8100 and 8800 MHz have been measured at 4.5 K. The new circulator will be used with a maser to provide low-noise amplification across a wide instantaneous bandwidth.

C032 Low-Noise Microwave Receiving Systems in a Worldwide Network of Large Antennas

M. S. Reid, R. C. Clauss, D. A. Bathker, and C. T. Stelzried

Proc. IEEE, Vol. 61, No. 9, pp. 1330–1335, September 1973

For abstract, see Reid, M. S.

COHEN, E. A.

C033 Fluorometric Search for Porphyrins in Apollo 15 Exhaust-Contaminated Surface Fines and Deep Drill Cores and Apollo 16 Surface Fines

J. H. Rho, A. J. Bauman, and E. A. Cohen

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 2, pp. 2261–2265

For abstract, see Rho, J. H.

COLBURN, D. S.

C034 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

COLEMAN, P. J., JR.

C035 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

COLLINS, D. J.

C036 Experimental and Theoretical Investigations in Two-Dimensional Transonic Flow

D. J. Collins and J. A. Krupp

AIAA J., Vol. 12, No. 6, pp. 771–778, June 1974

This paper presents experimental and theoretical results from a study of the flow over a family of transonically scaled circular-arc bodies mounted in a solid-wall wind tunnel. Data for Reynolds numbers between 1.2×10^6 and 3.6×10^6 based on chord, are compared with the results of computations based on inviscid theory in order to examine the scaling of inviscid transonic flows in a solid-wall wind tunnel, and to obtain a description of the flow near choking. For those cases for which extensive separation of the model and tunnel boundary layers does not occur, excellent agreement between theory and experiment is demonstrated for the flow in the vicinity of the model, and to a lesser degree for the flow near the opposite tunnel boundary. Some results are presented which illustrate the analogy between choked flow in a solid-wall wind tunnel and unbounded flow at $M_\infty = 1.0$.

C037 Laminar Viscous–Inviscid Interactions at Transonic Speeds

D. J. Collins

AIAA J., Vol. 12, No. 8, pp. 1146–1149, August 1974

The interaction between the boundary layer which forms on an aerodynamic surface and the inviscid outer flowfield is most pronounced at transonic speeds where the nature of the mixed supersonic and subsonic inviscid flowfield is often determined by the viscous portions of the flow. In previous investigations, it has been clear that a strong interaction exists between the viscous and the inviscid flows; and as a consequence the boundary layer cannot be treated theoretically as a small perturbation to the outer flow, but must be closely coupled with the outer flow and must be solved simultaneously. This article discusses some aspects of the laminar viscous–inviscid interaction at transonic speeds by examining data obtained on a 6% thick biconvex circular-arc airfoil and comparing the results with theory.

CONEL, J. E.

C038 Visible and Near-Infra-Red Transmission and Reflectance Measurements of the Luna 20 Soil

J. B. Adams (Fairleigh Dickinson University, Virgin Islands), P. M. Bell (Carnegie Institution of Washington), J. E. Conel, H. K. Mao (Carnegie Institution of Washington), T. B. McCord (Massachusetts Institute of Technology), and D. B. Nash

Geochim. Cosmochim. Acta, Vol. 37, No. 4, pp. 731–743, April 1973

For abstract, see Adams, J. B.

C039 Spectral Reflectance Systematics for Mixtures of Powdered Hypersthene, Labradorite, and Ilmenite

D. B. Nash and J. E. Conel

J. Geophys. Res., Vol. 79, No. 11, pp. 1615–1621, April 10, 1974

For abstract, see Nash, D. B.

C040 Vitrification Darkening of Rock Powders: Implications for Optical Properties of the Lunar Surface

D. B. Nash and J. E. Conel

The Moon, Vol. 8, No. 3, pp. 346–364, September 1973

For abstract, see Nash, D. B.

COSTOGUE, E. N.

C041 Power Processor Design Considerations for a Solar Electric Propulsion Spacecraft

E. N. Costogue and J. A. Gardner

Technical Memorandum 33-705, June 30, 1974

This memorandum describes the work performed during 1973 on the study of the propulsion power processor design options as part of the Solar Electric Propulsion System Integration Technology (SEPSIT) program. This propulsion power processor would generate the regulated dc voltages and currents from a solar array source of a solar-electric propelled spacecraft. The power processor consists of 12 power supplies that provide the regulated voltages and currents necessary to power a 30-cm mercury ion thruster that is applied in this study to a 1980 Comet Encke rendezvous mission.

Included are: the study of the design options for processing the 200 to 400 V unregulated solar-array power; the design options for generating this regulated power required by each supply; the technical approaches utilized in the developed design; and the technological limitations of the identified design options. Alternate approaches for delivering power to a number of mercury ion thrusters (eight for the Comet Encke rendezvous mission) and methods of optimizing are also described.

The study identified a number of viable design options for processing and generating regulated power by each power supply and a proposed power processor configuration that has advantages over the current design approach. It was concluded that this proposed power processor design should be considered for application in solar-electric propulsion missions of the future.

CRAWFORD, D.

C042 Short-Term Frequency Measurement Capability in DSN Equipment Maintenance Facilities

R. M. Smith, D. Crawford, and C. H. Fourtner

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 182–185, April 15, 1974

For abstract, see Smith, R. M.

CROSBY, D.

C043 Mariner Mars 1971 Television Picture Catalog: Experiment Design and Picture Data

D. Crosby

Technical Memorandum 33-585, Vol. I, Addendum 1, August 15, 1974

This addendum to the *Mariner Mars 1971 Television Picture Catalog, Volume I*, comprises footprint plots of the Mariner Mars 1971 television mapping of the Martian surface from Revolution 100 through Revolution 676 and catalogs of the pictures and their quadrangle locations.

CROW, R. B.

C044 DSN Progress Report for November–December 1973: Bandwidth Selection for Block IV SDA

R. B. Crow

Technical Report 32-1526, Vol. XIX, pp.122–125, February 15, 1974

This article presents a review of the bandwith selection for the Block III Subcarrier Demodulator Assembly (SDA). The design philosophy regarding bandwidth selection for the Block IV SDA and its implementation in the Block IV SDA engineering model is described.

CUFFEL, R. F.

C045 Comparison of Results Obtained With Various Sensors Used To Measure Fluctuating Quantities in Jets

S. P. Parthasarathy, P. F. Massier, and R. F. Cuffel

Preprint 73-1043, AIAA Aero-Acoustics Conference, Seattle, Washington, October 15–17, 1973

For abstract, see Parthasarathy, S. P.

CULLEN, T. J.

C046 Preliminary S-Band Noise Temperature Statistics at DSS 14 for 1971 and 1972

R. W. D. Booth, M. S. Reid, and T. J. Cullen

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 84–91, April 15, 1974

For abstract, see Booth, R. W. D.

CURKENDALL, D. W.

C047 Sequential Filter Design for Precision Orbit Determination and Physical Constant Refinement

D. W. Curkendall and C. T. Leondes (University of California, Los Angeles)

Celest. Mech., Vol. 8, No. 4, pp. 481–494, January 1974

Earth-based spacecraft tracking data have historically been processed with classical least-squares filtering techniques both for navigation purposes and for physical constant determination. The small, stochastic, non-gravitational forces acting on the spacecraft are described in order to motivate the use of sequential estimation as an alternative to the least-squares fitting procedures. The stochastic forces are investigated both in terms of their effect on the tracking data and their influence on estimation accuracy.

A flexible sequential filter design which leaves the existing trajectory, variational equations, observable data and partial computations undisturbed is described. A detailed filter design is presented that meets the precision demands and flexibility requirements of deep-space navigation and scientific problems. It is one which provides a high degree of numerical integrity and numerical analysis capability, facilitates the efficient computation of multi-

ple solutions, and makes few demands on the supporting computational structure.

CUTTS, J. A.

C048 Mariner Mars 1971 Television Picture Catalog: Experiment Design and Picture Data

J. A. Cutts

Technical Memorandum 33-585, Vol. I, June 30, 1974

This memorandum is a compilation of Mariner Mars 1971 television data which have been arranged and edited to help the serious scientific user in the study of the planet Mars and of its two satellites, Phobos and Deimos. Although only a part of the entire data base can be reproduced in a document of this size, an attempt has been made to indicate its size and availability. The concept of the basic mission, camera characteristics, and various processing techniques of the raw television data recovered from the spacecraft are discussed. In later sections, data are arranged into disciplines: mapping and geology, polar studies, geodesy, variable surface features, atmospheric phenomena, and satellites. Reproduction and arrangements of approximately 3000 individual pictures and photomosaics are presented.

DANIELSON, G. E., JR.

D001 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

D002 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

DARNTON, L. A.

D003 Linewidths of HCl Broadened by CO_2 and N_2 and CO Broadened by CO_2

R. A. Toth and L. A. Darnton (University of California, Santa Barbara)

J. Molec. Spectrosc., Vol. 49, No. 1, pp. 100–105, January 1974

For abstract, see Toth, R. A.

DAVIES, M. E.

D004 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

D005 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

DAVIS, E. K.

D006 Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 13–16, April 15, 1974

Following the successful launch of the Mariner Venus/Mercury 1973 (MVM'73) spacecraft on November 3, 1973, the emphasis of DSN support for the MVM'73 Project switched from premission preparations to flight support. A high level of implementation activity continued in parallel so that additional capabilities committed for availability by January 1, 1974 might be operationally ready.

D007 Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 8–11, June 15,1974

During January and February 1974, DSN preparations for the Mariner Venus/Mercury 1973 Venus encounter were completed, and the encounter was supported in a nearly flawless manner. In addition, this period saw the continuation of spacecraft problems which required the DSN to respond with additional implementation and new operational techniques to facilitate achievement of mission objectives.

D008 Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 5–8, December 15, 1974

This article covers the period from March 1, 1974, through April 15, 1974. April 15, 1974 marked the end of the Mariner Venus/Mercury 1973 (MVM'73) Project's primary mission and the beginning of the Mariner 10 Extended Mission Project. Consequently, this is the final article in the MVM'73 series. March 1974 proved to be the most dynamic and critical period of this rather eventful mission. DSN preparations for trajectory correction maneuver 3 and for Mercury encounter were completed, and support was provided in a near-flawless manner. In addition, this period saw the correction of some spacecraft problems and the occurrence of new problems requiring the DSN to respond rapidly with appropriate changes in plans, procedures, configurations, and schedules.

DAVIS, L., JR.

D009 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

DAVIS, W.

D010 Modifying an HA/Dec Coordinate Antenna Pointing System to Process Data From an X/Y-Mounted Antenna

W. Davis

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 115–118, December 15, 1974

About mid-1972, JPL assumed responsibility for the operation of NASA's Spaceflight Tracking and Data Network (STDN) station at Canberra. This action was prompted by the decommissioning of DSS 41 at Woomera and increased tracking commitments for the DSN. Although DSS 44 (previously STDN's Honeysuckle Apollo) is a unified S-band 26-m-diameter antenna, its coordinate system is X/Y. This article addresses the differences between the X/Y system and that of the DSN's HA/dec, and describes how a functional system was created using subsystem assemblies from both stations.

DAYMAN, B., JR.

D011 The Importance of Aerodynamics in the Design of Intra-Urban Trains Traveling in Tunnels

D. W. Kurtz and B. Dayman, Jr.

High Speed Ground Transp. J., Vol. 7, No. 3, pp. 381–399, Fall 1973

For abstract, see Kurtz, D. W.

DeMORE, W. B.

D012 Temperature Dependence of the Reactions of OH and HO_2 with O_3

W. B. DeMore and E. Tschuikow-Roux (University of Calgary, Canada)

J. Phys. Chem., Vol. 78, No. 15, pp. 1447–1451, July 18, 1974

Chain destruction of O_3 by HO_x radicals has been studied in the range 0–69°C by the technique of steady-state photolysis of O_2–H_2O and O_2–H_2O–CO mixtures at 1849 Å. The chain propagation and termination reactions studied are $OH + O_3 \rightarrow HO_2 + O_2$, $HO_2 + O_3 \rightarrow OH + 2O_2$, $OH + HO_2 \rightarrow H_2O + O_2$, and $HO_2 + HO_2 \rightarrow H_2O_2 + O_2$. The results yielded rate constant ratios from which rate constants and reaction energies were found. As a test of mechanism, the O_3 steady states were found to obey the predicted inverse square root dependence on water pressure over a wide range.

DEUZÉ, J. L.

D013 Instrumentation Optimization in Fourier Spectroscopy. 1: Far Infrared Beam Splitters

J. L. Deuzé (Université des Sciences et Techniques de Lille, France) and A. L. Fymat

Appl. Opt., Vol. 13, No. 8, pp. 1807–1813, August 1974

This article describes computations of the reflectivity, transmissivity, and efficiency properties for TE, TM, and T45° waves of far-infrared beam splitters (BS) and of the polarizations induced at both reflection and transmission. Effects of variations in the state of polarization, orientation, pointing accuracy, and wavelength of the incident light, as well as variations in refractive index and thickness of the BS, are discussed. These results apply directly to Fourier interferometer–spectrometers. They can be used for optimizing the performance of these instruments. They indicate, in particular, that some advantages may be gained by the use of incident polarized light (angle of polarization smaller than about 45 deg or negative elliptical polarization) or light of large incidence angle (larger than approximately 60 deg) or both. A novel method of inversion of experimental results to the end of determining the BS physical parameters is proposed. It makes use of the variations with incident light direction of the BS reflectivity, transmissivity, or efficiency curves.

DIVINE, T. N.

D014 Titan Atmosphere Models (1973)

T. N. Divine

Technical Memorandum 33-672, February 1, 1974

This memorandum reviews the current state-of-the-art knowledge of the composition and structure of the atmosphere of Titan, based on theory and on spectroscopic and infrared data, for the development of numerical engineering models. Light, nominal, and heavy atmospheres are described and tabulated, and their profiles of radius, temperature, pressure, and density are illustrated. Corresponding descriptions of atmospheric dynamics, condensates, and surfaces are outlined.

D015 Jupiter Radiation Belt Models (July 1974)

T. N. Divine

Technical Memorandum 33-715, November 15, 1974

Flux profiles of electrons and protons were derived from data returned by Pioneer 10 during Jupiter encounter. These form the basis for a new set of numerical models for the energy spectra of electrons and protons in Jupiter's inner magnetosphere.

DIVITA, E. L.

D016 Jupiter's Radiation Belts and Their Effects on Spacecraft

R. H. Parker, E. L. Divita, and G. Gigas

Technical Memorandum 33-708, October 15, 1974

For abstract, see Parker, R. H.

DOWNHOWER, W. J.

D017 Mariner Venus/Mercury 1973: A Strategy of Cost Control

J. R. Biggs (NASA Office of Space Science) and W. J. Downhower

Astronaut. Aeronaut., Vol. 12, No. 6, pp. 48–53, June 1974

For abstract, see Biggs, J. R.

DOWNS, G. S.

D018 Interplanetary Navigation Using Pulsating Radio Sources

G. S. Downs

Technical Report 32-1594, October 1, 1974

Radio beacons with distinguishing signatures exist in nature as pulsating radio sources (pulsars). These objects radiate well determined pulse trains over hundreds of megahertz of bandwidth at radio frequencies. Since they

are at known positions, they can also be used as navigation beacons in interplanetary space. Pulsar signals are weak and dispersive when viewed from Earth. If an omnidirectional antenna is connected to a wideband receiver (200 MHz bandwidth centered at 200 MHz) in which dispersion effects are removed, nominal spacecraft position errors of 1500 km can be obtained after 24 h of signal integration. An antenna gain of 10 dB would produce errors as low as 150 km. Since the spacecraft position is determined from the measurement of the phase of a periodic signal, ambiguities occur in the position measurement. Simultaneous use of current spacecraft navigation schemes eliminates these ambiguities.

DREYER, W. J.

D019 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

A mass spectrograph, coupled to automatic sample preparation devices and an electro-optical ion detector/computer system, capable of detecting many ion species simultaneously, presents a promising new approach to biomedical analysis. It will permit simultaneous multicomponent analysis of appropriately prepared samples and may detect as little as 10^{-15} g of a single component. This approach offers significant advantages over other methods, including conventional mass spectrometry.

DUMAS, L. N.

D020 Temperature Control of the Mariner-Class Spacecraft: A Seven-Mission Summary

L. N. Dumas

Thermophysics and Spacecraft Thermal Control (Progr. Astronaut. Aeronaut., Vol. 35), pp. 531–547, 1974

Mariner spacecraft have completed five missions of scientific investigation of the planets. Two additional missions are planned. A description of the thermal design of these seven spacecraft is given. The factors that have influenced the thermal design include the mission requirements and constraints, the flight environment, certain programmatic considerations, and the experience gained as each mission is completed. These factors are reviewed, and the impact of each on thermal design and developmental techniques is assessed. It is concluded that the flight success of these spacecraft indicates that adequate temperature control has been obtained, but that improvements in design data, hardware performance, and analytical techniques are needed.

DUNNE, J. A.

D021 Mariner 10 Venus Encounter

J. A. Dunne

Science, Vol. 183, No. 4131, pp. 1289–1291, March 29, 1974

The Mariner Venus/Mercury 1973 spacecraft encountered Venus at 1701 GMT on February 5, 1974. The preplanned encounter science sequence was executed satisfactorily, accomplishing all objectives despite a number of spacecraft problems that had occurred in the early phases of the flight. Seven experiments were conducted, including observations of the solar-wind interaction region, extreme ultraviolet and infrared emissions, radio occultation, and imaging.

D022 Mariner 10 Mercury Encounter

J. A. Dunne

Science, Vol. 185, No. 4146, pp. 141–142, July 12, 1974

The Mariner Venus/Mercury 1973 spacecraft's closest approach to Mercury on March 29, 1974 occurred on the dark side of the planet at a range of approximately 700 km. The spacecraft trajectory passed through the shadows of both the Sun and Earth. Experiments conducted included magnetic fields, plasma and charged-particle studies of the solar-wind interaction region, television photography, extreme ultraviolet spectroscopy of the atmosphere, the detection of infrared thermal radiation from the surface, and a dual-frequency radio occultation in search of an ionosphere.

DUXBURY, T. C.

D023 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

For abstract, see Born, G. H.

D024 Viewing Phobos and Deimos for Navigating Mariner 9

T. C. Duxbury, G. H. Born, and N. Jerath

J. Spacecraft Rockets, Vol. 11, No. 4, pp. 215–222, April 1974

A new on-board optical-navigation data technique has been successfully demonstrated on the Mariner Mars 1971 spacecraft (Mariner 9). Science TV pictures of Phobos and Deimos against star fields were used in the real-time navigation process for inserting Mariner 9 into orbit about Mars. Real-time and postflight evaluation results have shown that the satellite/star data taken by Mariner 9 surpassed preflight accuracy predictions. Orbital insertion could have been achieved using only optical data to determine encounter parameters. The use of a science TV camera to obtain this data was successfully demonstrated. Stars as dim as 9th magnitude were detected and measurement accuracies of 3 arc sec (1 σ) were achieved.

DYAL, P.

D025 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

DYER, J. S.

D026 Trajectory Selection for the Mariner Jupiter/Saturn 1977 Project

J. S. Dyer and R. F. Miles, Jr.

Technical Memorandum 33-706, October 15, 1974

This memorandum describes the use of decision analysis to facilitate a group decision-making problem in the selection of trajectories for the two spacecraft of the Mariner Jupiter/Saturn 1977 Project. This NASA project includes the participation of some 80 scientists divided by specialization among 11 science teams. A set of 32 candidate trajectory pairs was developed by the Project in collaboration with the science teams. Each science team then ordinally ranked and assigned cardinal utility function values to the trajectory pairs. The data and statistics derived from collective choice rules were used by the scientists in selecting the science-preferred trajectory pair.

ECKHARDT, D. H.

E001 Lunar Physical Librations and Laser Ranging

J. G. Williams, M. A. Slade, D. H. Eckhardt (Air Force Cambridge Research Laboratories), and W. M. Kaula (University of California, Los Angeles)

The Moon, Vol. 8, No. 4, pp. 469–483, October 1973

For abstract, see Williams, J. G.

EDMUNDS, R. S.

E002 Mariner Mars 1971 Attitude Control System

R. S. Edmunds

Technical Memorandum 33-681, September 15, 1974

The Mariner Mars 1971 attitude control subsystem (ACS) is a three-axis stabilized system that evolved from the Ranger and early Mariner designs. It is comprised of a Sun-sensor set, a Canopus tracker, an inertial reference unit, two cold-gas reaction control assemblies, two rocket engine gimbal actuators, and an attitude control electronics unit. The subsystem has the following eight operating modes: launch, Sun acquisition, roll search, celestial cruise, all-axes inertial, roll inertial, commanded turn, and thrust vector control.

In the celestial cruise mode, the position control is held to ±0.25 deg. Commanded turn rates are ±0.18 deg/s. The attitude-control logic in conjunction with command inputs from other spacecraft subsystems establishes the ACS operating mode. The logic utilizes Sun and Canopus acquisition signals generated within the ACS to perform automatic mode switching so that dependence on ground control is minimized when operating in the Sun-acquisition, roll-search, and celestial-cruise modes. The total ACS weight is 29.8 kg (65.7 lb), and includes 2.4 kg (5.4 lb) of nitrogen gas. Total power requirements vary from 9 W for the celestial-cruise mode to 54 W for the commanded-turn mode.

EISENBERGER, I.

E003 Cost Effective Spares Provisioning for the Deep Space Network

I. Eisenberger, F. R. Maiocco, and G. Lorden (California Institute of Technology)

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 128–134, April 15, 1974

This article discusses a cost effective procedure for spares provisioning of the various components of an

assembly that is assumed to fail if any one of the components fails. The procedure not only provides a means for obtaining a given operational availability at minimum cost, but it is also applicable when a constraint is placed upon the total cost of the spares for the components making up the assembly.

E004 A Preliminary Deep Space Station Operational Availability Model

I. Eisenberger, F. R. Maiocco, and G. Lorden (California Institute of Technology)

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 55–58, June 15, 1974

This article describes a method for determining deep space station operational availability as a function of the reliability of replaceable subassemblies and the time required to replace them when they fail. It is shown that a reduction in replacement time can have a significant effect on station operational availability.

ELACHI, C.

E005 Parametric Interactions Between Alfven Waves and Sonic Waves

C. Elachi

IEEE Trans. Anten. Prop., Vol. AP-21, No. 6, pp. 907–909, November 1973

This paper presents a study of parametric interactions between a sonic-pump wave and a weak Alfven wave. It is shown that if the Alfven-wave velocity V_A is small relative to the sonic-wave velocity V_s there is a time-growing instability leading to the increase of the Alfven wave at the expense of the sonic wave. This phenomenon can be of importance in solar and stellar physics. For V_A large relative to V_s, the interaction is of the stop-band type.

E006 Mode Conversion in Periodically Disturbed Thin-Film Waveguides

C. Elachi and C. Yeh (University of California, Los Angeles)

J. Appl. Phys., Vol. 45, No. 8, pp. 3494–3499, August 1974

Mode conversion in a periodically perturbed thin-film optical waveguide is studied in detail. Three different types of perturbations are considered: periodic index of refraction of the film, periodic index of refraction of the substrate, and periodic boundary. The applications in filters, mode converters, and distributed feedback lasers are discussed.

ESCUDIER, M. P.

E007 Aerodynamics of a Burning Turbulent Gas Jet in a Crossflow

M. P. Escudier (University of Southern California)

Combust. Sci. Technol., Vol. 4, No. 6, pp. 293–301, February 1972

A theoretical treatment is presented of the motion of a turbulent gas jet burning in an oxidizing crossflow. The study represents a significant extension of the entrainment theory for weak plumes, through the incorporation into its framework of the influences of radiative thermal-energy transfer, large density variations, and thermal-energy generation through chemical reaction. Numerical calculations are presented for the variation of bulk temperature and species concentrations along the plume trajectory. The concentrations are shown to be strongly coupled with the temperature, suggesting a possible simplification of the problem of calculating the production rates of pollutants formed in secondary reactions. Thermal radiation is found to be of secondary importance to plume dynamics. Comparisons are made between exact (numerical) and approximate (asymptotic) calculations of plume trajectory, with and without thermal energy release. These calculations show that for conditions typical of those encountered in a gas-fired furnace, a plume's motion is not significantly influenced by buoyancy forces until well downstream of the reaction zone.

ESTABROOK, F. B.

E008 Bäcklund Transformation for Solutions of the Korteweg–de Vries Equation

H. D. Wahlquist and F. B. Estabrook

Phys. Rev. Lett., Vol. 31, No. 23, pp. 1386–1390, December 3, 1973

For abstract, see Wahlquist, H. D.

E009 Comments on Generalized Hamiltonian Dynamics

F. B. Estabrook

Phys. Rev., Pt. D: Part. Fields, Vol. 8, No. 8, pp. 2740–2743, October 15, 1973

A reasonable generalization of Hamiltonian theory to $3m$-dimensional phase space suggests a geometrical structure giving the proper characteristic vector field. This structure, however, has only a single integral invariant, and implies no sensible generalization of either Poisson-bracket formalism, or Hamilton–Jacobi theory. Associated statistical mechanics and quantization are unlikely. The algebraic source of the difficulty is the lack of understanding of canonical expressions and classes of closed 3-forms.

EVANS, D. D.

E010 Comment on: Computation of Angular Functions π_n and τ_n Occurring in Mie Theory

D. D. Evans

Appl. Opt., Vol. 13, No. 7, p. 1545, July 1974

This article compares two different definitions of the function K_π used in the computation of the angular functions π_n and τ_n occurring in Mie scattering theory. A number of test cases were run using both algorithms. It is concluded that the difference between the two in error propagation is insignificant for the purpose of summing Mie series, but that one method requires fewer computations and does not require new definitions for established notations.

E011 Mathematical Models for the Reflection Coefficients of Dielectric Half-Spaces

D. D. Evans

Radio Sci., Vol. 8, No. 12, pp. 1083–1092, December 1973

The reflection coefficients at normal incidence are found for a large class of one-dimensionally inhomogeneous or stratified half-spaces, which contain a homogeneous half-space. The formulation of the problem involves a combination of the classical boundary value technique, and the nonclassical principle of invariant imbedding. Solutions are in closed form and expressible in terms of Bessel functions. All results are given in terms of the ratio of the distance between free space and the homogeneous half-space to the wavelength in vacuo.

One special case is that of an arbitrary number of layers lying on a homogeneous half-space where the dielectric constant of each layer has a constant gradient. A number of other special cases, limiting cases, and generalizations are developed including one in which the thickness of the top layer obeys a probability distribution, and another formulation that is computationally efficient in which there is an extremely small change in the dielectric constant such as with atmospheric inversion layers.

FALIN, B.

F001 DSN Progress Report for November–December 1973: Network Command System Performance Test Report for Mariner Venus/Mercury 1973

B. Falin

Technical Report 32-1526, Vol. XIX, pp. 224–226, February 15, 1974

This article describes Network Command System performance tests that were executed throughout the DSN in support of the Mariner Venus/Mercury 1973 (MVM'73) Project. The objectives of the performance tests and a description of the various sections of the test procedure are presented, and the status of each deep space station at MVM'73 launch is reported.

FANALE, F. P.

F002 Sodium D-Line Emission From Io: Sputtering and Resonant Scattering Hypothesis

D. L. Matson, T. V. Johnson, and F. P. Fanale

Astrophys. J., Vol. 192, No. 1, Pt. 2, pp. L43–L46, August 15, 1974

For abstract, see Matson, D. L.

F003 Surface Properties of the Orgueil Meteorite: Implications for the Early History of Solar System Volatiles

F. P. Fanale and W. A. Cannon

Geochim. Cosmochim. Acta, Vol. 38, No. 3, pp. 453–470, March 1974

Dehydration of the Orgueil meteorite by stepwise calcination produced more than a tenfold change in its Kr Brunnauer–Emmett–Teller surface area, which increased to 120 m^2/g, then fell to 40 m^2/g. This phenomenon characterizes structures of the montmorillonite type, but not other plausible constituents of Orgueil. It results from the vacating of interlayer sites by H_2O molecules which are replaced by Kr until finally the sheets collapse, excluding Kr. Differential calorimetric scans of Orgueil also gave a better match for montmorillonite than for other minerals. However, a simple identification as montmorillonite conflicts with chemical analyses of Orgueil phyllosilicates.

Exchangeability of H_2O in Orgueil was shown by water regain from lab air between calcination cycles and the similarity of the cycles. Room temperature dehydration revealed up to 6% free-surface adsorbed water. High D/H ratios in CI meteorites may result from D enrichment in OH-groups during equilibration of dispersed phyllosilicate dust with nebula gas at temperatures $\ll$0°C. Adsorption on the very large free and interlayer surface areas of this dust was the major mechanism by which volatiles still uncondensed at the time of gas–dust separation (including planetary primordial Ar, Kr, and Xe) were incorporated into solid solar-system material.

F004 Optical Properties of Carbonaceous Chondrites and Their Relationship to Asteroids

T. V. Johnson and F. P. Fanale

J. Geophys. Res., Vol. 78, No. 35, pp. 8507–8518, December 10, 1973

For abstract, see Johnson, T. V.

F005 Exchange of Adsorbed H_2O and CO_2 Between the Regolith and Atmosphere of Mars Caused by Changes in Surface Insolation

F. P. Fanale and W. A. Cannon

J. Geophys. Res., Vol. 79, No. 24, pp. 3397–3402, August 20, 1974

Estimates have been made of the capacity of the Martian regolith to exchange adsorbed H_2O and CO_2 with the atmosphere-plus-cap system (APCS). These estimates are based upon measured isotherms for H_2O and CO_2 adsorption on pulverized basalt at low temperatures and on theoretical considerations. Under favorable circumstances the top 3 cm can exchange much more H_2O with the lower atmosphere each day than is necessary to produce the diurnal brightening. The process appears to be seasonally reversible. The total regolith may contain, in the adsorbed phase alone, as much as 1% of the H_2O and 5% of the CO_2 surface inventories expected for a hypothetical Mars that has experienced degassing as intensive as that of Earth.

Long-term ($\sim 10^5$ yr) variations in surface insolation caused by variations in the obliquity of Mars could cause efficient desorption of adsorbed CO_2 and H_2O from a 100-m regolith; and variations in solar output with periods $>$ 1 million years may well desorb H_2O and CO_2 efficiently from all the unconsolidated material on Mars. Enough CO_2 could be desorbed to initiate major climatic change even if there is not enough in the APCS. The paradox presented by the fact that the APCS contains barely enough CO_2 molecules to form caps is mitigated by the observation that the APCS is itself in transient equilibrium with a much larger reservoir of adsorbed CO_2.

FANSELOW, J. L.

F006 DSN Progress Report for November–December 1973: Radio Interferometry Measurements of a 16-km Baseline With 4-cm Precision

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, D. J. Spitzmesser, and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 36–54, February 15, 1974

For abstract, see Thomas, J. B.

FARMER, C. B.

F007 Infrared Measurements of Stratospheric Composition

C. B. Farmer

Can. J. Chem., Vol. 52, No. 8, Pt. 2, pp. 1544–1599, April 1974

This article reviews the observational techniques and results of infrared measurements of the minor and trace molecular composition of the lower stratosphere. Emphasis is given to those theoretical aspects of the formation of emission and absorption spectra which affect the quantitative interpretation of observational data in terms of the vertical distribution of observed molecular species.

A detailed summary of current knowledge of the abundances and spatial variability of the known minor constituents is presented. The question of the determination of the minimum detectable concentration of a constituent molecule and its relationship to the instrumental parameters, the molecular transition intensities, and observation geometry is discussed. Upper limit concentrations are given for some additional species of importance in current stratospheric studies.

F008 Detection of Nitric Oxide in the Lower Stratosphere

R. A. Toth, C. B. Farmer, R. A. Schindler, O. F. Raper, and P. W. Schaper

Nature Phys. Sci., Vol. 244, No. 131, pp. 7–8, July 2, 1973

For abstract, see Toth, R. A.

F009 Measurement of the Abundance of Several Natural Stratospheric Trace Constituents From High Altitude Aircraft

C. B. Farmer, P. W. Schaper, O. F. Raper, R. A. Schindler, and R. A. Toth

Proceedings of the Second Joint Conference on Sensing of Environmental Pollutants, Washington, D.C., December 10–12, 1973, pp. 9–15

This article presents a summary of the initial results obtained from near-infrared observations of the stratosphere from the Anglo-French SST Concorde together with the most recent results from previous flights aboard an Air Force NC-135. The measurements were made with a fast Fourier interferometer spectrometer operating in the 1.2 to 7.5 μ range of the infrared with a spectral resolution of 0.25 cm^{-1}. For the Concorde experiments, flight times and trajectories were selected which allowed the Sun to be viewed near the horizon with the relative solar elevation angle held constant throughout the measurements. Mixing ratios as low as a few parts per ten billion for the trace constituents in the

absorption path were determined by spectroscopic analysis of the data. Results to be reported include the identification of features due to N_2O, NO, NO_2, CO, CO_2, CH_4, H_2O and indications of their latitudinal variations. New values for the upper limit of concentration levels for other trace gases of importance to pollution studies, such as HCl and H_2CO, have been determined and are discussed.

FEDORS, R. F.

F010 On the Phenomenology of Rubberlike Behavior

R. F. Landel and R. F. Fedors

Deformation and Fracture of High Polymers, pp. 131–148, Plenum Publishing Corp., New York, 1973

For abstract, see Landel, R. F.

F011 A Relationship Between the Volume and Chemical Structure at the Glass Transition Temperature

R. F. Fedors

J. Polym. Sci., Pt. B: Polym. Lett., Vol. 11, No. 12, pp. 767–770, December 1973

Since critical volumes have been measured for only a relatively few liquids, it is sometimes necessary to estimate the critical volumes of low-molecular-weight liquids as a function of molecular weight and chemical structure. This paper describes a system of additive group contributions from which the critical volumes of liquids can be estimated from a knowledge of the chemical structure alone, and presents a relationship between the volume and chemical structure at the glass transition temperature. A list of group and atomic contributions to molar volume is included.

F012 Effect of Degree of Crosslinking on the Tearing Energy

R. F. Fedors

J. Polym. Sci., Pt. A-2: Polym. Phys., Vol. 12, No. 2, pp. 289–293, February 1974

Much recent work has been carried out on the tear behavior of elastomers, both filled and unfilled. The effects of variables such as test temperature, test rate, specimen geometry, and chemical nature of the elastomer have been investigated by use of a criterion for tearing involving the concept of the tearing energy. The one variable which has not yet been studied is the specific effect of changes in the degree of crosslinking on tear behavior. By use of data published in the literature on the smooth tear behavior of unfilled SBR (styrene-butadiene rubber) vulcanizates, it is shown that these data can all be superposed onto a common response curve when the proper normalizations are applied.

F013 A New Mechanism of Failure in Polymers

R. F. Fedors

J. Polym. Sci., Pt. B: Polym. Lett., Vol. 12, No. 2, pp. 81–84, February 1974

In connection with other work, we had occasion to prepare and observe the swelling in distilled water of 1/2-inch-thick transparent laminates containing imbedded crystals of various ionic and nonionic substances. Briefly, we observed that under certain conditions it is possible for disk-shaped cracks to form around the swollen pockets containing a dissolving crystal. The role of water-soluble impurities in promoting the absorption of water by elastomers has been thoroughly discussed by Briggs, Edwards, and Storey. Briefly, they observed that the absorption of water, which in some cases can be appreciable, is directly relatable to osmotic pressure. Equilibrium water absorption occurs when the osmotic pressure of the solution formed within the rubber by the dissolution of the water-soluble material becomes equal to the hydrostatic pressure exerted by the rubber matrix on the boundary of the cavity. What we wish to describe here is that under certain conditions cracks associated with the cavities can form before equilibrium swelling is reached and that the occurrence of such cracks can severely damage the elastomer.

F014 A Method for Estimating Both the Solubility Parameters and Molar Volumes of Liquids

R. F. Fedors

Polym. Eng. Sci., Vol. 14, No. 2, pp. 147–154, February 1974

The solubility parameters and molar volumes of substances can be used, in conjunction with suitable theory, to provide estimates of the thermodynamic properties of solutions; the solubility characteristics of polymer-solvent systems and the estimation of the equilibrium uptake of liquids by polymers are examples of the type of practical problems that are amenable to treatment.

For low molecular weight liquids, the solubility parameter δ is conveniently calculated using the expression $\delta = (\Delta E_v/V)^{1/2}$, where ΔE_v is the energy of vaporization at a given temperature and V is the corresponding molar volume which is calculated from the known values of molecular weight and density. For high molecular weight polymers, the volatility is much too low for ΔE_v to be obtained directly and hence recourse must be made to indirect methods for estimating δ for these materials. One such widely used method is based on Small's additive group "molar-attraction constants" which when summed allow the estimation of δ from a knowledge of

the structural formula of the material; however, the density must still be determined experimentally.

The proposed method of estimating δ, also based on group additive constants is believed to be superior to Small's method for two reasons: (1) the contributions of a much larger number of functional groups have been evaluated, and (2) the method requires only a knowledge of the structural formula of the compound.

F015 A Method for Estimating Both the Solubility Parameters and Molar Volumes of Liquids. Supplement

R. F. Fedors

Polym. Eng. Sci., Vol. 14, No. 6, p. 472, June 1974

In a recent paper carrying the above title, a method based on additive atomic and group contributions for estimating both the solubility parameters δ and molar volumes V of liquids was reported. Since that time, the contributions of several other groups not listed in the original publication have been evaluated. This paper reports these additional contributions.

F016 Recent Advances in Elastomer Service-Life Prediction

R. F. Landel, R. F. Fedors, and J. Moacanin

Polymeric Materials for Unusual Service Conditions (proceedings of 22nd Applied Polymer Symposia, Ames Research Center, Nov. 29–Dec. 1, 1972), pp. 157–168, John Wiley & Sons, N. Y., 1973

For abstract, see Landel, R. F.

FERG, D. A.

F017 Nuclear Electric Propulsion Reactor Control Systems Status

D. A. Ferg

Technical Report 32-1585, December 15, 1973

This report describes and summarizes the thermionic-reactor control system design studies conducted over the past several years for a nuclear–electric propulsion system. The relevant reactor control system studies are discussed in qualitative terms, pointing out the significant advantages and disadvantages that the various control systems would have on the nuclear–electric propulsion system design. A recommendation for the reference control system is made, and a program for future work leading to an engineering model is described.

FERRARI, A. J.

F018 The Determination of the Satellite Orbit of Mariner 9

G. H. Born, E. J. Christensen, A. J. Ferrari, J. F. Jordan, and S. J. Reinbold

Celest. Mech., Vol. 9, No. 3, pp. 395–414, May 1974

For abstract, see Born, G. H.

FINLEY, S. G.

F019 Square-Root Algorithm for Evaluating Mismodeled Process Noise

C. L. Thornton and S. G. Finley

J. Spacecraft Rockets, Vol. 11, No. 4, pp. 223–230, April 1974

For abstract, see Thornton, C. L.

FISHMAN, L. S.

F020 Ultrasonic Transmission Measurements on Human Brain Sections

L. S. Fishman (Children's Hospital of Los Angeles), R. C. Heyser, and D. H. Le Croissette

Radiology, Vol. 112, No. 1, pp. 211–213, July 1974

Transmission images similar to radiographic pictures using ultrasound in the 2–3 MHz frequency range have been made. Measurements of the attenuation of ultrasound energy in brain tissue have shown anomalously high attenuation in tumorous regions in a formalin-fixed section from the posterior thalamus.

FLEISCHER, G. E.

F021 Attitude Dynamics Simulation Subroutines for Systems of Hinge-Connected Rigid Bodies

G. E. Fleischer and P. W. Likins

Technical Report 32-1592, May 1, 1974

This report describes several computer subroutines designed to provide the solution to minimum-dimension sets of discrete-coordinate equations of motion for systems consisting of an arbitrary number of hinge-connected rigid bodies assembled in a tree topology. In particular, these routines may be applied to (1) the case of completely unrestricted hinge rotations, (2) the totally linearized case (i.e., all system rotations are small), and (3) the mixed, or partially linearized, case. The use of the programs in each case is demonstrated using a five-body

spacecraft and attitude control system configuration. The ability of the subroutines to accommodate prescribed motions of system bodies is also demonstrated. Complete listings and user instructions are included for these routines (written in Fortran V) which are intended as multi- and general-purpose tools in the simulation of spacecraft and other complex electromechanical systems.

FLIEGEL, H. F.

F022 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

FORTENBERRY, J.

F023 Viking Mars Lander 1975 Dynamic Test Model/ Orbiter Developmental Test Model Forced Vibration Test: Summary Report

J. Fortenberry and G. R. Brownlee

Technical Memorandum 33-689, November 15, 1974

The Viking Mars 1975 Lander dynamic test model and Orbiter developmental test model were subjected to forced-vibration tests during November–December 1973, at JPL's dynamic test facility. Flight acceptance and type approval test levels were applied to the spacecraft structure in a longitudinal test configuration using a 133,440-N (30,000-lb) force shaker. Testing in the two lateral axes (X, Y) was performed at lower levels using four 667-N (150-lb) force shakers.

Forced vibration qualification test levels were successfully imposed on the spacecraft at frequencies down to 10 Hz. Measured responses showed the same character as analytical predictions, and correlation was reasonably good. Because of control system test tolerances, Orbiter primary structure generally did not reach the design load limits attained in earlier static testing. A post-test examination of critical Orbiter structure disclosed no apparent damage to the structure as a result of the test environment.

FOSTER, C. F.

F024 Automated Pulsar Receiver

C. F. Foster

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 135–138, April 15, 1974

This article describes a self-contained computer-controlled 30-MHz-to-baseband receiver. This receiver has three selectable predetection bandwidths, a diode power detector, an internal level set, and 15 postdetection bandwidths. It is designed to directly interface with an on-site data reduction system. Its primary utilization is the automatic monitoring of pulsar signals.

FOURTNER, C. H.

F025 Short-Term Frequency Measurement Capability in DSN Equipment Maintenance Facilities

R. M. Smith, D. Crawford, and C. H. Fourtner

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 182–185, April 15, 1974

For abstract, see Smith, R. M.

FRAMAN, E. P.

F026 Automated Firearms Identification System (AFIDS): Phase I

R. J. Blackwell and E. P. Framan

Special Publication 43-8, July 1, 1974

For abstract, see Blackwell, R. J.

FRANDSEN, A. M. A.

F027 Plasmaspheric Hiss Intensity Variations During Magnetic Storms

E. J. Smith, A. M. A. Frandsen, B. T. Tsurutani, R. M. Thorne (University of California, Los Angeles), and K. W. Chan (University of California, Los Angeles)

J. Geophys. Res., Space Physics, Vol. 79, No. 16, pp. 2507–2510, June 1, 1974

For abstract, see Smith, E. J.

F028 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

FRASHER, W. G.

F029 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

FREILEY, A. J.

F030 DSN Progress Report for November–December 1973: Radio Frequency Performance of DSS 14 64-m Antenna at 3.56- and 1.96-cm Wavelengths

A. J. Freiley

Technical Report 32-1526, Vol. XIX, pp. 110–115, February 15, 1974

During February and March 1973, the Mars Deep Space Station 64-m-diameter antenna was fitted with major structural braces, and other structural modifications were made to improve low-angle-elevation system gain performance at centimeter wavelengths. The new system performance, as defined by the radio metric measurements of May 1973, is compared to the previous performance, with respect to system efficiency, subreflector focus, and equivalent radio frequency surface tolerance. The evaluation shows that the predicted effect of the structural braces has been achieved; however, either the main reflector or subreflector surface tolerance, or both, have been degraded. The degradation is well defined at X- and Ku-band frequencies; at S-band the effect is nearly negligible.

FRIEDMAN, L. D.

F031 A Design for a Venus Orbital Imaging Radar Mission

J. R. Rose and L. D. Friedman

Preprint 74-222, AIAA Twelfth Aerospace Sciences Meeting, Washington, D.C., January 30–February 1, 1974

For abstract, see Rose, J. R.

FRIESEMA, S. E.

F032 Network Control System Block I and Block II Software

S. E. Friesema

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 160–169, August 15, 1974

The Network Control System (NCS) software implementation for Block I and Block II involves two distinct multicomputer systems. NCS Block I is a three-computer system; NCS Block II is a five-computer system. While completely separate, these two systems will operationally complement each other to provide required NCS operational support until NCS Block III is implemented. Both systems are presently designed and coded and are under NCS testing. NCS Block I will be available for operational testing July 1, 1974. This will not include the capabilities for sequence-of-events and tracking-predicts generation. Both programs are scheduled for operation at a later date. NCS Block II will be available for operational testing in early September 1974.

FYMAT, A. L.

F033 Instrumentation Optimization in Fourier Spectroscopy. 1: Far Infrared Beam Splitters

J. L. Deuzé (Université des Sciences et Techniques de Lille, France) and A. L. Fymat

Appl. Opt., Vol. 13, No. 8, pp. 1807–1813, August 1974

For abstract, see Deuzé, J. L.

F034 Scattering-Independent Determination of the Thermal-Emission Profile of a Planetary Atmosphere and Related Radiative-Equilibrium Considerations

A. L. Fymat

J. Opt. Soc. Am., Vol. 64, No. 2, pp. 145–147, February 1974

For a realistic model of a planetary atmosphere, a gradient–flux relation for both continuum and continuum-plus-spectral-line frequencies is derived. It provides the thermal-emission profile of the atmosphere, independent of scattering and of polarization. The relation also provides an experimental criterion for the existence of radiative equilibrium across the atmosphere.

F035 Inverse Multiple Scattering Problems—II. Limited Information Content of Partially Fitted Planetary Curves With Application to the Venusian Visual Phase Curve

A. L. Fymat and R. E. Kalaba (University of Southern California)

J. Quant. Spectrosc. Radiat. Transfer, Vol. 14, No. 9, pp. 919–933, September 1974

The random grid search method and the minimization search method recently developed by Fymat for solving inverse multiple-scattering problems of planetary atmospheres are employed for a study of the extent and nature of true information yielded by theoretical partial fits of observed planetary curves. The study is conducted with the Venusian visual phase curve as a background example. It is shown that such fits cannot be used to infer the model scattering parameters of the planet's atmosphere. They cannot provide any indication of the shape of the scattering diagram, even in the region of the fit. It is also shown that the measured Bond albedo can provide neither a criterion for sorting out different possible scattering model candidates nor a means for accurately determining the single scattering albedo. A high value of the latter albedo for Venus' atmosphere at visible wavelengths is also found, and Euler's scattering model is definitely discarded for this planet.

F036 Invariant Imbedding and Radiation Dosimetry: IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab

R. Bellman (University of Southern California), A. L. Fymat, S. Ueno (University of Southern California), and R. Vasudevan (University of Southern California)

Math. Biosci., Vol. 20, Nos. 3/4, pp. 315–325, April 1974

For abstract, see Bellman, R.

GARBA, J. A.

G001 Development and Correlation: Viking Orbiter Analytical Dynamic Model With Modal Test

B. K. Wada, J. A. Garba, and J. C. Chen

Technical Memorandum 33-690, June 1, 1974

For abstract, see Wada, B. K.

GARDNER, J. A.

G002 Power Processor Design Considerations for a Solar Electric Propulsion Spacecraft

E. N. Costogue and J. A. Gardner

Technical Memorandum 33-705, June 30, 1974

For abstract, see Costogue, E. N.

GARDNER, R. A.

G003 DSN Progress Report for November–December 1973: Radio Metric Applications of the New Broadband Square Law Detector

R. A. Gardner, C. T. Stelzried, and M. S. Reid

Technical Report 32-1526, Vol. XIX, pp. 89–92, February 15, 1974

A new constant law detector has a wider dynamic range and a more accurate square-law response than has been available in the past. This article discusses the use and performance of this detector in a noise-adding radiometer system at the Venus Deep Space Station.

G004 DSN Progress Report for November–December 1973: System Noise Temperature Calibrations of the Research and Development Systems at DSS 14

M. S. Reid and R. A. Gardner

Technical Report 32-1526, Vol. XIX, pp. 100–104, February 15, 1974

For abstract, see Reid, M. S.

GARY, B. L.

G005 Jupiter, Saturn, and Uranus Disk Temperature Measurements at 2.07 and 3.56 cm

B. L. Gary

Astron. J., Vol. 79, No. 2, pp. 318–320, February 1974

Observations at 2.07 cm with the Goldstone 64-m (210-ft) antenna yield the following planetary disk temperatures: Jupiter, 173.4 ± 5.2 K; Saturn, 162.3 ± 3.8 K; and Uranus 178.7 ± 12.9 K. An observation of Saturn at 3.56 cm with the same antenna yields a disk temperature of 169.7 ± 2.3 K.

GATZ, E. C.

G006 DSN Data Record Generation

E. C. Gatz

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 178–181, April 15, 1974

The DSN is implementing a central Ground Communications Facility Log of all data received and/or generated in the DSN. Selected data from the log are sorted and placed in time order to form an Intermediate Data Record (IDR). This IDR is the principal nonreal-time interface with flight projects.

G007 DSN Telemetry System, 1973–1976

E. C. Gatz

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 5–10, October 15, 1974

This article provides a definition, functional description, and block diagram of the DSN Telemetry System. The characteristics of the capabilities being added during the 1973–1976 period are described. This system will be used to provide multiple-mission support to various flight projects.

GAULT, D. E.

G008 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

G009 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

GAYMAN, W. H.

G010 Experimental Determination of the Principal Moments of Inertia of the Helios Prototype Spacecraft

W. H. Gayman and K. Liechti

Technical Memorandum 33-707, November 15, 1974

This memorandum presents methods of measuring moments of inertia with very high accuracy. The moment of inertia of the Helios Spacecraft about its spin axis was determined by use of a roll-fixture having two sets of crossed flexure pivots as elastic constraints. The test procedure entailed measurement of a system oscillation period with each of a set of added moment-of-inertia increments. The tare effect of the fixture was determined by a like process and was subtracted from the gross value to yield the spacecraft roll moment of inertia to an estimated accuracy of 0.2%.

Lateral moments of inertia (i.e., about each of three axes normal to the spin axis) were determined by a gravity pendulum method that makes use of the fact that any physical pendulum has a minimum period of oscillation determined by a particular distance from the axis of rotation to the system center of gravity. In situations where a knife-edge support is used, this distance is equal to the system centroidal radius of gyration. In the subject tests, the pivoting action was provided by hardened pins rolling on flat ways. The effect of the finite radius of the pins was considered in deriving the equations of motion, from which an error analysis revealed the criterion for maximum accuracy in determining the square of the centroidal radius of gyration. Though the centroidal moment of inertia of the swing fixture was over twice that of the spacecraft, an error analysis showed that accuracies of better than 1.0% were realized for the two lateral principal moments of inertia.

GEORGEVIC, R. M.

G011 Transformation Between Orbital Parameters in Different Coordinate Systems of the General Relativistic Schwarzschild Problem

R. M. Georgevic and J. D. Anderson

J. Franklin Inst., Vol. 296, No. 4, pp. 275–286, October 1973

This paper develops the relationships between the osculating orbital elements for a family of solutions of the general relativistic Schwarzschild problems. These relationships provide a method for evaluating orbital elements in different Schwarzschild coordinate systems without the necessity of fitting the elements to real data every time the system of coordinates is changed. The objectivity of different coordinate systems is discussed. Considerations of orbital motions favor the standard Schwarzschild metric, but the propagation of light signals is more objective in the metric of Painlevé. Because the orbital motions usually dominate the representation of data, the standard Schwarzschild coordinates are the best objective choice for most applications.

GIFFIN, C. E.

G012 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

GIGAS, G.

G013 Jupiter's Radiation Belts and Their Effects on Spacecraft

R. H. Parker, E. L. Divita, and G. Gigas

Technical Memorandum 33-708, October 15, 1974

For abstract, see Parker, R. H.

GOFORTH, L. J.

G014 Metaphase Spread Detection and Focus Using Closed Circuit Television

E. T. Johnson and L. J. Goforth

J. Histochem. Cytochem., Vol. 22, No. 7, pp. 536–545, July 1974

For abstract, see Johnson, E. T.

GOLDSTEIN, B. E.

G015 Observations of Electrons at the Lunar Surface

B. E. Goldstein

J. Geophys. Res., Space Physics, Vol. 79, No. 1, pp. 23–35, January 1, 1974

Observations of electrons at the Apollo 12 and 15 sites by the Alsep Solar Wind Spectrometer experiments showed qualitative differences. In the geomagnetic tail the Apollo 15 instrument provided measurements of lunar photoelectron fluxes from 5 to 40 eV; at 20 eV the flux was 2×10^6 el/cm^2 sec eV ster. The estimated height-integrated conductivity of the photoelectron layer is 10^{-4} to 10^{-5} ohm^{-1}. A theoretical model, ignoring the magnetic field, indicates that most solar wind electrons should reach the lunar surface; a lunar surface potential at the subsolar point of +5 to −3 V is calculated. At the Apollo 15 site (6-γ local magnetic field) electron densities and temperatures agree with this model. At the Apollo 12 site (38-γ local field) energetic nonsymmetric electron fluxes are observed. The data support a local space charge separation and a magnetic field of 5 km scale size or less. Downward-moving solar wind electrons require a balancing current due to upward-moving lunar photoelectrons; this suggests that the less energetic lunar photoelectrons should decrease electron pressure on magnetic field lines connected to the Moon. When the magnetic field and solar wind velocity are approximately parallel, a solar wind density enhancement upstream of the Moon is required for pressure balance.

GOLDSTEIN, R.

G016 Optical Properties of Mercury Ion Thruster Exhausts and Implications for Science Instruments

K. M. Monahan and R. Goldstein

Technical Memorandum 33-711, December 1, 1974

For abstract, see Monahan, K. M.

GOLDSTEIN, R. M.

G017 Surface Features on Mercury

S. Zohar and R. M. Goldstein

Astron. J., Vol. 79, No. 1, pp. 85–91, January 1974

For abstract, see Zohar, S.

GOODWIN, P. S.

G018 Helios Mission Support

P. S. Goodwin

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 16–21, August 15, 1974

The Helios-A spacecraft is now less than 6 months from launch. DSN activity is shifting from implementation to operational preparations. There have been, however, three significant recent developments: (1) the final selection of the targeted perihelion distance for the Helios-A mission has been established as 0.31 AU; (2) the Helios-A launch trajectory has been changed from a direct-ascent mode to a parking-orbit mode; and (3) the prototype model spacecraft has successfully passed compatibility testing with the DSN. This article discusses the significance to the Tracking and Data System of each of these developments.

G019 Helios Mission Support

P. S. Goodwin

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 19–21, October 15, 1974

The Helios Prototype Model Spacecraft has been transported to Cape Canaveral where it will serve both as a forerunner to the first flight spacecraft and as back-up. This article treats the compatibility verification tests that were performed after the prototype's arrival at Cape Canaveral, with particular emphasis upon the first use of the former Spacecraft Compatibility Station equipment in the consolidated Spacecraft Tracking and Data Network facility at Merritt Island, Florida.

GOTTLIEB, P.

G020 DSN Progress Report for November–December 1973: Analysis of Staffing and Training Policies for a DSN Tracking Station

A. Bahadur and P. Gottlieb

Technical Report 32-1526, Vol. XIX, pp. 207–220, February 15, 1974

For abstract, see Bahadur, A.

GREENHALL, C. A.

G021 Minimum Cost Assignment of Crews to Meet Tracking Requirements

C. A. Greenhall

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 119–136, June 15, 1974

This article describes a model of the tracking constraints, maintenance constraints, labor constraints, and labor costs of a DSN complex. The problem of minimizing the labor costs while satisfying the constraints is solved. Minimum cost schedules for all cases of interest are given and modifications of the model are suggested.

GREGG, M. A.

G022 X-Band Radar Development

M. A. Gregg and R. B. Kolbly

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 44–48, April 15, 1974

This article describes the development progress of the Mars Deep Space Station X-band radar transmitter. Specific subassemblies discussed are the exciter, combiner-controller for the two 250-kW klystrons, and various high-power components associated with klystron-output combining and monitoring.

GROTCH, S. L.

G023 Statistical Method for the Prediction of Matching Results in Spectral File Searching

S. L. Grotch

Anal. Chem., Vol. 46, No. 4, pp. 526–534, April 1974

In file search techniques, the distribution of mismatches quantitatively measures the fit of a particular unknown against a given library. A simple theoretical method is developed to predict, *a priori*, this distribution. With this procedure, for any unknown code and library, the mean number of mismatches can be calculated exactly. For a given library and coding scheme, the mismatch distribution for most unknown codes closely follows a common curve which is easily calculated from statistical properties of the library. When this common curve is normalized to a constant mean, the observed matching behavior is well predicted. The theory should permit the user to more clearly assess the effects of errors on file search performance and suggest techniques by which recognition performance may be optimized.

G024 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

GUBBAY, J.

G025 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

GUISINGER, J. E.

G026 Laser Recording on MnBi Films

G. Lewicki and J. E. Guisinger

IEEE Trans. Magnetics, Vol. MAG-9, No. 4, pp. 700–704, December 1973

For abstract, see Lewicki, G.

GUPTA, K. K.

G027 On a Combined Sturm Sequence and Inverse Iteration Technique for Eigenproblem Solution of Spinning Structures

K. K. Gupta

Int. J. Numer. Methods Eng., Vol. 7, No. 4, pp. 509–518, 1973

This paper describes an efficient numerical algorithm for the accurate computation of specific eigenvalues and related vectors of spinning structures. The Sturm sequence technique is first applied to isolate the required roots, which are then individually located by an inverse iteration technique adopting an efficient matrix formulation specially developed for this purpose. The associated digital computer procedure is numerically stable, which also fully exploits the banded form of relevant matrices. Furthermore, the algorithm proves to be much faster than other related existing procedures.

A computer program, based on the current algorithm, has been developed in FORTRAN V for the JPL UNIVAC 1108 computer. Numerical results for representative structures, computed by the program, are also presented in detail. Extensive applications of the program are envisaged in the attitude control of spacecraft and in the natural frequency analysis of spinning structures, discretized by the finite element method.

HAGLER, R., JR.

H001 Explosive-Actuated Valve Design Concept That Eliminates Blow-By

R. Hagler, Jr.

Technical Memorandum 33-682, May 1, 1974

This memorandum presents the JPL method of evaluating the normally open and normally closed, explosive-actuated valves that were selected for use in the trajectory correction propulsion subsystem of the Thermoelectric Outer Planet Spacecraft (TOPS) Program. The design philosophy which determined the requirements for highly reliable valves that could provide the performance capability during long-duration (10-year) missions to the outer planets is discussed. The techniques that were used to fabricate the valves and manifold, 10 valves in an assembly, with the capability of five propellant-flow initiation/isolation sequences are described. The test program, which was conducted to verify valve design requirements, is outlined and significant results are shown.

H002 Combined Effects of Hydrazine Exposure and Endurance Testing on Solenoid-Actuated Valve Performance

R. Hagler, Jr.

Technical Memorandum 33-691, July 1, 1974

This memorandum presents the results of a test program which was conducted to assess the capability of various solenoid-actuated valve design concepts to provide performance characteristics commensurate with long-duration (10-year) missions to explore the outer planets. The valves were installed in a hydrazine-flow test setup and periodically cycled during a nine-month test period under test conditions comparable to anticipated mission operating conditions. In situ valve performance was periodically determined, and leakage was continuously monitored.

HALL, R. C.

H003 Annual Chronology of International Astronautical Events: 1972

R. C. Hall

Acta Astronaut. (formerly *Astronaut. Acta*), Vol. 1, Nos. 7–8, pp. xii–xxxi, July–August 1974

This article presents a chronology, compiled by the International Academy of Astronautics, of scientific and technological events and achievements during 1972 which attest to international cooperation in the exploration and use of outer space. Included is a bibliography of 1972 publications that pertain to the history of astronautics and a list of United Nations documents on the uses of outer space.

H004 Annual Chronology of International Astronautical Events: 1971

R. C. Hall

Astronaut. Acta, Vol. 18, No. 6, pp. 457–469, December 1973

This article presents a chronology, compiled by the International Academy of Astronautics, of scientific and technological events and achievements during 1971 which attest to international cooperation in the exploration and use of outer space. Included is a bibliography of publications for the same year that pertain to the history of astronautics.

H005 Fifth International Symposium on the History of Rocketry and Astronautics: Brussels, September 1971

R. C. Hall

Technol. Culture, Vol. 15, No. 1, pp. 70–75, January 1974

The Fifth International Symposium on the History of Rocketry and Astronautics of the International Academy of Astronautics (IAA) was held in Brussels, September 23, 1971. The symposium met in conjunction with the Twenty-second International Astronautical Federation (IAF) Congress. As in past IAA history symposia, the twelve memoir and research papers that were presented complied with the "twenty-year rule" incorporated into the 1971 program theme: "new contributions to the historical literature on rocket technology and astronautics before 1951." This article presents the title, author(s), and summary of each paper.

HALL, R. I.

H006 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of N_2O

R. I. Hall, A. Chutjian, and S. Trajmar

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 12, pp. L365–L368, December 1973

Electron-scattering spectra of nitrous oxide are reported in the 5–10 eV energy-loss range at scattering angles of 20, 30, 90, and 130 deg at a residual energy of 7.0 eV; and at residual energies of 10.0, 2.0, 1.0, 0.6, and 0.2 eV at a scattering angle of 90 deg. Several new distinct and overlapping continua are observed to lie in this energy-loss range. The experimental spectra are discussed in the light of semiempirical INDO calculations by Chutjian and Segal (1972) of the vertical transition energies of N_2O. An assignment of the symmetries of the observed excitations consistent with the experimental and theoretical data is suggested.

HAM, N. C.

H007 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

For abstract, see Butman, S.

H008 Helios Spin Modulation Simulation Tests

N. C. Ham

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 154–166, April 15, 1974

Additional analysis and study have completed the mathematical model of the Helios spacecraft low-gain antenna and permitted the formulation of experimental tests for simulating the spin modulation effects at a typical deep space station communication system. This article discusses the details of the test technique, system test configuration, and results of the simulation tests.

H009 Helios Spin-Modulation Doppler Effects

N. C. Ham

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 87–91, October 15, 1974

It is predicted that the spinning of the spin-stabilized Helios spacecraft will affect the observed radio frequency doppler signal, which is normally only a function of the spacecraft-to-Earth radial velocity, when the spacecraft's low-gain antenna is used for communication. The effect is due largely to the spin modulation created by the spacecraft rotation and the right-circularly-polarized element of the spacecraft antenna system that is physically offset several radio frequency wavelengths from the rotational axis. This article develops the expected effects on the general doppler equation, and presents expressions for the resultant one-way uplink and downlink and two-way coherent doppler frequency cases.

HAMILTON, G. B.

H010 Viking 1975 Analog Recording

G. B. Hamilton

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 119–120, December 15, 1974

The requirements on the FR1400 analog magnetic tape recorders in the DSN have been increasing in recent years. Viking Mars 1975 requirements appeared particularly stringent. Problems of insufficient tape recording channels or bandwidth were solved by decreasing telemetry requirements and by providing no backup recording for occultation purposes on the standard telemetry recorders.

HAPKE, B.

H011 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

H012 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

HARDY, J. P.

H013 1-Butanol–Hydrogen Chloride: An Allegedly Anhydrous Esterification Reagent

J. P. Hardy, S. L. Kerrin, and S. L. Manatt

J. Org. Chem., Vol. 38, No. 24, pp. 4196–4200, November 1973

The stability of a common Fischer esterification reagent used extensively for preparation of amino acid and carboxylic acid esters, 2.1 *M* HCl-1-butanol, has been studied in detail. After 2 hr at 100 and 150°C, the concentrations of 1-chlorobutane, di-1-butyl ether, and water in this reagent are 0.71, 0.04, and 0.75, and 2.36, 0.22, and 2.58 *M*, respectively. Approximate rate constants for formation of these products at 100 and 150°C have been determined. It is concluded that esterifications with this reagent should be carried out below 100°C to achieve best yields. An equilibrium constant of 0.15 ± 0.03 has been measured in the esterification of a typical aliphatic amino acid, leucine. The significance of the production of water in this esterification reagent is discussed especially in light of its use in amino acid esterification procedures where the carboxylic acid concentrations may be at the millimolar or lower concentration level.

HARPER, L. H.

H014 On DSN Antenna Scheduling

L. H. Harper, R. J. McEliece, and A. M. Odlyzko

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 53–56, April 15, 1974

This article presents the formulation and solution of a problem related to the efficient assignment of DSN antennas to astronomical objects. The solution involves the well-developed theory of network flow.

HARRINGTON, T. M.

H015 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

A γ-ray spectrometer has been flown on the Apollo 15 and 16 spacecrafts to determine lunar-surface composition and measure cosmic γ-ray flux. The instrument included a NaI(Tl) scintillation crystal coupled to a 7.6 cm photomultiplier tube, a plastic mantle for anti-coincidence rejection of charged particles, and 511 channels of analysis. Boom-mounted operation permitted a significant reduction in the background. The data were transmitted on an event-by-event basis. About 22% of the lunar surface was mapped, and spectra of the cosmic γ-ray flux over an energy range of 0.065–27.5 MeV have been obtained.

HARRISON, E. C.

H016 Size Comparisons of Commercial Prosthetic Heart Valves

E. J. Roschke and E. C. Harrison (University of Southern California Medical Center)

Med. Instrum., Vol. 7, No. 5, pp. 277–282, November–December 1973

For abstract, see Roschke, E. J.

HARSTAD, K. G.

H017 Nonstationary Homogeneous Nucleation

K. G. Harstad

Technical Memorandum 33-666, January 15, 1974

This memorandum reviews the theory of homogeneous condensation and presents equations describing this process. Numerical computer solutions to transient problems in nucleation (relaxation to steady state) are presented and compared to a prior computation. The present method of computation is much faster than that used previously.

HARTLE, R. E.

H018 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

HARTLEY, R. B.

H019 Deep Space Network Support of the Manned Space Flight Network for Apollo: 1971–1972

R. B. Hartley

Technical Memorandum 33-452, Vol. III, March 1, 1974

This memorandum summarizes DSN activities in support of Project Apollo during 1971 and 1972. Beginning with the Apollo 14 mission and concluding with the Apollo 17 mission, the summary includes a mission description, the NASA support requirements placed on the DSN, and a comprehensive account of the support activities provided by each committed DSN deep space station. Associated equipment and activities of the three elements of the DSN (i.e., the Deep Space Instrumentation Facility, the Space Flight Operations Facility, and the Ground Communications Facility) used in meeting the radio metric and telemetry demands of the missions are documented.

HARTMAN, R. E.

H020 TEM Data Retrieval for Computer Electron Micrograph Processing

H. Alsberg, R. E. Hartman, and R. Nathan

Seminar Proceedings on Optical Instrumentation in Medicine II, Vol. 43, pp. 235–241, Chicago, November 1973

For abstract, see Alsberg, H.

HARTOP, R. W.

H021 DSN Progress Report for November–December 1973: X-Band Antenna Feed Cone Assembly

R. W. Hartop

Technical Report 32-1526, Vol. XIX, pp. 173–175, February 15, 1974

In support of Viking Mars 1975 and future projects, the DSN must provide for X-band signal reception at its 64-m-diameter antenna stations. This article reports the progress to date in the construction of the new X-band feed cone assemblies, for which the feed subassemblies have been completed.

HATCH, J. T.

H022 Real-Time High-Rate Telemetry Support of Mariner 10 Operations

J. T. Hatch and J. W. Capps

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 125–131, October 15, 1974

Television pictures from the Mariner Venus/Mercury 1973 spacecraft were received and displayed in real-time at JPL during important phases of the mission. In order for the DSN to support this activity, the telemetry data processing equipment at the Mars Deep Space Station had to be modified and a special microwave super-group channel established between the station and JPL to handle transmission of the high rate (117.6 kbps) data. How this capability was implemented and operated by the DSN is described in this article.

HEYSER, R. C.

H023 Ultrasonic Transmission Measurements on Human Brain Sections

L. S. Fishman (Children's Hospital of Los Angeles), R. C. Heyser, and D. H. Le Croissette

Radiology, Vol. 112, No. 1, pp. 211–213, July 1974

For abstract, see Fishman, L. S.

H024 A New Ultrasonic Imaging System Using Time Delay Spectrometry

R. C. Heyser and D. H. Le Croissette

Ultrasound Med. Biol., Vol. 1, No. 2, pp. 119–131, March 1974

This article describes a new method of forming a visual image by ultrasound. A shadowgraphic transmission image similar to an X-ray radiograph is produced by the application of a technique known as time delay spectrometry. The system uses a repetitive frequency sweep with a linear relationship between frequency and time, and the transmitting and receiving crystal are scanned in raster fashion about the subject. By electronic processing, an image may be built up which represents the energy transmitted through the specimen with a given time delay. An intensity modulated picture encompassing the full shades-of-gray capability of the recording system can be produced.

A second type of image showing transmission time through the specimen may also be formed. Brightness changes in the displayed image in this case correspond to changes in the ultrasonic transmission time through the specimen. There is no analog for this type of image in current X-ray or ultrasonic practice. Examples of both types of images of specimens both *in vitro* and *in vivo* are shown. The advantages and potentials of this method for biomedical ultrasonic imaging and analysis are discussed.

HILDEBRAND, C. E.

H025 Orbit Determination Capability Analysis for the Mariner-Jupiter-Saturn 1977 Mission

G. A. Ransford, C. E. Hildebrand, and V. J. Ondrasik

J. Spacecraft Rockets, Vol. 11, No. 9, pp. 658–663, September 1974

For abstract, see Ransford, G. A.

HOLCOMB, L. B.

H026 Survey of Auxiliary-Propulsion Systems for Communications Satellites

L. B. Holcomb and D. H. Lee (TRW Systems Group)

Communications Satellite Technology (Progr. Astronaut. Aeronaut., Vol. 33), pp. 191–243, 1972

This article surveys current auxiliary-propulsion systems to provide insight for the selection of attitude and station-keeping propulsion systems for future communications satellites. Thruster systems specifically considered are stored gas, vaporizing ammonia/electrothermal, catalytic monopropellant hydrazine, electrothermal monopropellant hydrazine, plenum monopropellant hydrazine, ion, colloid, and pulsed plasma. Details of each of the thruster types are divided into three sections: (1) description of thruster system and how it functions, (2) spaceflight experience, and (3) survey of state-of-the-art thrusters. In addition, a qualitative tabulation of thruster characteristics is included.

HOOKE, A. J.

H027 The 1973 Mariner Mission to Venus and Mercury: Part One

A. J. Hooke

Spaceflight, Vol. 16, No. 1, pp. 25–34, January 1974

The Mariner Venus/Mercury 1973 spacecraft will perform history's first dual-planet flyby using gravitational assist and will return close-up pictures of the cloud cover of Venus and the first detailed glimpse of Mercury and its environment. This article is the first part of a two-part document that discusses in detail the Mariner Venus/Mercury 1973 mission. Specific areas covered are: project organization, mission objectives, science instruments and objectives, spacecraft trajectory and coordinate system, overall spacecraft configuration, specific spacecraft subsystems, and the proposed flight plan.

H028 The 1973 Mariner Mission to Venus and Mercury: Part Two

A. J. Hooke

Spaceflight, Vol. 16, No. 2, pp. 46–54, February 1974

The Mariner Venus/Mercury 1973 spacecraft will perform history's first dual-planet flyby using gravitational assist and will return close-up pictures of the cloud cover of Venus and the first detailed glimpse of Mercury and its environment. This article is the second part of a two-part document that dicusses in detail the Mariner Venus/Mercury 1973 mission. Specific areas covered are: project organization, mission objectives, science instruments and objectives, spacecraft trajectory and coordinate system, overall spacecraft configuration, specific spacecraft subsystems, and the proposed flight plan.

HOUSEMAN, J.

H029 On-Board Hydrogen Generator for a Partial Hydrogen Injection Internal Combustion Engine

J. Houseman and D. J. Cerini

Paper 740600, SAE West Coast Meeting, Anaheim, Calif., August 12–16, 1974

A compact onboard hydrogen generator has been developed for use with a hydrogen-enriched gasoline internal combustion engine. The unit uses gasoline and air in a partial oxidation reactor to produce a gaseous product containing hydrogen, nitrogen, carbon monoxide, and minor amounts of methane, carbon dioxide, and water. A study of the theoretical equilibrium product composition has indicated an optimum operating point at an air/fuel ratio of 5.15, where a hydrogen/fuel mass ratio of 0.136 can be obtained under soot-free conditions. This is based on a gasoline with an atomic hydrogen to carbon ratio of 1.92.

Both thermal and catalytic reactors have been tested. The thermal unit requires a reaction temperature of 2400°F to obtain 80% of the theoretical hydrogen yield. Soot formation tends to be a problem. The catalytic reactor yields close to theoretical yields at an operating temperature of 1800°F without any soot formation. A commercial nickel catalyst is used. A 100 h test with the catalytic unit showed no signs of performance degradation, using fully leaded Indolene 30. The calculated effect of hydrogen generator operating conditions on the fuel efficiency of a generator/engine combination is presented.

HOWARD, H. T.

H030 Venus: Mass, Gravity Field, Atmosphere, and Ionosphere as Measured by the Mariner 10 Dual-Frequency Radio System

H. T. Howard (Stanford University) et al.

Science, Vol. 183, No. 4131, pp. 1297–1301, March 29, 1974

Analysis of the doppler tracking data from the Mariner Venus/Mercury 1973 spacecraft near Venus encounter yields a value for the ratio of the mass of the Sun to that of Venus of 408,523.9 ± 1.2, which is in good agreement with prior determinations based on data from Mariner 2 and Mariner 5. Preliminary analysis indicates that the magnitudes of the fractional differences in the principal moments of inertia of Venus are no larger than 10^{-4}, given that the effects of gravity-field harmonics higher than the second order are negligible. Additional analysis is needed to determine the influence of the higher order harmonics on this bound.

Four distinct temperature inversions were found at altitudes of 56, 58, 61, and 63 km. The X-band signal was much more rapidly attenuated than the S-band signal and disappeared completely at 52-km. The nightside ionosphere consists of two layers having a peak density of 10^4 electrons/cm^3 at altitudes of 140 and 120 km. The dayside ionosphere has a peak density of 3×10^5 electrons/cm^3 at an altitude of 145 km. The electron number density observed at higher altitudes was ten times less than that observed by Mariner 5, and no strong evidence for a well-defined plasmapause was found.

Contributors to this article include:

Stanford University: H. T. Howard and G. L. Tyler

Jet Propulsion Laboratory: G. Fjeldbo, A. J. Kliore, G. S. Levy, D. L. Brunn, R. Dickinson, R. E. Edelson, W. L. Martin, R. B. Postal, B. Seidel, T. T. Sesplaukis, D. L. Shirley, C. T. Stelzried, D. N. Sweetnam, A. I. Zygielbaum, P. B. Esposito, and J. D. Anderson

Massachusetts Institute of Technology: I. I. Shapiro and R. D. Reasenberg

H031 Mercury: Results on Mass, Radius, Ionosphere, and Atmosphere From Mariner 10 Dual-Frequency Radio Signals

H. T. Howard (Stanford University) et al.

Science, Vol. 185, No. 4146, pp. 179–180, July 12, 1974

Analysis of the radio-tracking data from the Mariner Venus/Mercury 1973 spacecraft (Mariner 10) yields 6,023,600 ± 600 for the ratio of the mass of the Sun to that of Mercury, in very good agreement with values determined earlier from radar data alone. Occultation measurements yielded values for the radius of Mercury of 2440 ± 2 and 2438 ± 2 km at latitudes of 2°N and 68°N, respectively, again in close agreement with the average equatorial radius of 2439 ± 1 km determined from radar data. The mean density of 5.44 g cm^{-3} deduced for Mercury from Mariner 10 data thus virtually coincides with the prior determination. No evidence of either an ionosphere or an atmosphere was found, with the data yielding upper bounds on the electron density of about 1500 and 4000 el cm^{-3} on the dayside and nightside, respectively, and an inferred upper bound on the surface pressure of 10^{-8} millibar.

Contributors to this article include:

Stanford University: H. T. Howard and G. L. Tyler

Jet Propulsion Laboratory: P. B. Esposito, J. D. Anderson, G. Fjeldbo, A. J. Kliore, G. S. Levy, D. L. Brunn, R. Dickinson, R. E. Edelson, W. L. Martin, R. B. Postal, B. Seidel, T. T. Sesplaukis, D. L. Shirley, C. T. Stelzried, D. N. Sweetnam, G. E. Wood, and A. I. Zygielbaum

Massachusetts Institute of Technology: R. D. Reasenberg and I. I. Shapiro

HSIEH, T. M.

H032 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

For abstract, see Mondt, J. F.

HU, C. L.

H033 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

HUNTRESS, W. T., JR.

H034 Reactions of Fragment Ions in Methane: Ion–Molecule Reactions in Methane and Helium–Methane Mixtures

W. T. Huntress, Jr., J. B. Laudenslager, and R. F. Pinizzotto, Jr.

Int. J. Mass Spectr. Ion Phys., Vol. 13, No. 4, pp. 331–341, April 1974

The rate constants and product distributions for the reactions of CH_2^+ and CH^+ ions with methane have been measured over the range of ion kinetic energies from near thermal velocities to approximately 6 eV by using ion cyclotron resonance methods. The rate constant and product distribution for the reaction of He^+ ions with methane are also measured at near thermal velocities, and the possibility for the production of excited CH_2^+ and CH^+ ions by this latter reaction is examined.

H035 Product Distributions and Rate Constants for Ion–Molecule Reactions in Water, Hydrogen Sulfide, Ammonia, and Methane

W. T. Huntress, Jr. and R. F. Pinizzotto, Jr.

J. Chem. Phys., Vol. 59, No. 9, pp. 4742–4756, November 1, 1973

The thermal-energy, bimolecular ion–molecule reactions occurring in gaseous water, hydrogen sulfide, ammonia, and methane have been identified and their rate constants determined using ion cyclotron resonance methods. Absolute rate constants were determined for the disappearance of the primary ions by using the trapped ion method, and product distributions were determined for these reactions by using the cyclotron ejection method. Previous measurements are reviewed and compared with the results using the present methods. The relative rate constants for hydrogen-atom abstraction, proton transfer, and charge transfer are also determined for reactions of the parent ions.

H036 Formation of HO_2^+ by Reaction of Metastable O_2^+ Ions With H_2

J. M. Ajello, W. T. Huntress, Jr., A. L. Lane, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 60, No. 4, pp. 1211–1213, February 15, 1974

For abstract, see Ajello, J. M.

H037 Ion–Molecule Reactions and Vibrational Deactivation of H_2^+ Ions in Mixtures of Hydrogen and Helium

L. P. Theard and W. T. Huntress, Jr.

J. Chem. Phys., Vol. 60, No. 7, pp. 2840–2848, April 1974

For abstract, see Theard, L. P.

H038 Photoionization and Ion Cyclotron Resonance Studies of the Reaction of Vibrationally Excited $C_2H_2^+$ Ions With H_2

S. E. Buttrill, Jr., J. K. Kim, W. T. Huntress, Jr., P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 61, No. 5, pp. 2122–2128, September 1, 1974

For abstract, see Buttrill, S. E., Jr.

H039 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

HURD, W. J.

H040 Efficient Generation of Statistically Good Pseudonoise by Linearly Interconnected Shift Registers

W. J. Hurd

IEEE Trans. Computers, Vol. C-23, No. 2, pp. 146–152, February 1974

This article presents some new algorithms for efficiently generating pseudorandom noise both in hardware and software. In software, a new word of pseudorandom bits can be generated about every 12 machine cycles, and hardware implementations can generate pseudo-Gaussian noise with bandwidth of 20 MHz or more. The algorithms generate binary maximal-length linear recursive sequences of high degree and with many nonzero terms. The ability to efficiently implement high-degree recursions is important because the number of consecutive bits which can be guaranteed to be both linearly and statistically independent is equal to the degree of the recursion. The implementations are by interconnection of several short shift registers in a linear manner in such a way that different widely spaced phase shifts of the same pseudonoise sequence appear in the stages of the several registers. Some specific algorithms have been subjected to extensive statistical evaluation, with no evidence found to distinguish the sequences from purely random binary sequences.

H041 An Analysis and Demonstration of Clock Synchronization by VLBI

W. J. Hurd

IEEE Trans. Instr. Meas., Vol. IM-23, No. 1, pp. 80–89, March 1974

A prototype of a semi-real-time system for synchronizing the DSN station clocks by radio interferometry was successfully demonstrated on August 30, 1972. The system utilized an approximate maximum-likelihood estimation procedure for processing the data, thereby achieving essentially optimum time synchronization estimates for a given amount of data, or equivalently, minimizing the amount of data required for reliable estimation. Synchronization accuracies as good as 100 ns rms were achieved between the Pioneer and Echo Deep Space Stations, both at Goldstone, Calif. The accuracy can be improved by increasing the system bandwidth until the fundamental limitations due to baseline and source position uncertainties and atmospheric effects are reached. These limitations are under 10 ns for transcontinental baselines.

HYDE, J. R.

H042 Exploring Jupiter and Its Satellites With an Orbiter

J. C. Beckman, J. R. Hyde, and S. I. Rasool (NASA Office of Space Sciences)

Astronaut. Aeronaut., Vol. 12, No. 9, pp. 24–35, September 1974

For abstract, see Beckman, J. C.

INGHAM, J. D.

I001 Microbial Abundance and Thermoluminescence of Antarctic Dry Valley Soils

J. D. Ingham, R. E. Cameron, and D. D. Lawson

Soil Sci., Vol. 117, No. 1, pp. 46–57, January 1974

The ecologies of Antarctica and other severe terrestrial environments are of fundamental interest in connection with the determination of the factors that most significantly affect the survivability and adaptability of living organisms under extreme conditions. A better understanding of such limited ecologies is particularly relevant to the prospects of life and methods of life detection in planetary rocks and soils, and in the assessment of potential contamination of planetary environments by adaptable terrestrial microorganisms. Although studies have been conducted to relate geologic age, stratigraphical features, microclimate, mineral composition, and radiation history to thermoluminescence (TL) of rocks, determination of the relationships (if any) between bacterial abundance and TL response of soils has not been attempted.

Because some of the many factors affecting bacterial abundance also affect TL response, this work was initiated to define any potential correlations. TL data can be more easily and quickly obtained than bacterial abundances through cultural methods; therefore, TL measurements might be useful for soil surveys of an ecological nature. TL could be used to indicate appropriate sites for bacterial abundance measurements, or it could be interpolated with limited cultural tests to determine bacterial abundances. Data reported here demonstrate an approximate inverse trend between TL response and bacterial abundance for Antarctic valley soils, and a clear relationship between salt concentration or TL response and bacterial abundance for Victoria Valley soils.

INGRAM, M.

I002 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

IRONS, A. S.

I003 Development and Fabrication of Heat-Sterilizable Inhalation Therapy Equipment

A. S. Irons

Technical Memorandum 33-670, January 15, 1974

A considerable amount of medical apparatus, because of its incompatibility with reliable sterilization methods, is implicated in the transmission of disease-producing microorganisms. One such device, an intermittent positive-pressure breathing apparatus, was modified in conjunction with a manufacturer to demonstrate the feasibility of converting an existing apparatus to one which is compatible with dry heat sterilization. This sterilization method has been proven to be capable of highly efficient, reliable, total destruction of all bacterial and viral forms of life.

NASA-developed material, design, and sterilization technologies were utilized to effect the appropriate modifications to this apparatus. Prototype units are capable of withstanding repeated sterilization cycles at 125°C. The results of hospital field testing substantiated the effectiveness of this effort.

ISHIMARU, A.

I004 Effects of Turbulence in a Planetary Atmosphere on Radio Occultation

R. T. Woo and A. Ishimaru (University of Washington)

IEEE Trans. Anten. Prop., Vol. AP-22, No. 4, pp. 566–573, July 1974

For abstract, see Woo, R. T.

I005 Observations of Small-Scale Turbulence in the Atmosphere of Venus by Mariner 5

R. T. Woo, A. Ishimaru (University of Washington), and W. Kendall (Mark Resources, Inc.)

J. Atmos. Sci., Vol. 31, No. 6, pp. 1698–1706, September 1974

For abstract, see Woo, R. T.

JACKSON, E. B.

J001 DSN Progress Report for November–December 1973: DSN Research and Technology Support

E. B. Jackson

Technical Report 32-1526, Vol. XIX, pp. 137–140, February 15, 1974

This article discusses the activities of the Development Support Group in operating and maintaining the Venus Deep Space Station. Activities included planetary-radar experiments (Venus and Mercury), radio-source sky survey using the 26-m-diameter antenna, Faraday-rotation data collection, weak-radio-source flux density measurement, X-band 400-kW radar development and testing, Block IV receiver/exciter installation and testing/checkout, 26-m-diameter antenna receiving system temperature improvement, differential very-long-baseline-interferometry experiments, clock-synchronization transmissions, Mars Deep Space Station high-power transmitter maintenance support, and Pioneer 10 science support.

J002 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 124–127, April 15, 1974

This article describes the activities of the Development Support Group in operating and maintaining the Venus Deep Space Station and the Microwave Test Facility. Activities noted include planetary radar experiments, station automation demonstration development, weak radio source observation, 26-m antenna pattern sidelobe measurements, and testing of an adhesive planned for use in construction of an insulated subreflector for the overseas 64-m antennas. Support for the Block IV receiver/exciter at the Mars Deep Space Station (DSS 14) is noted; a capsule progress report on the 400-kW X-band planetary radar is given; and high-power transmitter maintenance at DSS 14 and testing of DSN klystrons are discussed. Differential very-long-baseline interferometry (VLBI) transmissions and Pioneer 10 science support are also discussed.

J003 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 65–68, June 15, 1974

This article describes the activities of the Development Support Group in operating and maintaining the Venus Deep Space Station and the Microwave Test Facility. Activities include interferometric planetary radar measurements of the surface of Venus, support of station

automation (pulsar) testing and observing, weak radio source observation for 64-m antenna gain calibration, completion of the sidelobe measurements on the 26-m antenna (with resultant changes in gain and system temperature), and extensive sky survey measurements. Additionally, major support was given to spacecraft projects with Faraday rotation data collection, support of the Block IV receiver/exciter at the Mars Deep Space Station, X-band (400-kW) radar testing and Rio Cofio Deep Space Station 100-kW transmitter testing.

J004 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 109–113, August 15, 1974

The activities of the Development Support Group in operating and maintaining the Venus Deep Space Station and the Microwave Test Facility are discussed and progress noted. Major activities include support of testing of the 100-kW transmitters to be installed into the overseas 64-m antennas, testing and modification required for the 400-kW X-band radar system, testing of station automation and pulsar observation, installation of new Faraday-rotation polarimeters, and clock synchronization transmissions. Other activities include Pioneer 10 and 11 science support, sky survey, and weak-radio-source observations.

J005 DSN Research and Technology Support

E. B. Jackson and A. L. Price

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 78–84, December 15, 1974

This article discusses the activities of the Development Support Group in operating and maintaining the Venus Deep Space Station (DSS 13) and the Microwave Test Facility (MTF). Major activities include equipment modifications required for the planned automation demonstration, measurements made of radiation from the planet Jupiter and various radio sources, testing and installation of the 400-kW X-band planetary system, efficiency measurements on a DSN 20-kW transmitter, a brief summary of initial testing of microwave power transmission over a distance of 1.5 km, clock synchronization transmissions, and various interferometric observations of radio sources. Additionally, a discussion of the phased-array video enhancement experiment on the Mariner Venus/Mercury 1973 second Mercury encounter and DSS 13's role in that experiment is given.

JACOBI, N.

J006 Phonons in Quantum Solids With Defects

N. Jacobi and J. S. Žmuidzinas

Technical Memorandum 33-701, September 1, 1974

This memorandum develops a formalism for temperature-dependent, self-consistent phonons in quantum solids with defects. Lattice vacancies and interstitials in solid helium and metallic hydrogen, as well as electronic excitations in solid helium, are treated as defects that modify properties of these systems. The information to be gained from the modified phonon spectrum is discussed.

JACOBSON, R. A.

J007 Iterative Explicit Guidance for Low Thrust Spaceflight

R. A. Jacobson and W. F. Powers (University of Michigan)

J. Spacecraft Rockets, Vol. 11, No. 7, pp. 494–497, July 1974

A retargeting procedure is developed for use as a nonlinear, low-thrust guidance scheme. The selection of a control program composed of a sequence of inertially fixed thrust-acceleration vectors permits all trajectory computations to be made with closed-form expressions, and allows the controls to be represented by constant parameters, thrust-acceleration vectors, and thrusting times. By requiring each trajectory to be time optimal, the guidance problem is transformed into a parameter optimization problem which is solved by a Davidon-type method. The scheme is applied to a low-thrust capture mission, and the results of computer simulations are presented.

J008 Terminal Navigation Analysis for the 1980 Comet Encke Slow Flyby Mission

R. A. Jacobson, J. P. McDanell, and G. C. Rinker

J. Spacecraft Rockets, Vol. 11, No. 8, pp. 590–596, August 1974

This article presents the initial results of a terminal navigation analysis for the proposed 1980 solar-electric slow flyby mission to the comet Encke. The navigation technique employs onboard optical measurements with the scientific television camera, ground-based observations of the spacecraft and comet, and ground-based orbit determination and thrust vector update computation. The knowledge and delivery accuracies of the spacecraft are evaluated as a function of the important parameters affecting the terminal navigation. These in-

clude optical measurement accuracy, thruster noise level, duration of the planned terminal coast period, comet ephemeris uncertainty, guidance initiation time, guidance update frequency, and optical data rate.

JAFFE, L. D.

J009 Unmanned Surface Traverses of Mars and Moon: Science Objectives, Payloads, Operations

L. D. Jaffe and R. Choate (TRW Systems Group)

J. Spacecraft Rockets, Vol. 11, No. 6, pp. 353–354, June 1974

This synoptic of a full paper provides an initial evaluation of science aspects of a long traverse mission across the surface of Mars or the Moon, using a remotely-controlled roving vehicle. No mission constraints were imposed, and no attempt was made to define minimum missions.

JERATH, N.

J010 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

For abstract, see Born, G. H.

J011 Viewing Phobos and Deimos for Navigating Mariner 9

T. C. Duxbury, G. H. Born, and N. Jerath

J. Spacecraft Rockets, Vol. 11, No. 4, pp. 215–222, April 1974

For abstract, see Duxbury, T. C.

J012 Mariner IX Optical Navigation Using Mars Lit Limb

N. Jerath and H. Ohtakay

J. Spacecraft Rockets, Vol. 11, No. 7, pp. 505–511, July 1974

Optical spacecraft navigation data, i.e., the lit limb TV image of Mars, acquired during the approach phase of the Mariner Mars 1971 spacecraft to Mars, has been successfully demonstrated to augment the radio spacecraft tracking data. Accurate in-flight calibration of the TV instrument and the scan platform was performed by referencing stars and planets. Simulated real-time processing and the detailed postflight analyses of the onboard optical data have shown that planet limb data is an important data source in a far-encounter period for which other types of onboard optical measurements, e.g., natural satellite(s) of the target planet with star background, may not be available.

JET PROPULSION LABORATORY

J013 Proceedings of the Workshop on Photovoltaic Conversion of Solar Energy for Terrestrial Applications (Held at Cherry Hill, New Jersey, October 23–25, 1973): Working Group and Panel Reports

Jet Propulsion Laboratory

Special Publication 43-3, Vol. I, April 1974

The Workshop on Photovoltaic Conversion of Solar Energy for Terrestrial Applications, organized by JPL, was held in Cherry Hill, New Jersey on October 23–25, 1973, under the sponsorship of the National Science Foundation (NSF)–Research Applied to National Needs program (Grant No. AG-485). The meeting was called in recognition of the pressing need for the exchange of information among researchers in this field and to promote a dialogue between the researchers on the one hand and representatives of manufacturing, marketing, government, and utilities on the other. Considerable effort was devoted to obtaining participation from a broad representation of the manufacturing, marketing, and user fields having an interest in large-scale photovoltaic application for national energy needs. The meeting was also intended to aid NSF in planning resources and in developing reasonable goals and milestones for the photovoltaic program within the constraints of expected funding.

The proceedings of this Photovoltaic Workshop (NSF document NSF-RA-N-74-013) have been published in two volumes. Volume I covers the introductory remarks by NSF, the working group summaries and discussions, and the panel discussions, and includes the agenda for the entire three-day workshop and the list of attendees.

J014 Proceedings of the Workshop on Photovoltaic Conversion of Solar Energy for Terrestrial Applications (Held at Cherry Hill, New Jersey, October 23–25, 1973): Invited Papers

Jet Propulsion Laboratory

Special Publication 43-3, Vol. II, April 1974

The Workshop on Photovoltaic Conversion of Solar Energy for Terrestrial Applications, organized by JPL, was held in Cherry Hill, New Jersey on October 23–25, 1973, under the sponsorship of the National Science Foundation (NSF)–Research Applied to National Needs program (Grant No. AG-485). The meeting was called in recognition of the pressing need for the exchange of information among researchers in this field and to promote a dialogue between the researchers on the one hand

and representatives of manufacturing, marketing, government, and utilities on the other. Considerable effort was devoted to obtaining participation from a broad representation of the manufacturing, marketing, and user fields having an interest in large-scale photovoltaic application for national energy needs. The meeting was also intended to aid NSF in planning resources and in developing reasonable goals and milestones for the photovoltaic program within the constraints of expected funding.

The proceedings of this Photovoltaic Workshop (NSF document NSF-RA-N-74-013) have been published in two volumes. Volume II encompasses the five sessions of technical presentations and discussions. The questions, answers, and comments following each presentation were transcribed as completely as possible from tape recordings, with some editing being employed to improve readability.

J015 The Many Faces of Mars

Jet Propulsion Laboratory

Technical Memorandum 33-654, December 1973

The Mariner Mars 1971 spacecraft was the first to orbit another planet. For 349 days, it transmitted a vast amount of data gathered by its five scientific instruments, including 7300 television pictures. This memorandum presents some of the findings on the characteristics of the surface, atmosphere, and satellites of Mars. Included are surface maps, spectrometric data for the atmosphere, and photographs of the surface, atmosphere, and satellites.

JOHNSON, D. E.

J016 Report of the Two-Station Doppler (VLBI) Demonstration Conducted With Mariner 9

B. D. Mulhall, C. C. Chao, D. E. Johnson, and J. W. Zielenbach

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 27–40, April 15, 1974

For abstract, see Mulhall, B. D.

J017 Results of the Tau/Mu Alternate Ranging Demonstration

B. D. Mulhall, F. Borncamp, and D. E. Johnson

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 27–31, June 15, 1974

For abstract, see Mulhall, B. D.

JOHNSON, E. T.

J018 Metaphase Spread Detection and Focus Using Closed Circuit Television

E. T. Johnson and L. J. Goforth

J. Histochem. Cytochem., Vol. 22, No. 7, pp. 536–545, July 1974

Automatic focus and detection of metaphase chromosome spreads have been implemented in an automated light microscope system and performance has been evaluated. The video signal from a standard closed circuit television camera is used to generate focus quality and spread presence parameters that are input to a computer. The computer, through its operating software, controls lateral and vertical motion of the microscope stage to search the slide for metaphase chromosome spreads and to focus them. The video signal processing required to generate the parameters, its implementation, and the operating software are described. The evaluation of spread detection performance emphasizes the need for well prepared slides with clean backgrounds. The performance of two methods of obtaining a focus parameter is compared. The first method involves measuring the high spatial frequency content of the image; the second method uses the distribution of optical density within the image.

JOHNSON, T. V.

J019 Sodium D-Line Emission From Io: Sputtering and Resonant Scattering Hypothesis

D. L. Matson, T. V. Johnson, and F. P. Fanale

Astrophys. J., Vol. 192, No. 1, Pt. 2, pp. L43–L46, August 15, 1974

For abstract, see Matson, D. L.

J020 Optical Properties of Carbonaceous Chondrites and Their Relationship to Asteroids

T. V. Johnson and F. P. Fanale

J. Geophys. Res., Vol. 78, No. 35, pp. 8507–8518, December 10, 1973

This article presents the diffuse reflectance measurements of nine samples of carbonaceous chondrites (one C1, three C2, four C3, and one C4) and one iron meteorite. Measurements were also made of mineral mixtures in an attempt to understand the causes of some features of the meteorite reflectances. The results of these measurements were compared with current photometry of asteroids. It is concluded that, among materials of known cosmic importance, carbonaceous material appears to provide the best match to the optical properties of some asteroids.

JOHNSTON, A. R.

J021 An Experiment in Manipulator Control with Proximity Sensors

A. R. Johnston

Technical Memorandum 33-678, April 1, 1974

This memorandum describes an experiment in which optical proximity sensors were used in a feedback loop to automatically position a manipulator hand for grasping. The experiment was a simplified one, involving two-dimensional motion only. Two proximity sensors were mounted on the hand, and control signals derived from their outputs were used to drive the hand vertically and horizontally. The sensors employ a pulsed gallium-arsenide light-emitting diode together with a silicon detector. They indicate, without contact, the approximate distance between the manipulator hand and object in the range from 5 to 12 cm. Positioning within approximately ±5 mm was observed. Extension of the technique to general three-dimensional control is briefly discussed.

JOHNSTON, D. W.

J022 DSN Progress Report for November–December 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XIX, pp. 10–22, February 15, 1974

For abstract, see Mudgway, D. J.

J023 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 5–10, August 15, 1974

For abstract, see Mudgway, D. J.

J024 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 15–18, October 15, 1974

For abstract, see Mudgway, D. J.

JONES, D. E.

J025 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

JONES, V. D.

J026 Telemetry and Command Multiple-Mission Software (Model C)

V. D. Jones

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 180–182, August 15, 1974

This article gives the status of the deep space station telemetry and command operational software dedicated to the support of the Pioneer (10 and 11), Helios, Viking Mars 1975, and Extended Mariner Venus/Mercury 1973 missions. New application programs have been written and integrated with the existing executive program. Model C retains the telemetry capabilities of Models A and B, and utilizes the DSN Mark III-74 Command System (command redesign module). Additional functions have been added to support the Viking mission.

J027 An Interrupt Timing Simulation

V. D. Jones and R. L. Schwartz

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 183–189, August 15, 1974

This article describes a timing simulator written in ANSI FORTRAN. The program was developed to aid in the location of timing anomalies in existing interrupt-driven software and to assist in the design of new real-time programs.

JORDAN, J. F.

J028 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

J029 The Determination of the Satellite Orbit of Mariner 9

G. H. Born, E. J. Christensen, A. J. Ferrari, J. F. Jordan, and S. J. Reinbold

Celest. Mech., Vol. 9, No. 3, pp. 395–414, May 1974

For abstract, see Born, G. H.

J030 Application of Sequential Filtering to Estimation of the Interplanetary Orbit of Mariner 9

K. H. Rourke and J. F. Jordan

J. Spacecraft Rockets, Vol. 10, No. 12, pp. 773–778, December 1973

For abstract, see Rourke, K. H.

J031 Testing Relativistic Gravity Theories Using Radio Tracking Data From Planetary Orbiting Spacecraft

J. F. Jordan, W. G. Melbourne, and J. D. Anderson

Space Research XIII, pp. 83–92, Akademie-Verlag, Berlin, 1973

This article presents an analysis of a computational method for determining the numerical values of the relativity and other related dynamical parameters using two-way doppler and ranging data from planet-orbiting spacecraft. The computational method consists of the determination of Earth-planet distance values to 100 ns accuracy from the tracking data and the treatment of these values, along with planetary radar and meridian-circle data, as raw data in a regression analysis to solve for the significant solar-system parameters. The main conclusions of the article are that a 5% determination of the metric parameter β is attainable using a time base that spans both Mariner Mars 1971 and Viking Mars 1975 and includes ground-based radar tracking of Mars. Over the same span γ is determined to at least 1%.

KALABA, R. E.

K001 Inverse Multiple Scattering Problems—II. Limited Information Content of Partially Fitted Planetary Curves With Application to the Venusian Visual Phase Curve

A. L. Fymat and R. E. Kalaba (University of Southern California)

J. Quant. Spectrosc. Radiat. Transfer, Vol. 14, No. 9, pp. 919–933, September 1974

For abstract, see Fymat, A. L.

KATOW, M. S.

K002 A Proposed Method of Reducing the Gravity Distortions of the 64-Meter Antenna Main Reflector

M. S. Katow

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 92–97, October 15, 1974

The surface panels of the 64-m-diameter main reflector at Goldstone are presently set to a prescribed paraboloid for a 45-deg elevation angle. Rotation about the elevation axis to the horizon or zenith introduces additional root-mean-square (rms) distortions due to the change in the direction of the gravity vector with respect to the symmetry axis. This article proposes a method of reducing the humps or bumps over the unyielding "hard" portions of the elevation wheel assembly supporting the reflector structure, thus reducing the rms distortions due to gravity for the structure. The bumps can be effectively removed by controlling the height of the panels above the reflector structure by means of mechanical leverage connections to the elevation motion, thus maintaining the simplicity and reliability of the reflector system. A table of overall rms distortions resulting from the summations of various options is included.

KAULA, W. M.

K003 Lunar Physical Librations and Laser Ranging

J. G. Williams, M. A. Slade, D. H. Eckhardt (Air Force Cambridge Research Laboratories), and W. M. Kaula (University of California, Los Angeles)

The Moon, Vol. 8, No. 4, pp. 469–483, October 1973

For abstract, see Williams, J. G.

KENDALL, J. M.

K004 Wind Tunnel Experiments Relating to Supersonic and Hypersonic Boundary Layer Transition

J. M. Kendall

Preprint 74-133, AIAA Twelfth Aerospace Sciences Meeting, Washington, D.C., January 30–February 1, 1974

Hot-wire anemometry is used to study the origin and growth of "natural" fluctuations in zero-pressure-gradient boundary layers and the location of transition to turbulence for several Mach numbers between 1.6 and 8.5. The importance to transition of certain physical mechanisms is examined through comparison of the fluctuation growth with the sound-forcing and stability theories of Mack. The mechanisms are shown to assume

varying importance in low supersonic, high supersonic and hypersonic regimes. The effect on transition of cone angle of attack, tip heating, and model vibration is mentioned.

KENDALL, W.

K005 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase II

R. T. Woo and W. Kendall

Technical Memorandum 33-702, August 15, 1974

For abstract, see Woo, R. T.

K006 Observations of Small-Scale Turbulence in the Atmosphere of Venus by Mariner 5

R. T. Woo, A. Ishimaru (University of Washington), and W. Kendall (Mark Resources, Inc.)

J. Atmos. Sci., Vol. 31, No. 6, pp. 1698–1706, September 1974

For abstract, see Woo, R. T.

KENT, S. S.

K007 Open-Loop Receiver/Predetection Recording System for the DSN

S. S. Kent and A. G. Slekys

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 139–148, April 15, 1974

This article describes a configuration for recording the telemetry intermediate frequency output of an open-loop receiver and reproducing the data at minimal loss by incorporating a digital time-jitter compensator on playback. Results of tests performed at the JPL Compatibility Test Area in a DSN-compatible environment show a total system degradation of less than 0.5 dB at bit rates as low as 16 bits/s and over a range from −2 to 9 dB.

KERRIN, S. L.

K008 1-Butanol–Hydrogen Chloride: An Allegedly Anhydrous Esterification Reagent

J. P. Hardy, S. L. Kerrin, and S. L. Manatt

J. Org. Chem., Vol. 38, No. 24, pp. 4196–4200, November 1973

For abstract, see Hardy, J. P.

KIEFFER, H. H.

K009 Determination of Particle Sizes in Saturn's Rings From Their Eclipse Cooling and Heating Curves

H. H. Aumann and H. H. Kieffer (University of California, Los Angeles)

Astrophys. J., Vol. 186, No. 1, Pt. 1, pp. 305–311, November 15, 1973

For abstract, see Aumann, H. H.

KIKIN, G. M.

K010 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

For abstract, see Mondt, J. F.

K011 A Homogeneous Heat Pipe Design Code

A. M. Nakashima and G. M. Kikin

Technical Memorandum 33-663, January 15, 1974

For abstract, see Nakashima, A. M.

KIM, J. K.

K012 Photoionization and Ion Cyclotron Resonance Studies of the Reaction of Vibrationally Excited $C_2H_2^+$ Ions With H_2

S. E. Buttrill, Jr., J. K. Kim, W. T. Huntress, Jr., P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 61, No. 5, pp. 2122–2128, September 1, 1974

For abstract, see Buttrill, S. E., Jr.

KLASCIUS, A. F.

K013 Microwave Radiation Hazards Around Large Microwave Antenna

A. F. Klascius

Am. Ind. Hygiene Assoc. J., Vol. 34, No. 3, pp. 97–101, March 1973

The microwave radiation hazards associated with the use of large antennas become increasingly more dangerous to personnel as the transmitters go to ever higher powers. The near-field area is of the greatest concern. It has

spillover from the sub-reflector and reflections from nearby objects. Centimeter waves meeting in phase will reinforce each other and create hot spots of microwave energy. This has been measured in front of and around several 26-m antennas. Hot spots have been found and are going to be the determining factor in delineating safe areas for personnel to work. Better techniques and instruments to measure these fields are needed for the evaluation of hazard areas.

KLEIN, M. J.

K014 Flux-Density Measurements of Selected Radio Sources Relative to Cassiopeia A at 21.84 GHz

M. J. Klein

Astron. J., Vol. 79, No. 2, pp. 139–143, February 1974

This article reports new measurements of the flux-density ratios of seven radio sources relative to Cassiopeia A at 21.84 GHz. Based on the assumption that the flux density of Cassiopeia A was 266.6 flux units at the mean epoch 1971.1, the flux densities of the program sources are given. The DR 21 flux density agrees with the short wavelength flux-density scale proposed by Dent. The fluxes of the other sources are consistent with their extrapolated spectra except Cygnus A, which appears to exhibit a microwave spectrum with greater convex curvature than previously believed.

KLIMASAUSKAS, C. C.

K015 Observations on Microprocessors and Computing Efficiency

C. C. Klimasauskas and J. W. Layland

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 118–124, August 15, 1974

This article presents results of a continuation of a previous study of computing efficiency in DSN-related tasks. The two task models considered here are manipulation of man-readable character-string data, and a very simple process-variable monitoring operation. Several currently available minicomputers and microprocessors are compared. The principal result is that the microprocessors appear considerably more cost-effective than the more powerful machines for simple, repetitive tasks, but that the opposite is true for more complex operations.

KOLBLY, R. B.

K016 X-Band Radar Development

M. A. Gregg and R. B. Kolbly

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 44–48, April 15, 1974

For abstract, see Gregg, M. A.

KOSKELA, P. E.

K017 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

KROGH, F. T.

K018 Efficient Implementation of a Variable Projection Algorithm for Nonlinear Least Squares Problems

F. T. Krogh

Commun. ACM (Association for Computing Machinery, Inc.), Vol. 17, No. 3, pp. 167–169, March 1974

Nonlinear least-squares problems frequently arise for which the variables to be solved for can be separated into a linear and a nonlinear part. A variable projection algorithm has been developed recently which is designed to take advantage of the structure of a problem whose variables separate in this way. This article gives a slightly more efficient and slightly more general version of this algorithm than has appeared previously.

KRUPP, J. A.

K019 Experimental and Theoretical Investigations in Two-Dimensional Transonic Flow

D. J. Collins and J. A. Krupp

AIAA J., Vol. 12, No. 6, pp. 771–778, June 1974

For abstract, see Collins, D. J.

KUPPERMANN, A.

K020 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

KURTZ, D. W.

K021 The Importance of Aerodynamics in the Design of Intra-Urban Trains Traveling in Tunnels

D. W. Kurtz and B. Dayman, Jr.

High Speed Ground Transp. J., Vol. 7, No. 3, pp. 381–399, Fall 1973

Aerodynamics can be a major factor in the design and operation of intraurban subway-train transportation systems. In order to develop an adequate understanding of the aerodynamic characteristics of such systems, an experimental program was carried out. The major portion of the testing was conducted under equilibrium, incompressible conditions so that the fundamental aerodynamic characteristics could be isolated. The effects of geometric parameters (such as train speed, blockage ratio, wall roughness, and train and tunnel length) upon train drag and tunnel flow velocities were determined and compared with a simple theoretical model. The effect of aerodynamic forces upon typical subway-train operations is shown in order to give proper perspective to the importance of aerodynamics.

KWAN, Y. Y.

K022 The Measurement of the Absorption Strengths of Some Lines in the $\nu_1 + \nu_2$ and $\nu_2 + \nu_3$ Bands of Ammonia

J. S. Margolis and Y. Y. Kwan

J. Molec. Spectrosc., Vol. 50, Nos. 1–3, pp. 266–280, March 30, 1974

For abstract, see Margolis, J. S.

K023 Intensities of Rotational Lines in First Overtone Bands for Axially Symmetric Molecules of the Group C_{3v}

Y. Y. Kwan

J. Molec. Spectrosc., Vol. 51, No. 1, pp. 151–159, April 1974

The interaction of vibration and rotation is considered in the computation of the intensities of rotational lines in the first overtone bands of axially symmetric molecules of the group C_{3v}. The calculation utilizes the contact transformation method through first order of approximation as outlined by Hanson and Nielsen. General formulas for the intensities of the lines in the first overtone bands $2\nu_n$ and $2\nu_m$ are obtained, where n and m denote normal modes of species A_1 and E, respectively. It is found that to this order of approximation the usual selection rules are observed for the overtone band $2\nu_n$, but for the overtone band $2\nu_m$, the selection rules are more complicated.

LANDEL, R. F.

L001 On the Phenomenology of Rubberlike Behavior

R. F. Landel and R. F. Fedors

Deformation and Fracture of High Polymers, pp. 131–148, Plenum Publishing Corp., New York, 1973

A simple functional statement of stress–strain response can be used as the basis for a phenomenological investigation of the response, including rupture. Experimental observations on time–temperature or time–chain concentration superposition, time–strain factorizability, and the proportionality of stress with chain concentration can all be invoked to produce a simple, all-encompassing representation of the response. The results turn out to be very similar for all elastomers.

A semiquantitative molecular theory is reviewed which, though incomplete, accounts for much of the response in the rubbery region. Nine molecular parameters are identified. Unsolved problems include the origin and molecular description of the slow relaxation processes associated with entanglements and a molecular theory of finite-strain elastic and viscoelastic response.

L002 Recent Advances in Elastomer Service-Life Prediction

R. F. Landel, R. F. Fedors, and J. Moacanin

Polymeric Materials for Unusual Service Conditions (proceedings of 22nd Applied Polymer Symposia, Ames Research Center, Nov. 29–Dec. 1, 1972), pp. 157–168, John Wiley & Sons, N. Y., 1973

The mechanical properties of an elastomer, including rupture and its time dependence, are defined uniquely by a "tensile property surface" in normalized stress–time coordinates. In practice, the "property surface" is determined from short time constant strain-rate uniaxial tests. By using the time reduction properties of both temperature and crosslink density, an effective time scale of over ten decades of log time can be covered. Changes in crosslink density, filler content, or swelling do not affect the limits of the "property surface" when plotted in logarithmic coordinates but merely shift their positions. The shape, however, may be modified in certain cases.

The service life of an elastomer in the absence of aging reactions can be estimated from the "property surface," especially its limits, along with the knowledge of ex-

pected in-use conditions such as strains (static or dynamic). When an elastomer experiences aging reactions, some of the parameters will change with time in a manner determined by the kinetics of the aging reactions. Consequently, the position of the "property surface" will shift with time. The parameters which are of primary interest are crosslink density and the extent of plasticization (sol fraction, swelling, etc.). This means that the performance of an elastomer can be anticipated from the knowledge of the kinetics of changes of very few parameters.

LANDINI, A. J.

L003 The Availability of Local Aerial Photography in Southern California

W. Allen III, B. Sledge, C. K. Paul, and A. J. Landini (City of Los Angeles)

Special Publication 43-14, December 1, 1974

For abstract, see Allen, W., III

LANE, A. L.

L004 Formation of HO_2^+ by Reaction of Metastable O_2^+ Ions With H_2

J. M. Ajello, W. T. Huntress, Jr., A. L. Lane, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 60, No. 4, pp. 1211–1213, February 15, 1974

For abstract, see Ajello, J. M.

L005 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

LAUDENSLAGER, J. B.

L006 Reactions of Fragment Ions in Methane: Ion–Molecule Reactions in Methane and Helium–Methane Mixtures

W. T. Huntress, Jr., J. B. Laudenslager, and R. F. Pinizzotto, Jr.

Int. J. Mass Spectr. Ion Phys., Vol. 13, No. 4, pp. 331–341, April 1974

For abstract, see Huntress, W. T., Jr.

LAWSON, D. D.

L007 Microbial Abundance and Thermoluminescence of Antarctic Dry Valley Soils

J. D. Ingham, R. E. Cameron, and D. D. Lawson

Soil Sci., Vol. 117, No. 1, pp. 46–57, January 1974

For abstract, see Ingham, J. D.

LAYLAND, J. W.

L008 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

For abstract, see Butman, S.

L009 DSS Test of Sequential Decoding Performance

J. W. Layland

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 69–77, April 15, 1974

This article describes the results to date of a series of one-way tests of the DSN sequential decoding capability, which have been performed at the Cape Kennedy Spacecraft Compatibility/Monitor Station. The tests utilize the Data Decoder Assembly as configured for the Helios formats and data rates, and are aimed principally at establishing the telemetry threshold for the Helios requirement of a 10^{-4} deletions probability.

L010 Observations on Microprocessors and Computing Efficiency

C. C. Klimasauskas and J. W. Layland

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 118–124, August 15, 1974

For abstract, see Klimasauskas, C. C.

L011 Characteristics and Simulated Performance of Short Convolutional Codes: Length 7, Rate 1/3

J. W. Layland

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 52–57, October 15, 1974

This article compares the characteristics and performance of two near-optimal constraint-length 7, rate 1/3 convolutional codes. Performance estimates are based upon software simulations for the additive white Gaussian noise channel.

L012 Buffer Management for Sequential Decoding

J. W. Layland

IEEE Trans. Commun., Vol. COM-22, No. 10, pp. 1685–1690, October 1974

Sequential decoding has been found to be an efficient means of communicating at low undetected error rates from deep space probes, but another failure mechanism known as erasure or computational overflow remains a significant problem. The erasure of a block occurs when the decoder has not finished decoding that block at the time that it must be output. The erasure rate can be unacceptably high even when the decoder is spending over half of its time idly awaiting incoming data. By drawing upon analogies in computer time sharing, this article develops a buffer-management strategy which reduces the decoder idle time to a negligible level, and therefore improves the erasure probability of a sequential decoder. For a decoder with a speed advantage of ten and a buffer size of ten blocks, operating at an erasure rate of 10^{-2}, use of this buffer-management strategy reduces the erasure rate to less than 10^{-4}.

LAZARUS, A. J.

L013 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

LE CROISSETTE, D. H.

L014 Ultrasonic Transmission Measurements on Human Brain Sections

L. S. Fishman (Children's Hospital of Los Angeles), R. C. Heyser, and D. H. Le Croissette

Radiology, Vol. 112, No. 1, pp. 211–213, July 1974

For abstract, see Fishman, L. S.

L015 A New Ultrasonic Imaging System Using Time Delay Spectrometry

R. C. Heyser and D. H. Le Croissette

Ultrasound Med. Biol., Vol. 1, No. 2, pp. 119–131, March 1974

For abstract, see Heyser, R. C.

LEAVITT, R. K.

L016 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

LeBRETON, P. R.

L017 Formation of HO_2^+ by Reaction of Metastable O_2^+ Ions With H_2

J. M. Ajello, W. T. Huntress, Jr., A. L. Lane, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 60, No. 4, pp. 1211–1213, February 15, 1974

For abstract, see Ajello, J. M.

L018 Photoionization and Ion Cyclotron Resonance Studies of the Reaction of Vibrationally Excited $C_2H_2^+$ Ions With H_2

S. E. Buttrill, Jr., J. K. Kim, W. T. Huntress, Jr., P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 61, No. 5, pp. 2122–2128, September 1, 1974

For abstract, see Buttrill, S. E., Jr.

L019 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

LEE, D. H.

L020 Survey of Auxiliary-Propulsion Systems for Communications Satellites

L. B. Holcomb and D. H. Lee (TRW Systems Group)

Communications Satellite Technology (Progr. Astronaut. Aeronaut., Vol. 33), pp. 191–243, 1972

For abstract, see Holcomb, L. B.

LEFLANG, J. G.

L021 Automation of Microwave Configuration Control

J. G. Leflang

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 59–64, June 15, 1974

This article describes hardware being developed for the purpose of permitting computer control of a portion of the Mars Deep Space Station configuration control group. The configuration control group is part of the antenna microwave subsystem.

L022 Automatic Microwave Configuration

J. G. Leflang

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 85–87, December 15, 1974

Work has been completed on the design and fabrication of hardware which provides computer access to the microwave subsystem configuration control group. Testing is nearly complete.

LEGG, A.

L023 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

LEIBOWITZ, L. P.

L024 Jupiter Entry Simulation With the ANAA Shock Tube

L. P. Leibowitz

Preprint 74-610, AIAA Eighth Aerodynamic Testing Conference, Bethesda, Maryland, July 8–10, 1974

An annular-arc-accelerator (ANAA) shock tube has been built which produces shock velocities and pressures that simulate entry into the atmosphere of Jupiter. The ANAA driver deposits the energy of an arc discharge into a flowing gas, which then expands and cools without any delay for the opening of a diaphragm. A flow transducer, trigger system and spark gap switches have been developed to coordinate the flow from a high pressure helium driver with the discharge from a 300-kjoule capacitor bank.

Shock velocities up to 47 km/s have been produced in 1.0 torr of hydrogen with the ANAA shock tube, compared with a 35 km/s velocity produced in a conical arc driver with three times the available energy. Attenuation with the ANAA shock tube is comparable to that of a conical arc driver shock tube and initial spectroscopic measurements indicate that an impurity-free test slug is formed behind the shock wave.

L025 Radiative Relaxation Behind Strong Shock Waves in Hydrogen–Helium Mixtures

L. P. Leibowitz, W. A. Menard, and G. H. Stickford, Jr.

Recent Developments in Shock Tube Research, pp. 306–317, Stanford University Press, Stanford, 1973

This paper investigates radiative-relaxation rates in a series of hydrogen–helium mixtures over a range of temperatures encountered during outer-plant atmospheric

entry. Using a conical electric-arc shock tube, shock waves with velocities between 10 and 36 km/s were studied in mixtures of 10 to 85% hydrogen in helium diluent. Intensities for several hydrogen-continuum wavelengths and the H_α and H_β lines of hydrogen were measured as a function of time. Time resolved measurements of the electron density within the nonequilibrium zone were made by monitoring the growth of the H_β line with a fiber-optics slit system.

The nonequilibrium relaxation times were longer than expected for shock velocities greater than 18 km/s and reached a plateau at higher shock velocities. Data from all mixtures were found to correlate with shock-wave temperature. Numerical calculations of the ionization kinetics and radiation relaxation predict the variation of the experimental data with shock velocity and mixture ratio when the dissociation rate of molecular hydrogen is the same or slower than the ionization rate of hydrogen. Good agreement was found between the electron densities obtained from the H_β line shape measurements and the kinetics calculations.

L026 Development of an Annular Arc Accelerator Shock Tube Driver

L. P. Leibowitz

Recent Developments in Shock Tube Research, pp. 678–689, Stanford University Press, Stanford, 1973

The desire to produce shock velocities of 40 to 60 km/s in hydrogen–helium mixtures has created the need for new and improved shock-tube driver techniques. An annular-arc-accelerator (ANAA) shock-tube driver has been developed that deposits the energy of an arc discharge into a flowing gas, which then expands and cools without any delay for the opening of a diaphragm. A simplified one-dimensional flow analysis of the ANAA shock tube has been performed, which indicates that shock velocities greater than 40 km/s may be obtained using a 300-kjoule capacitor bank.

The ANAA driver consists of a high-pressure driver, an expansion section, and an electrode section. In operation, the cold-gas driver is pressurized until the diaphragm bursts sending a pressure front down the expansion tube to the arc section. When the accelerated flow arrives at the electrode section, a 300-kjoule 100-capacitor bank is discharged either by breaking an insulating diaphragm between the electrodes or by the triggering of a series of external switches. Shock velocities of 28 km/s have been obtained and modifications are described that are expected to improve performance.

LEONDES, C. T.

L027 Sequential Filter Design for Precision Orbit Determination and Physical Constant Refinement

D. W. Curkendall and C. T. Leondes (University of California, Los Angeles)

Celest. Mech., Vol. 8, No. 4, pp. 481–494, January 1974

For abstract, see Curkendall, D. W.

LEOVY, C. B.

L028 Mariner 9 Observations of the Mars North Polar Hood

G. A. Briggs and C. B. Leovy (University of Washington)

Bull. Am. Meteorol. Soc., Vol. 55, No. 4, pp. 278–296, April 1974

For abstract, see Briggs, G. A.

LEPPERT, E. L.

L029 Modal Test of the Viking Orbiter

E. L. Leppert, B. K. Wada, and R. Miyakawa (Martin Marietta Corporation)

Technical Memorandum 33-688, July 15, 1974

A modal test of the Viking Mars 1975 Orbiter Development Test Model (ODTM) has been conducted to verify, or update, the mathematical model used for load analysis. The approach used to assure the quality and validity of the experimental data is defined, the modal test is described, and test results are presented and compared with analysis results. Good correlation between the analyses and the test data assures an acceptable model for incorporation into the mathematical model of the launch system.

LEPPLA, F. B.

L030 System Performance Tests for the Network Control System

F. B. Leppla

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 115–118, June 15, 1974

System performance tests are executed throughout the DSN whenever modifications that may affect system performance are made, and are required for the verification of performance of new equipment and capabilities. The Network Control System is being implemented in three major steps defined as Block I, Block II, and Block III. Each of these Blocks is further broken down into phases. This article describes the system performance tests performed during the implementation and transfer to Opera-

tions of the Network Control System, Block I, Phases 1 and 2.

LESH, J. R.

L031 Verification of Commands From the Transmitting Medium

J. R. Lesh

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 186–189, April 15, 1974

This article describes a system for bit-by-bit verification of Pioneer command modulation by sampling the S-band transmitted signal directly at the antenna. This system was installed at the Mars Deep Space Station and operated flawlessly during the entire 60-day Pioneer 10 encounter sequence.

L032 Sequential Decoding in the Presence of a Noisy Carrier Reference

J. R. Lesh

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 111–124, October 15, 1974

This article describes a new model for predicting the computational performance of a sequential decoder operating in a noisy carrier reference environment. The major difference between this model and previous models is that the new model characterizes the number of computations per frame as the sum of the computations resulting from a number of independent searches. This number of independent searches can then be considered as an effective frame length. When this computational model is averaged over noisy reference phase errors using a medium-rate interpolation scheme, the results are found to agree quite favorably with experimental measurements.

L033 Signal-to-Noise Ratios in Coherent Soft Limiters

J. R. Lesh

IEEE Trans. Commun., Vol. COM-22, No. 6, pp. 803–811, June 1974

Expressions for the output signal-to-noise power ratio of a bandpass soft limiter followed by a coherent detection device are presented and discussed. It is found that a significant improvement in the output signal-to-noise ratio (SNR) at low input SNR's can be achieved by such soft limiters as compared to hard limiters. This indicates that the soft limiter may be of some use in the area of threshold extension. Approximation methods for determining output signal-to-noise spectral densities are also presented.

LEU, R. L.

L034 DSN Progress Report for November–December 1973: X-Band Radar System

R. L. Leu

Technical Report 32-1526, Vol. XIX, pp. 77–81, February 15, 1974

This article describes the development of an X-band radar system which will provide wider bandwidths at increased ranges. This system will be applicable for uplink and downlink communications with future spacecraft.

LEVINE, M. D.

L035 Computer Determination of Depth Maps

M. D. Levine, D. A. O'Handley, and G. M. Yagi

Comput. Graph. Image Process., Vol. 2, No. 2, pp. 131–150, October 1973

The research in support of the integrated robot project at JPL is partially directed towards the problem of visual perception by computer. It is anticipated that the autonomous behavior of the robot will be predicated on the feedback obtained by an analysis of the environment. Thus the robot will be equipped with a pair of identical television cameras which will provide a digitized stereoscopic input. Using the latter, one approach to representing three-dimensional objects in a scene is the depth map. This article describes a computer method for obtaining the depth map which mirrors the detail in the original scene. To this end, an adaptive correlation window is incorporated as an aid in the solution of the correspondence problem. Heuristic strategies based on local context and texture measures have also been invoked. Results are included which demonstrate the success of the technique.

LEVITT, B. K.

L036 DSN Progress Report for November–December 1973: Frame Synchronization Performance Analysis for MVM'73 Uncoded Telemetry Modes

B. K. Levitt

Technical Report 32-1526, Vol. XIX, pp. 126–136, February 15, 1974

This article describes a practical frame-synchronization acquisition and maintenance algorithm based on the Hamming distance metric, which is a generalization of the algorithm developed for the Mariner Venus/Mercury 1973 (MVM'73) mission. For the special case of uncoded phase-shift-keyed data received over the binary symmetric channel, formulas are derived for computing an upper

bound on the probability of false-synchronization acquisition, the mean time to synchronization acquisition and the mean time to the subsequent loss of synchronization, as functions of the bit error rate, frame length, synchronization, word length, and algorithm parameters. These formulas are directly applicable to the uncoded MVM'73 telemetry modes, and a numerical example relating to the 117.6 kilobits/s real time TV mode is included.

L037 Effects of Lognormal Amplitude Fading on Bit Error Probability for Uncoded Binary PSK Signaling

B. K. Levitt and M. Y. Rhee

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 45–54, June 15, 1974

The 1978 Pioneer Venus mission will require direct communication links between the planetary probes and Earth. Data from the Russian spacecraft Venera 4 indicate that these links will be subjected to lognormal fading resulting from atmospheric turbulence. This article analyzes the bit error rate degradation for uncoded binary phase-shift-keyed telemetry in the presence of such fading.

L038 Performance Degradation of Uncoded and Sequentially Decoded PSK Systems Due to Log-Normal Fading

B. K. Levitt

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 58–67, October 15, 1974

The Pioneer Venus 1978 (PV'78) orbiter will dispatch several probes into the planet's atmosphere. The telemetry from these probes will be transmitted directly to Earth as coherent, binary phase-shift-keyed (PSK) uncoded or convolutionally-encoded/sequentially-decoded data. These communication links will be subjected to log-normal fading due to turbulence in the atmosphere of Venus. This article offers a theoretical model for predicting the effects of the channel fading on PV'78 telemetry performance. Because this model considers the effects of a noisy carrier reference on the telemetry performance, it permits the determination of the optimum modulation angle which minimizes the link error rate for a given system. The model predicts that the fading will cause a 1.1 to 1.3 dB increase in the signal-to-noise levels required to achieve a frame deletion rate of 10^{-3} for the PV'78 coded telemetry modes.

L039 Pioneer Venus 1978: Telemetry Performance Predicts

B. K. Levitt

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 51–59, December 15, 1974

The Pioneer Venus 1978 probe-to-Earth telemetry links will be degraded by fading in the atmosphere of Venus. The severity of this fading is characterized by the variance σ_χ^2, where the amplitude fading is represented by the lognormal random variable e^χ. For the convolutionally encoded/sequentially decoded telemetry modes, the link performance depends on σ_χ^2, the total received signal-to-noise ratio P_T/N_0, the modulation index θ, and the decoder computational capacity N. Using nominal values for anticipated system losses, and assuming a maximum deletion rate requirement of 10^{-2} the minimum required P_T/N_0 and optimum θ are profiled as functions of N and σ_χ^2 for the 256-bps large-probe telemetry mode. These predictions are based on a recently developed theoretical model for the combined effects of lognormal fading and noisy carrier reference on sequentially decoded phase-shift-keyed telemetry.

L040 Optimum Frame Synchronization for Biorthogonally Coded Data

B. K. Levitt

IEEE Trans. Commun., Vol. COM-22, No. 8, pp. 1130–1134, August 1974

The optimum procedure for locating a synchronization word periodically inserted in uncoded binary data received over a binary symmetric channel is based on the Hamming or bit-distance metric. This article addresses the corresponding frame-synchronization problem for biorthogonally coded data transmitted over the additive white Gaussian noise channel. For conceptual convenience, the k-bit words from the decoder output are treated as "super symbols" from an alphabet of dimension 2^k. It is argued that the optimum synchronization-word search over the decoded data stream is based on a super-symbol distance rule matched to the properties of the biorthogonally coded transmissions over the noisy channel. An optimum frame-synchronization acquisition algorithm based on this distance rule is formulated, and its performance is investigated. As an example, the performance of this optimum frame-synchronization algorithm is contrasted analytically with that of a Hamming-distance algorithm operating on decoded (32, 6) biorthogonal data, a case of interest to some recent unmanned American space missions.

LEVY, G. S.

L041 A Tracking Polarimeter for Measuring Solar and Ionospheric Faraday Rotation of Signals From Deep Space Probes

J. E. Ohlson (Naval Postgraduate School), G. S. Levy, and C. T. Stelzried

IEEE Trans. Instr. Meas., Vol. IM-23, No. 2, pp. 167–177, June 1974

For abstract, see Ohlson, J. E.

LEVY, R.

L042 Antenna Bias Rigging for Mission-Dependent Performance Objective

R. Levy

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 112–120, April 15, 1974

This article describes a procedure for the computation of the optimum paraboloidal-antenna rigging angle to minimize the expected average-mean-square half-pathlength surface deviations for gravity loading. Statistics of deep space planetary missions are employed to develop weighting factors for antenna elevation angles during these missions. Comparisons for the existing Mars Deep Space Station antenna show that average gain losses from gravity loading can be reduced by 15 to 30% for this antenna by using the optimal rigging angle of approximately 35 degrees rather than the current rigging angle of 45 degrees.

L043 Computer Design of Antenna Reflectors

R. Levy and R. Melosh (Virginia Polytechnic Institute and State University)

J. Struct. Div., Proc. ASCE, Vol. 99, No. ST11, pp. 2269–2285, November 1973

Performance of paraboloidal antenna reflectors is adversely influenced by surface distortions from a perfect paraboloid, which cause pathlength variations of the RF energy beam. The structural design objective for the surface backup structure is to minimize the rms pathlength deviations for gravity loading. Two design approaches are illustrated and applied to sample antenna structure designs. These are a sectional search method and a virtual work/Lagrange multiplier method. Both are shown to provide useful performance improvements. The second method, however, seems to be more capable of rapid design execution and is more readily coded for design automation of large structures. A special purpose in-core version of this program is shown to complete all the design iterations for a moderate-size problem with computation times comparable to those required for single sets of statics loading analyses by general purpose computer programs.

LEWICKI, G.

L044 Laser Recording on MnBi Films

G. Lewicki and J. E. Guisinger

IEEE Trans. Magnetics, Vol. MAG-9, No. 4, pp. 700–704, December 1973

This article describes the results of laser recording experiments in which a magnetic field controls the magnetization distribution along Curie-point-switched, micron-wide tracks. These experiments showed that analog as well as digital information may be recorded in this manner.

LEWIS, R. A.

L045 Autonomous Manipulation on a Robot: Summary of Manipulator Software Functions

R. A. Lewis

Technical Memorandum 33-679, March 15, 1974

This memorandum examines a six-degrees-of-freedom computer-controlled manipulator and derives the relationships between the arm's joint variables and 3-space. Arm trajectories using sequences of third-degree polynomials to describe the time history of each joint variable are presented and two approaches to the avoidance of obstacles are given. The equations of motion for the arm are derived and then decomposed into time-dependent factors and time-independent coefficients. Several new and simplifying relationships among the coefficients are proven; and two sample trajectories are analyzed in detail for purposes of determining the most important contributions to total force in order that relatively simple approximations to the equations of motion can be used.

LI, S. P.

L046 A Measurement Technique of Time-Dependent Dielectric Breakdown in MOS Capacitors

S. P. Li

Microelectron. Reliabil., Vol. 13, No. 3, pp. 209–214, June 1974

The statistical nature of time-dependent dielectric breakdown characteristics in metal-oxide-semiconductor capacitors was evidenced by testing large numbers of capacitors fabricated on single wafers. A multi-point probe and an automatic electronic visual display technique are introduced that will yield statistical results which are necessary for the investigation of temperature, electric field, thermal annealing, and radiation effects in the breakdown characteristics, and an interpretation of the physical mechanisms involved. It is shown that capaci-

tors of area greater than 2×10^{-3} cm^2 may yield worst-case results, and that a multi-point probe of capacitors of smaller sizes can be used to obtain a profile of non-uniformities in the SiO_2 films.

LIECHTI, K.

L047 Experimental Determination of the Principal Moments of Inertia of the Helios Prototype Spacecraft

W. H. Gayman and K. Liechti

Technical Memorandum 33-707, November 15, 1974

For abstract, see Gayman, W. H.

LIESKE, J. H.

L048 A Method of Revitalizing Sampson's Theory of the Galilean Satellites

J. H. Lieske

Astron. Astrophys., Vol. 31, No. 2, pp. 137–150, March 1974

This article describes a method for revitalizing Sampson's theory of motion for Jupiter's Galilean satellites by use of algebraic-manipulation software on a digital computer. The objectives are: (1) to remove algebraic errors existing in the current Sampson theory, (2) to introduce some neglected effects due to solar interactions and the 3–7 commensurability between the outer two satellites, (3) to allow for non-zero amplitude and phase of the libration, (4) to allow future revision of the arbitrary constants of integration, (5) to express the final results as analytic functions of variations in the numerous arbitrary constants of integration and arbitrary parameters, and (6) to provide analytic partial derivatives by means of which one can adjust the numerical values of coefficients in the expressions for the coordinates. The level of precision desired is one arc second (Jovicentric) for the coordinates (2 km, 3.3 km, 5.2 km, and 9.1 km, respectively, for satellites I through IV). The method makes extensive use of algebraic-manipulation computer software capable of handling Poisson series with up to 73 polynomial variables and up to 28 trigonometric arguments in algebraic form.

LIKINS, P. W.

L049 Dynamic Analysis of a System of Hinge-Connected Rigid Bodies With Nonrigid Appendages

P. W. Likins

Technical Report 32-1576, February 1, 1974

Equations of motion are derived for use in simulating a spacecraft or other complex electromechanical system amenable to idealization as a set of hinge-connected rigid bodies of tree topology, with rigid axisymmetric rotors and nonrigid appendages attached to each rigid body in the set. This report provides a complete minimum-dimension formulation suitable for generic programming for digital-computer numerical integration.

L050 Attitude Dynamics Simulation Subroutines for Systems of Hinge-Connected Rigid Bodies

G. E. Fleischer and P. W. Likins

Technical Report 32-1592, May 1, 1974

For abstract, see Fleischer, G. E.

L051 Analytical Dynamics and Nonrigid Spacecraft Simulation

P. W. Likins

Technical Report 32-1593, July 15, 1974

This report contains an exposition of several alternative methods of analytical dynamics, and the application of these methods to alternative models of nonrigid spacecraft. This information permits the comparative evaluation of these methods for spacecraft simulation. Applications to idealized spacecraft are considered both for multiple-rigid-body models and for models consisting of combinations of rigid bodies and elastic bodies, with the elastic bodies being defined either as continua, as finite-element systems, or as a collection of given modal data. Several specific examples are developed in detail by alternative methods of analytical mechanics, and results are compared to a Newton–Euler formulation.

L052 Hybrid-Coordinate Spacecraft Dynamics Using Large-Deformation Modal Coordinates

P. W. Likins

Astronaut. Acta, Vol. 18, No. 5, pp. 331–348, November 1973

For a vehicle amenable to idealization as a set of $n + 1$ rigid bodies interconnected by n line hinges (implying tree topology), a set of minimum-dimension matrix equations of motion is recorded in terms of variables including the relative rotations of contiguous bodies. When a substructure or portion of the vehicle is subjected to large gross deformations but restricted to small strains or local deformations, the n-body model is (for sufficiently large n) assumed to experience small relative rotations of contiguous bodies within the substructure, and the equations of motion are linearized in these variables. The application of coordinate transformations and truncations to the linearized subset of the system equations of

motion then produces a hybrid-coordinate formulation of the problem involving both discrete and distributed coordinates. The resulting equations promise to be much more amenable to stable and efficient numerical integration than are the original discrete-coordinate equations.

LIU, A. S.

L053 DSN Progress Report for November–December 1973: Range Measurements to Pioneer 10 Using the Digitally Controlled Oscillator

A. S. Liu

Technical Report 32-1526, Vol. XIX, pp. 63–70, February 15, 1974

Analysis of the new doppler data from the Mars Deep Space Station using the digitally controlled oscillator (DCO) has established that range measurements to Pioneer 10 can be obtained without the use of a ranging system per se by ramping the carrier frequency with the DCO. The accuracy of these measurements is on the order of 10 km.

L054 Three Topocentric Range Measurements to Pioneer 10 Near Jupiter Encounter and a Preliminary Estimate of an Earth Barycenter to Jupiter Barycenter Distance

A. S. Liu

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 32–40, June 15, 1974

By using ground digitally controlled oscillator (DCO) apparatus installed at the Mars Deep Space Station and Ballima Deep Space Station, ramped carrier frequency doppler data were received from Pioneer 10 just prior to and shortly after Jupiter encounter. The analysis of these DCO doppler data resulted in three independent topocentric range measurements. These range measurements were individually accurate to at least ±5 km. The observed accuracy was 500 m, but because of suspected systematic errors which were masked by the orbit adjustment procedure the actual accuracy was probably worse than 500 m. From the data residuals based on local orbit adjustments, the DCO data were no different from conventional doppler. The data error was on the order of 2 mHz. A longer solution was also attempted, whereby a Jupiter barycenter to Earth barycenter distance was found. The difference between the estimated barycenter-to-barycenter distance and that from the reference planetary ephemeris, Development Ephemeris 84, was −107 km. This difference was not significant because Development Ephemeris 84 has a one standard deviation error of 250 km.

LIVE, D. H.

L055 Metallic Fe Phases in Apollo 16 Fines: Their Origin and Characteristics as Revealed by Electron Spin Resonance Studies

F.-D. Tsay, S. L. Manatt, D. H. Live (California Institute of Technology), and S. I. Chan (California Institute of Technology)

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2751–2761

For abstract, see Tsay, F.-D.

LOBDELL, E. T.

L056 DSN Progress Report for November–December 1973: Network Telemetry System Performance Tests in Support of the MVM'73 Project

R. D. Rey and E. T. Lobdell

Technical Report 32-1526, Vol. XIX, pp. 196–206, February 15, 1974

For abstract, see Rey, R. D.

LOFGREN, C. L.

L057 Development of a Unique Graphite/Epoxy Antenna Subreflector

E. Y. Robinson, R. A. Stonier (Boeing Company Aerospace Group), and C. L. Lofgren (Boeing Company Aerospace Group)

Composite Materials: Testing and Design (Third Conference), Special Technical Publication 546, pp. 632–650, American Society for Testing and Materials, Philadelphia, 1974

For abstract, see Robinson, E. Y.

LORDEN, G.

L058 Cost Effective Spares Provisioning for the Deep Space Network

I. Eisenberger, F. R. Maiocco, and G. Lorden (California Institute of Technology)

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 128–134, April 15, 1974

For abstract, see Eisenberger, I.

L059 A Preliminary Deep Space Station Operational Availability Model

I. Eisenberger, F. R. Maiocco, and
G. Lorden (California Institute of Technology)

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 55–58, June 15, 1974

For abstract, see Eisenberger, I.

LOREMAN, J. R.

L060 DSN Progress Report for November–December 1973: Adjustable Tuner for S-Band High-Power Waveguide

J. R. Loreman

Technical Report 32-1526, Vol. XIX, pp. 169–172, February 15, 1974

As part of an effort to reduce the DSN transmitter backpower at the Mars Deep Space Station (DSS 14), an adjustable S-band waveguide tuner for use at 400 kW has been developed. The tuner will be used to improve the match of the transmitter waveguide to the antenna feed system at DSS 14 in an effort to reduce transmitter backpower at certain operating frequencies caused by a high voltage–standing wave ratio in the feed.

L061 Waveguide Inspection Techniques

J. R. Loreman

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 176–179, August 15, 1974

Because of the demonstrated contribution of certain waveguide internal flaws to system noise and high transmitter back power, an improved inspection is being performed on an S-band waveguide, using a new precision borescope.

LU, J.

L062 A Preliminary Analysis of the Distribution of Energy Usage at Goldstone DSCC

J. Lu

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 137–141, June 15, 1974

A survey has been conducted of energy used for space cooling, space heating, electromechanical and other functions, lighting, and electronics. Results show a preliminary estimated distribution of 46%, 24%, 18%, 6%, and 5%, respectively, for the aforementioned categories. The percentage figure for electromechanical and other functions was derived by elimination. The total primary energy consumption for Fiscal Year 1973 was known prior to undertaking this task.

LYON, R. F.

L063 Convolutional Codes for M-ary Orthogonal and Simplex Channels

R. F. Lyon

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 60–77, December 15, 1974

Convolutional codes chosen for greatest free distance or lowest error probability on a binary channel are not necessarily good codes for an M-ary channel. A rate k/ν coder generates a 2^ν-ary output symbol for each k input bits. If a binary channel is used, the appropriate measure of distance between these symbols is Hamming distance (number of bit disagreements). But if either a 2^ν-ary orthogonal channel, or a 2^ν-ary simplex channel is used, the distance between any two different symbols is unity (number of symbol disagreements). Other distance measures are appropriate on other M-ary channels.

Good rate 1/2 and 1/3 codes have been found by computer search for the orthogonal 4-ary and 8-ary channels. The result is a reduction of error probabilities by about a factor of two below previously tabulated codes. The computer technique used is described. At a fixed constraint length, further performance improvement results from increasing ν, up to a limit at $\nu = K$ (constraint length) on the orthogonal 2^ν-ary channel.

LYTTLETON, R. A.

L064 On the Status of the Rotation of Venus

R. A. Lyttleton

Astrophys. Space Sci., Vol. 26, No. 2, pp. 497–511, February 1974

Owing to its extremely slow rotation, Venus must be regarded as a triaxial body with differences of all three principal moments of inertia comparable in magnitude, thus rendering it a body essentially different from a rapidly rotating planet. The dynamical problem then arises of how such a body, with a rotation-period comparable to its orbital period, would be affected by couples exerted upon it by the gravitational action of the Sun. Equations for the rotational motion are set up in a form suitable for numerical solution by machine-calculations, but the problem so presented can be adequately investigated only for a hypothetical planet with far larger differences of principal moments than could hold for Venus.

Results obtained on this limited basis nevertheless suggest that for Venus the direction of the rotation axis may move almost randomly between the two hemispheres defined by the orbital plane and thus that the present direction near the south celestial pole of the orbit may be only a temporary situation. Order-of-magnitude considerations based on the equations of motion suggest that a time-scale of order 10^7 to 10^8 yr may on the average be required for large changes in the direction of the rotation axis to take place.

MacCONNELL, J. W.

M001 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

For abstract, see Butman, S.

MacDORAN, P. F.

M002 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

M003 DSN Progress Report for November–December 1973: Radio Interferometry Measurements of a 16-km Baseline With 4-cm Precision

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, D. J. Spitzmesser, and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 36–54, February 15, 1974

For abstract, see Thomas, J. B.

MACK, L. M.

M004 On the Application of Linear Stability Theory to the Problem of Supersonic Boundary-Layer Transition

L. M. Mack

Preprint 74-134, AIAA Twelfth Aerospace Sciences Meeting, Washington, D.C., January 30–February 1, 1974

Linear stability theory is used to calculate the amplitude ratio of constant-frequency disturbances as a function of Reynolds number for insulated and cooled-wall flat-plate boundary layers between Mach numbers 1.3 and 5.8. The growth curves are used to examine the consequences of using a fixed amplitude of the most unstable frequency as a transition criterion. The effect of the free-stream Mach number M_1 on insulated-wall boundary layers is calculated with three different assumptions concerning the initial disturbance level A_0: (1) A_0 constant, (2) A_0 proportional to M_1^2, and (3) A_0 proportional to M_1^2 and to the square root of the energy density of the one-dimensional power spectra of free-stream disturbances measured in supersonic wind tunnels.

The shape of the transition Reynolds number R_t vs M_1 curve observed in wind tunnels is closely duplicated with (3), but even with (1) there is a pronounced minimum in R_t near $M_1 = 4$ which points to the minimum as an inherent feature of stability theory. As a second example, the effect of wall cooling at $M_1 = 3.0$ is calculated with assumptions (1) and (3). A much faster increase of R_t with cooling is obtained than is observed experimentally. However, when A_0 is determined from the forced response of the boundary layer to irradiated sound and from the measured free-stream power spectrum, a rise in R_t similar to what is observed is obtained for a certain amplitude criterion.

MACLAY, J. E.

M005 DSN Monitor and Control System

J. E. Maclay

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 5–7, June 15, 1974

The last major upgrade to the DSN Monitor and Control System was during preparation for support of the Mariner Mars 1971 mission. Since then, several improvements have been made, specifically: incremental improvements in the deep space station Monitor and Control Subsystem, implementation by the Block I Network Control System (NCS) Project of the network operations control functions, and implementation by the Block II NCS Project of the design of the Network Control Monitor and Control Subsystem. These changes are described in this article.

MACOMBER, H. L.

M006 California Four Cities Program 1971–1973

H. L. Macomber and J. H. Wilson

Special Publication 43-4, May 15, 1974

A pilot project in aerospace-to-urban technology application, co-sponsored by NASA and the National Science Foundation and managed by JPL, was begun in 1971. Four companies each assigned a senior engineering professional to serve as Science and Technology Advisor in one of four participating city governments. Technical support was provided by the companies and JPL. The four cities, Anaheim, Fresno, Pasadena, and San Jose, California, provided the working environment and general service support. Each city/company team developed and carried out one or more technical or management pilot projects together with a number of less formalized technology efforts and studies. This document provides an account and evaluation of the initial two-year phase of the program, which has been continued and extended.

The initial effort demonstrated the effectiveness of this mode of technology application and communication. The capability of companies and advisors to contribute needed new techniques to urban management, and of cities to use and institutionalize research and development product and methodology, was shown. Specific management methods, software systems, and to a lesser extent advanced hardware were introduced and used.

MADRID, G. A.

M007 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

This report describes the functions of the tracking-system analytic calibration activity for Mariner Mars 1971 (MM'71), its objectives for this and future missions, and the support provided to the MM'71 navigation team during operations. The support functions encompass calibration of tracking data by estimating physical parameters whose uncertainties represent limitations to navigational accuracy, and detailed analysis of the tracking data to uncover and resolve any anomalies. Separate articles treat the activities and results of producing calibrations for the various error sources.

The titles and authors of these articles are:

"The Tracking System Analytic Calibration Activity for Mariner Mars 1971: Its Function and Scope" by G. A. Madrid

"Station Locations" by N. A. Mottinger and J. W. Zielenbach

"Charged Particles" by G. A. Madrid

"The Tropospheric Calibration Model for Mariner Mars 1971" by C. C. Chao

"Time and Polar Motion" by H. F. Fliegel and R. N. Wimberly

"Calibration Effects on Orbit Determination" by G. A. Madrid, F. B. Winn, J. W. Zielenbach, and K. W. Yip

"Polynomial Smoothing of DRIVID Data" by R. K. Leavitt

M008 The Measurement of Dispersive Effects Using the Mariner 10 S- and X-Band Spacecraft to Station Link

G. A. Madrid

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 22–27, August 15, 1974

This article describes the techniques used to measure dispersive effects from radio metric observables taken at S- and X-band frequencies during the Mariner Venus/Mercury 1973 mission. A derivation of the phase and group delay effects is presented based on basic electromagnetic propagation principles and the communication link configuration between the spacecraft and the Mars Deep Space Station.

MAIOCCO, F. R.

M009 Cost Effective Spares Provisioning for the Deep Space Network

I. Eisenberger, F. R. Maiocco, and G. Lorden (California Institute of Technology)

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 128–134, April 15, 1974

For abstract, see Eisenberger, I.

M010 A Preliminary Deep Space Station Operational Availability Model

I. Eisenberger, F. R. Maiocco, and G. Lorden (California Institute of Technology)

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 55–58, June 15, 1974

For abstract, see Eisenberger, I.

MANATT, S. L.

M011 1-Butanol–Hydrogen Chloride: An Allegedly Anhydrous Esterification Reagent

J. P. Hardy, S. L. Kerrin, and S. L. Manatt

J. Org. Chem., Vol. 38, No. 24, pp. 4196–4200, November 1973

For abstract, see Hardy, J. P.

M012 Metallic Fe Phases in Apollo 16 Fines: Their Origin and Characteristics as Revealed by Electron Spin Resonance Studies

F.-D. Tsay, S. L. Manatt, D. H. Live (California Institute of Technology), and S. I. Chan (California Institute of Technology)

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2751–2761

For abstract, see Tsay, F.-D.

MANCINI, R. A.

M013 Data Decoder Assembly Reliability Modifications

R. A. Mancini

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 92–94, June 15, 1974

While the Data Decoder Assembly has met the required goals of the decoding and processing of telemetry data in the DSN, it has exhibited a higher than desired failure rate. These failures were predominately of an intermittent nature and occurred more consistently in the controlling processor, the Interdata Model 4 (ID4) minicomputer. General lack of mechanical rigidity and the electromechanical construction used on the selector channels were determined to be the main contributors to these intermittent failures. These weaknesses in design initiated the bulk of the problems by causing connector contacts to become intermittent during operation. Mechanical redesign of the ID4 front panel hinges and a design for a cabinet strut stiffener were implemented in the DSN. Newer design, more reliable selector channels were purchased and installed in all ID4s in the DSN. These changes significantly reduced the failure rate; however, there still remains a much lower failure rate, the source of which is being investigated.

MAO, H. K.

M014 Visible and Near-Infra-Red Transmission and Reflectance Measurements of the Luna 20 Soil

J. B. Adams (Fairleigh Dickinson University, Virgin Islands), P. M. Bell (Carnegie Institution of Washington), J. E. Conel, H. K. Mao (Carnegie Institution of Washington), T. B. McCord (Massachusetts Institute of Technology), and D. B. Nash

Geochim. Cosmochim. Acta, Vol. 37, No. 4, pp. 731–743, April 1973

For abstract, see Adams, J. B.

MARGOLIS, J. S.

M015 Abundance and Rotational Temperature of Telluric Methane as Determined From the $2\nu_3$ Band

J. S. Margolis, J. V. Martonchik, R. Beer, and R. H. Norton

J. Atmos. Sci., Vol. 31, No. 3, pp. 823–827, April 1974

The rotational temperature of the $2\nu_3$ methane absorptions in the solar/telluric spectrum and the methane abundance in the Earth's atmosphere have been measured and are found to be 243.4 ± 5.3 K and 1.137 ± 0.117 cm-atm (STP) in a vertical column, respectively. The data were reduced using the results of laboratory measurements with proper allowance for the fine-structure of the methane absorption manifolds and the effects of vibration–rotation interaction (which causes an enhancement of the *R*-branch of this band).

M016 The Measurement of the Absorption Strengths of Some Lines in the $\nu_1 + \nu_2$ and $\nu_2 + \nu_3$ Bands of Ammonia

J. S. Margolis and Y. Y. Kwan

J. Molec. Spectrosc., Vol. 50, Nos. 1–3, pp. 266–280, March 30, 1974

The absorption strengths of more than 200 lines in the combination bands $\nu_1 + \nu_2$ (parallel) and $\nu_2 + \nu_3$ (perpendicular) of ammonia at 2.3 μm have been measured, using the curve-of-growth method and an average spectral resolution of 0.05 cm^{-1}. The measurements have been performed at low pressures so that the lines are nearly doppler shaped, thereby reducing the effects of collision broadening. The measured line strengths deviate, to a considerable extent, from those calculated on the basis of a rigid symmetric top model, revealing the effects of vibration–rotation interactions.

Nonlinear least-squares analyses were performed on the observed line strengths, using the intensity formulas derived by Kwan, which include the effects of vibration–rotation interaction up to first order approximation. Values for the intensity parameters were determined from the analysis.

MARSH, E. L.

M017 Attitude Stability of a Flexible Solar Electric Spacecraft: A Parametric Study

E. L. Marsh

J. Spacecraft Rockets, Vol. 11, No. 2, pp. 89–96, February 1974

This article analyzes the influence of large-area solar-array flexibility on the attitude control of a solar–electric spacecraft. The spacecraft consists of a rigid central body, two flexible roll-out solar arrays, and a cluster of three electric-propulsion engines. Each engine has gimballing or translational capacity, or both, for attitude control purposes. A parametric stability study of various spacecraft configurations was made, using hybrid coordinate techniques in an eigenvalue analysis. The variable parameters were solar-array aspect ratio, solar-array first natural frequency, solar-array rotation angle about the yaw axis, and sensor gain factors. Only the first six modes of solar-array vibration were included in the study.

The attitude response characteristics of the various spacecraft configurations were obtained by means of a digital computer simulation program of the system's equations of motion. The feasibility of using the thrusters for attitude control of electric-propulsion spacecraft is demonstrated. It is also shown that although the dynamics effects of large-area, flexible solar arrays can be harmful, changes in the control system parameters can insure stable attitude control.

MARSHALL, J. H.

M018 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

For abstract, see Harrington, T. M.

MARTONCHIK, J. V.

M019 Abundance and Rotational Temperature of Telluric Methane as Determined From the $2\nu_3$ Band

J. S. Margolis, J. V. Martonchik, R. Beer, and R. H. Norton

J. Atmos. Sci., Vol. 31, No. 3, pp. 823–827, April 1974

For abstract, see Margolis, J. S.

MASERJIAN, J.

M020 Tunneling Through Thin MOS Structures: Dependence on Energy ($E - \kappa$)

J. Maserjian and G. Petersson

Appl. Phys. Lett., Vol. 25, No. 1, pp. 50–52, July 1, 1974

The tunneling characteristics of $Cr/SiO_2/Si$ structures in the thickness range 23–34 Å are reported. The $E - \kappa$ dependence in the energy range extending 3.5 eV below the oxide conduction band is determined by the thickness dependence to be approximately of the Franz form with an effective mass ratio of 0.42. Tunneling into the indirect conduction band of silicon is reduced by a thickness-independent factor which decreases approximately exponentially with the energy below the direct band edge.

M021 Saturation Capacitance of Thin Oxide MOS Structures and the Effective Surface Density of States of Silicon

J. Maserjian, G. Petersson (Chalmers University of Technology, Sweden), and C. Svensson (Chalmers University of Technology, Sweden)

Solid-State Electron., Vol. 17, No. 4, pp. 335–339, April 1974

The capacitance vs voltage curve of thin oxide (30–40Å) MOS structures in strong accumulation was studied. The results were interpreted in terms of equivalent surface density of state masses, which was found to be $0.2m_0$ for the silicon valence band and $0.06m_0$ for the conduction band, for both 111 and 100 surfaces. The experimental densities of state masses were shown to be much lower than the bulk values. Equivalent densities of states masses were calculated from a surface quantization model and in this case agreement with the experiments was obtained for the valence band only.

MASSIER, P. F.

M022 Comparison of Results Obtained With Various Sensors Used To Measure Fluctuating Quantities in Jets

S. P. Parthasarathy, P. F. Massier, and R. F. Cuffel

Preprint 73-1043, AIAA Aero-Acoustics Conference, Seattle, Washington, October 15–17, 1973

For abstract, see Parthasarathy, S. P.

MATSON, D. L.

M023 Sodium D-Line Emission From Io: Sputtering and Resonant Scattering Hypothesis

D. L. Matson, T. V. Johnson, and F. P. Fanale

Astrophys. J., Vol. 192, No. 1, Pt. 2, pp. L43–L46, August 15, 1974

This article presents a model which explains the observations of sodium D-line emission from Io. Our model involves: (1) charged-particle sputtering of sodium from Io's surface, (2) ejection of sodium into a cloud surrounding Io, and (3) resonant scattering of incident sunlight. Observational consequences and tests of the proposed model are also discussed.

McALLASTER, J. R.

M024 Evaluation of a Flutter Compensator for DSN Predetection Recording

J. R. McAllaster

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 121–126, December 15, 1974

This article presents and discusses results of evaluation tests conducted on an R&D model digital flutter compensator designed to reduce the effects of flutter, or time-base error, in an instrumentation-quality magnetic tape recorder/reproducer. These tests were conducted using machines exhibiting a wide range of transport-servo stability in an effort to determine the effectiveness of the flutter compensator as a machine-independent device. The flutter compensation technique is potentially useful in the DSN for improving the reproduction capability of the pre-/post-detection recording subsystem.

McCLURE, J. P.

M025 DSN Progress Report for November–December 1973: High-Speed Data Outage Distribution

J. P. McClure

Technical Report 32-1526, Vol. XIX, pp. 161–164, February 15, 1974

The outages experienced on the present Ground Communications Facility 4800-bits/s high-speed data subsystem have been examined. An outage is defined as any interval when 10 or more consecutive high-speed data blocks were received in error or were not received at all. For a 3-month period in 1973, outages ranged from 2.5 s to 4.8 h in length. The median outage was 15 s. Approximately 16% of the outages exceeded 1 min, and only 1.5% exceeded 15 min.

M026 High-Speed Data Block Bursts

J. P. McClure

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 149–153, April 15, 1974

It is well established that ground communications bit errors occur in groups, or bursts. A recent study shows that in 1200-bit high-speed data blocks that contain errors, the errors also tend to occur in groups. A study of these block bursts indicates that single block errors are most common, but that about 10% of the block bursts are composed of seven or more blocks. A significant number of good blocks are contained within these bursts. The single block errors are apparently the result of random happenings, while the longer bursts represent deteriorating circuit conditions.

M027 High-Speed Data Throughput

J. P. McClure

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 74–77, October 15, 1974

A study of inbound high-speed data (HSD) at the JPL Ground Communications Facility over a 25-week period shows an overall throughput of 99.46% from the deep space stations. Of the faulty blocks, 19% contained bit errors and the remaining 81% were either not received or were not recognizable. Throughput performance is plotted on a weekly basis for each station.

M028 4800-bps High-Speed Data Error Statistics

J. P. McClure

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 108–114, December 15, 1974

Analysis of Ground Communications Facility 4800-bps high-speed data error statistics information shows error bursts have a median length of 26 bits, though the range of burst lengths is very wide. Approximately 70% of the bits within a typical burst are error free, and an error block usually contains only one burst. Several burst characteristics are directly related to bit error rate, and there is a small time correlation between errors experienced in opposite directions of transmission.

McCORD, T. B.

M029 Visible and Near-Infra-Red Transmission and Reflectance Measurements of the Luna 20 Soil

J. B. Adams (Fairleigh Dickinson University, Virgin Islands), P. M. Bell (Carnegie Institution of Washington), J. E. Conel, H. K. Mao (Carnegie Institution of Washington), T. B. McCord (Massachusetts Institute of Technology), and D. B. Nash

Geochim. Cosmochim. Acta, Vol. 37, No. 4, pp. 731–743, April 1973

For abstract, see Adams, J. B.

McDANELL, J. P.

M030 Terminal Navigation Analysis for the 1980 Comet Encke Slow Flyby Mission

R. A. Jacobson, J. P. McDanell, and G. C. Rinker

J. Spacecraft Rockets, Vol. 11, No. 8, pp. 590–596, August 1974

For abstract, see Jacobson, R. A.

McELIECE, R. J.

M031 On DSN Antenna Scheduling

L. H. Harper, R. J. McEliece, and A. M. Odlyzko

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 53–56, April 15, 1974

For abstract, see Harper, L. H.

M032 The Ultimate Limits of Binary Coding for a Wideband Gaussian Channel

S. Butman and R. J. McEliece

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 78–80, August 15, 1974

For abstract, see Butman, S.

M033 Forward Error Correction for the Ground Communications Facility?

O. H. Adeyemi and R. J. McEliece

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 114–117, August 15, 1974

For abstract, see Adeyemi, O. H.

McGLINCHEY, L. F.

M034 Viking Orbiter 1975 Thrust Vector Control System Accuracy

L. F. McGlinchey

Technical Memorandum 33-703, October 15, 1974

The purpose of the Viking Mars 1975 Orbiter Thrust Vector Control (TVC) System is to point the engine thrust at the vehicle center of mass and thus maintain attitude stability during propulsive maneuvers. This is accomplished by mounting the engine in a two-axis gimbal system. The TVC system then controls the pointing of the engine by closed-loop control of two linear actuators which extend or retract and rotate the engine in its gimbal system. The velocity vector ΔV pointing error incurred during a propulsive maneuver is made up of several parts, and the TVC system error is one of these. This error arises because the center of mass and engine thrust are not perfectly aligned.

This memorandum assesses the magnitude of the TVC system portion of the ΔV pointing error and provides simplified and linearized models for predicting its magnitude for the various propulsive maneuvers. The accuracy of the linearized analysis is verified using a detailed nonlinear six-degrees-of-freedom computer simulation.

McLYMAN, C. W. T.

M035 Design Parameters for Toroidal and Bobbin Magnetics

C. W. T. McLyman

Technical Memorandum 33-651, Rev. 1, July 1, 1974

The adoption by NASA of the metric system imposes a requirement on the U.S. transformer designer to convert from the familiar English units to the less familiar metric equivalents. Material is presented to assist in that transition for the field of transformer design and fabrication. The conversion data makes it possible for the designer to obtain a fast and close approximation of significant parameters such as size, weight, and temperature rise. Nomographs are included to provide a close approximation for breadboarding purposes. For greater convenience, derivations of some of the parameters are also presented.

M036 Simplified Cut Core Inductor Design

C. W. T. McLyman

Technical Memorandum 33-697, July 1, 1974

Although filter inductor designers have routinely tended to specify molypermalloy powder cores for use in high-frequency power converters and pulse-width modulated switching regulators, there are significant advantages in specifying C cores and cut toroids fabricated from grain oriented silicon steels which should not be overlooked. Such steel cores can develop flux densities of 1.6 tesla,

with useful linearity to 1.2 tesla, whereas molypermalloy cores carrying dc current have useful flux density capabilities only to about 0.3 tesla. The use of silicon steel cores thus makes it possible to design more compact cores, and therefore inductors of reduced volume, or conversely to provide greater load capacity in inductors of a given volume.

This memorandum presents information which makes it possible to obtain quick and close approximations of significant parameters such as size, weight, and temperature rise for silicon steel cores for breadboarding. Graphs, nomographs, and tables are presented for this purpose, but more complete mathematical derivations of some of the important parameters are also included for a more rigorous treatment.

MELBOURNE, W. G.

M037 Testing Relativistic Gravity Theories Using Radio Tracking Data From Planetary Orbiting Spacecraft

J. F. Jordan, W. G. Melbourne, and J. D. Anderson

Space Research XIII, pp. 83–92, Akademie-Verlag, Berlin, 1973

For abstract, see Jordan, J. F.

MELOSH, R.

M038 Computer Design of Antenna Reflectors

R. Levy and R. Melosh (Virginia Polytechnic Institute and State University)

J. Struct. Div., Proc. ASCE, Vol. 99, No. ST11, pp. 2269–2285, November 1973

For abstract, see Levy, R.

MENARD, W. A.

M039 Radiative Relaxation Behind Strong Shock Waves in Hydrogen–Helium Mixtures

L. P. Leibowitz, W. A. Menard, and G. H. Stickford, Jr.

Recent Developments in Shock Tube Research, pp. 306–317, Stanford University Press, Stanford, 1973

For abstract, see Leibowitz, L. P.

MENICHELLI, V. J.

M040 Thermal Coupling Measurement Method

L. A. Rosenthal (Rutgers University) and V. J. Menichelli

J. Spacecraft Rockets, Vol. 11, No. 5, pp. 282–286, May 1974

For abstract, see Rosenthal, L. A.

MENZIES, R. T.

M041 The Effect of Centrifugal Distortion on CO_2-Laser Frequencies

R. T. Menzies

IEEE J. Quantum Electron., Vol. QE-10, No. 5, pp. 486–489, May 1974

This article presents an analysis of the effects of higher order centrifugal distortion terms on $C^{12}O_2{}^{16}$-laser frequencies. This analysis, coupled with recent high-accuracy measurements of $C^{12}O_2{}^{16}$-laser beat frequencies by Petersen et al. at the National Bureau of Standards, points out the weakness of existing frequency tables for high J lines. Expected values for both H and L centrifugal distortion coefficients are calculated, and J values for which these terms become important are discussed.

M042 Air Pollution: Remote Detection of Several Pollutant Gases With a Laser Heterodyne Radiometer

R. T. Menzies and M. S. Shumate

Science, Vol. 184, No. 4136, pp. 570–572, May 3, 1974

An infrared heterodyne radiometer with a spectral resolution of 0.04 cm^{-1} has been used to remotely detect samples of ozone, sulfur dioxide, ammonia, and ethylene at room temperature, and samples of nitric oxide at 390 K. Each gas was observed in a background of nitrogen or oxygen at atmospheric pressure. Sensitivities to some of these gases are adequate for detection of ambient concentrations as low as a few parts per billion.

METZGER, A. E.

M043 Some Correlations Between Measurements by the Apollo Gamma-Ray Spectrometer and Other Lunar Observations

J. I. Trombka (Goddard Spaceflight Center), J. R. Arnold (University of California, San Diego), R. C. Reedy (University of California, San Diego), L. E. Peterson (University of California, San Diego), and A. E. Metzger

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2847–2853

For abstract, see Trombka, J. I.

M044 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

For abstract, see Harrington, T. M.

MILES, R. F., JR.

M045 A Contemporary View of Systems Engineering

R. F. Miles, Jr.

Technical Memorandum 33-667, January 15, 1974

This memorandum defines the concept of a system, discusses the systems approach, and presents four contemporary examples of the systems approach. It is a condensation and summary of a 1971 lecture series sponsored by the California Institute of Technology and published in *Systems Concepts: Lectures on Contemporary Approaches to Systems*, edited by Ralph F. Miles, Jr., John Wiley, 1973.

M046 Trajectory Selection for the Mariner Jupiter/Saturn 1977 Project

J. S. Dyer and R. F. Miles, Jr.

Technical Memorandum 33-706, October 15, 1974

For abstract, see Dyer, J. S.

MILLER, R. B.

M047 DSN Progress Report for November–December 1973: Pioneer 10 and 11 Mission Support

R. B. Miller

Technical Report 32-1526, Vol. XIX, pp. 23–24, February 15, 1974

This article describes significant aspects of the successful Pioneer 10 encounter of the planet Jupiter. The extensive role of the ground support system is emphasized.

M048 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 17–19, April 15, 1974

The current Pioneer Venus 1978 mission concept provides for a two-spacecraft mission with both launches during the 1978 Venus opportunity. One spacecraft will consist of a bus and four probes which will all enter the atmosphere of Venus. The second spacecraft will use the same basic bus but with the probes replaced by a propulsion package sufficient for achieving an orbit around Venus with a life in orbit of seven months or one Venusian year. This article is an introduction of the current DSN concept of supporting the telemetry for the probe mission.

M049 Pioneer 10 and 11 Mission Support

R. B. Miller

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 12–17, June 15, 1974

In an effort to simplify the Ground Data System for Pioneer Operations, the Ames Research Center initiated activity to implement a Direct Interface between the Pioneer Mission Operations Control Center and the deep space stations of the DSN. This article describes the functional requirements, detailed design, and implementation of the Direct Interface.

M050 Pioneer 10 and 11 Mission Support

R. B. Miller

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 11–15, August 15, 1974

Pioneers 10 and 11 continue to function normally and return new information on the interplanetary medium beyond the orbit of Mars. This article describes the current state of the Pioneer 10 and 11 missions, including discussions on significant events since Pioneer 10 Jupiter encounter, possible upgrading of communications capabilities for future Pioneer 10 and 11 operations, and the nature of the Pioneer 11 Saturn trajectory.

M051 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 37–40, October 15, 1974

The Pioneer Venus 1978 Project will consist of two missions: an orbiter mission and a multiprobe mission. The multiprobe mission will be made up of a bus, one large probe, and three small probes, all five of which will enter the Venusian atmosphere. This article describes the

physical characteristics, the science payload, and the telecommunications design of the multiprobe mission.

M052 Pioneer 10 and 11 Mission Support

R. B. Miller

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 35–39, December 15, 1974

This article describes preparations for the Pioneer 11 Jupiter encounter, including changes in the DSN implementation from that used for the Pioneer 10 encounter. The reliability of the Ground Data System with respect to commanding the spacecraft is discussed.

M053 Tracking and Data System Support for the Pioneer Project: Pioneers 6–9. Extended Missions: July 1, 1972–July 1, 1973

R. B. Miller

Technical Memorandum 33-426, Vol. XII, March 1, 1974

The Tracking and Data System supported the deep-space phases of the Pioneer 6, 7, 8, and 9 missions, with two spacecraft in an inward trajectory and two spacecraft in an outward trajectory from the Earth in heliocentric orbits. During the period covered in this memorandum, scientific instruments aboard each of the spacecraft continued to register information relative to interplanetary particles and fields, and radio metric data generated by the network continued to improve our knowledge of the celestial mechanics of the solar system. In addition to network support activity detail, network performance and special support activities are covered.

MINER, E. D.

M054 Preliminary Infrared Radiometry of Venus From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), and G. Neugebauer (California Institute of Technology)

Science, Vol. 183, No. 4131, pp. 1291–1292, March 29, 1974

For abstract, see Chase, S. C., Jr.

M055 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

For abstract, see Chase, S. C., Jr.

MITCHELL, R. T.

M056 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

MIYAKAWA, R.

M057 Modal Test of the Viking Orbiter

E. L. Leppert, B. K. Wada, and R. Miyakawa (Martin Marietta Corporation)

Technical Memorandum 33-688, July 15, 1974

For abstract, see Leppert, E. L.

MOACANIN, J.

M058 Recent Advances in Elastomer Service-Life Prediction

R. F. Landel, R. F. Fedors, and J. Moacanin

Polymeric Materials for Unusual Service Conditions (proceedings of 22nd Applied Polymer Symposia, Ames Research Center, Nov. 29–Dec. 1, 1972), pp. 157–168, John Wiley & Sons, N. Y., 1973

For abstract, see Landel, R. F.

MOHAN, S. N.

M059 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

For abstract, see Born, G. H.

MONAHAN, K. M.

M060 Optical Properties of Mercury Ion Thruster Exhausts and Implications for Science Instruments

K. M. Monahan and R. Goldstein

Technical Memorandum 33-711, December 1, 1974

Emission from the exhaust plume of a 30-cm mercury ion thruster was measured with spectral range 160 to 600 nm as a function of axial and radial distance from the thruster discharge chamber. The spectrally dispersed absolute intensities were used to construct an empirical volume emission rate function. The function was integrated along a typical instrument field of view, and the resulting apparent brightness was compared with instrument sensitivities to evaluate the extent of optical interference.

Most of the emitted radiation came from UV lines of excited mercury atoms and ions, with no observable continuum emission. The intensity levels degraded rapidly with distance from the thruster so that optical interference was negligible for fields of view not intercepting the beam axis. The operation of only one instrument, a zodiacal photopolarimeter, was considered incompatible with simultaneous thruster operation.

M061 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

The cross-section for dissociative photoionization of hydrogen by 584-Å radiation has been measured, yielding a value of 5×10^{-20} cm^2. The process can be explained as a transition from the $X^1 \Sigma_g^+$ ground state to a continuum level of the $X^2 \Sigma_g^+$ ionized state of H_2. The branching ratio for proton (H^+) vs molecular ion (H_2^+) production at this energy is 8×10^{-3}. This process is quite likely an important source of protons in the Jovian ionosphere near altitudes where peak ionization rates are found.

MONDT, J. F.

M062 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

This memorandum describes the application of a nuclear-electric propulsion (NEP) stage in the exploration of near-Earth, cometary and planetary space. The NEP stage is powered by a liquid-metal-cooled, fast-spectrum thermionic reactor capable of providing 120 kWe for 20,000 hr. This power is used to drive a number of mercury ion bombardment thrusters with specific impulse in the range of 4000–5000 s. The NEP description, characteristics, and functional requirements are discussed. These requirements are based on a set of five coordinate missions, which are described in detail. These five missions are a representative part of a larger set of missions used as a basis for an advanced propulsion comparison study. Additionally, the NEP stage development plan and test program is outlined and a schedule presented.

M063 Advanced Design Concepts in Nuclear Electric Propulsion

M. L. Peelgren and J. F. Mondt

Technical Memorandum 33-664, August 1, 1974

For abstract, see Peelgren, M. L.

MOORE, D. M.

M064 Lightweight 3.66-Meter-Diameter Conical Mesh Antenna Reflector

D. M. Moore

Technical Memorandum 33-685, June 15, 1974

This memorandum describes a 3.66-m (12-ft) diameter, nonfurlable, conical mesh antenna incorporating the line source feed principle recently developed at JPL. The weight of the mesh reflector and its support structure is 162 N (36.5 lb). An area weighted rms surface deviation of 0.28 mm (0.011 in.) has been obtained. RF performance measurements showed a gain of 48.3 dB at 8.448 GHz, corresponding to an efficiency of 66%.

During the design and development of this antenna, the technology for fabricating large conical membranes of knitted mesh was developed. As part of this technology a FORTRAN computer program, COMESH, was developed which permits the user to predict the surface accuracy of a stretched conical membrane.

MOORE, S. F.

M065 Redesign of High-Power Transmitter Control and Indicator Cards

J. R. Paluka and S. F. Moore (Resdel Engineering)

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 41–43, April 15, 1974

For abstract, see Paluka, J. R.

MORRISON, D.

M066 Preliminary Infrared Radiometry of Venus From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), and G. Neugebauer (California Institute of Technology)

Science, Vol. 183, No. 4131, pp. 1291–1292, March 29, 1974

For abstract, see Chase, S. C., Jr.

M067 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

For abstract, see Chase, S. C., Jr.

MOTTINGER, N. A.

M068 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

M069 Resolution of an Inconsistency in Deep Space Station Longitude Solutions

K. H. Rourke and N. A. Mottinger

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 132–143, December 15, 1974

For abstract, see Rourke, K. H.

MOYD, K.

M070 FORTRAN Implementation of Tutorial Input

K. Moyd

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 88–99, December 15, 1974

This article describes the FORTRAN implementation of "Tutorial Input," a computer/human interface for real-time control programs. The emphasis is on the communication between the standardized input routine and a real-time FORTRAN control program. Changes made to the Tutorial Input specifications are explained, and samples of the use of this implementation are given.

MUDGWAY, D. J.

M071 DSN Progress Report for November–December 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XIX, pp. 10–22, February 15, 1974

This article describes the Network Operations Plan for Viking Mars 1975 and includes some DSN support requirements unique to Viking which have resulted in unusual attention to deep space station hardware-failure-mode configurations. Samples of the single point failure strategies incorporated in the Viking Mars 1975 deep space station telemetry hardware configurations are discussed, and the rationale for the implementation of 100-kW transmitter capability at the Ballima Deep Space Station and the Robledo Deep Space Station (DSSs 43 and 63) is given.

M072 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 5–10, August 15, 1974

As part of the activity for preparing the DSN for support of the Viking mission, it is planned to conduct a series of tests in which multiple data streams are passed between the deep space stations (DSSs) and the Viking Mission Control and Computing Center (VMCCC). The data streams simulate real data types and data rates, and are handled by all the hardware and software in the DSN and VMCCC in exactly the same way as the real data. The performance of the DSN and VMCCC in generating, handling, and processing these data is a measure of the readiness of the entire Ground Data System to enter live mission support. The first series of these tests has recently been run between the Compatibility Test Area

(CTA 21) and the VMCCC, and the results are reported in this article.

M073 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 15–18, October 15, 1974

In a previous article the basis for integration and data systems testing between the Compatibility Test Area (CTA 21) and the Viking Mission Control and Computing Center (VMCCC) was given, and the first eleven of these tests were described. This article describes the concluding tests in the system integration series and the results of a series of five data system compatibility tests. These tests provide an end-to-end verification of the integrity of the Ground Data System under typical mission loading conditions. Starting with the modulated RF carriers input to CTA 21, the data are sequentially processed through the station, passed across the Ground Communications Facility to VMCCC and finally displayed in the Mission Support Areas. For several of these tests, maximum data loading conditions were established which included six simultaneous telemetry data streams, two command streams, one monitor, and one tracking data stream.

MULHALL, B. D.

M074 Report of the Two-Station Doppler (VLBI) Demonstration Conducted With Mariner 9

B. D. Mulhall, C. C. Chao, D. E. Johnson, and J. W. Zielenbach

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 27–40, April 15, 1974

The Mariner Mars 1971 spacecraft was simultaneously tracked by the Echo Deep Space Station at the Goldstone Deep Space Communications Complex and the Woomera Deep Space Station (no longer operational) during the month and a half prior to Mars encounter. The doppler data obtained were generated using hydrogen masers in the frequency and timing system. The benefits gained by tracking with two stations simultaneously and the difficulties encountered in processing the data are described. The results indicate that it is necessary to difference the two-way and three-way doppler explicitly if batch-filtering is to be employed when there is significant process noise related to the spacecraft. The results, though promising, are not as conclusive as might be hoped for due to the limited amount of data.

M075 Results of the Tau/Mu Alternate Ranging Demonstration

B. D. Mulhall, F. Borncamp, and D. E. Johnson

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 27–31, June 15, 1974

On August 14, 1971, an experiment to determine the relative accuracies of the Tau ranging machine and the Mu ranging machine was performed at the Goldstone Deep Space Communications Complex. This article describes results of this demonstration in which the two ranging measurements agreed to 7.925 ns over the pass.

MULLER, P. M.

M076 Lunar Gravity: Apollo 15 Doppler Radio Tracking

P. M. Muller, W. L. Sjogren, and W. R. Wollenhaupt

The Moon, Vol. 10, No. 2, pp. 195–205, June 1974

New detailed gravity measurements for the Moon were obtained over a 10- to 70-km surface strip from −70 to +70 deg longitude, during low-altitude orbits (≈12 km at periapsis). The trajectory path went over the centers of both Mare Serenitatis and Mare Crisium, providing a complete center gravity profile of two large mascons. Consistent with the previous results for Mare Nectaris and Mare Humorum, both Serenitatis and Crisium mascons are approximately disk-shaped near-surface mass anomalies of net uncompensated loading of 800 kg cm^{-2}. This strengthens Booker's contention that all mascons are approximately the same thickness. Also revealed for the first time are significant positive gravity measurements over mountain ranges—Apennines (near Hadley Mountain) and the Marius Hills. The data suggests that the Apennines have undergone some isostatic compensation, whereas the Marius Hills have not. The crater anomalies detected are all consistently negative as observed before, implying loss of mass from the impact event which formed them.

MÜNCH, G.

M077 Preliminary Infrared Radiometry of Venus From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), and G. Neugebauer (California Institute of Technology)

Science, Vol. 183, No. 4131, pp. 1291–1292, March 29, 1974

For abstract, see Chase, S. C., Jr.

M078 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

For abstract, see Chase, S. C., Jr.

MURPHY, A. J.

M079 The Role of Thermal Contact Resistance in Pyrotechnic Ignition

V. Sernas (Rutgers University) and A. J. Murphy

AIAA Preprint 74-694, AIAA/ASME (American Society of Mechanical Engineers) 1974 Thermophysics and Heat Transfer Conference, Boston, Massachusetts, July 15–17, 1974

For abstract, see Sernas, V.

MURRAY, B. C.

M080 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

The Mariner Venus/Mercury 1973 television cameras imaged the planet Venus in the visible and near ultraviolet for a period of 8 days at resolutions ranging from 100 m to 130 km. The general pattern of the atmospheric circulation in the upper tropospheric/lower stratospheric region is displayed in the pictures. Atmospheric flow is symmetrical between north and south hemispheres. The equatorial motions are zonal (east–west) at approximately 100 m/s, consistent with the previously inferred 4-day retrograde rotation. Angular velocity increases with latitude. The subsolar region, and the region downwind from it, show evidence of large-scale convection that persists in spite of the main zonal motion. Dynamical interaction between the zonal motion and the relatively stationary region of convection is evidenced by bowlike waves.

M081 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

The surface morphology and optical properties of Mercury resemble those of the Moon in remarkable detail and record a very similar sequence of events. Chemical and mineralogical similarity of the outer layers of Mercury and the Moon is implied, but Mercury is probably a differentiated planet with a large iron-rich core. Differentiation is inferred to have occurred very early. No evidence of atmospheric modification of landforms has been found. Large-scale scarps and ridges, unlike lunar or Martian features, may reflect a unique period of planetary compression near the end of heavy bombardment by small planetesimals.

NAKAMURA, Y.

N001 Explosive Propulsion Applications

Y. Nakamura, G. Varsi, and L. H. Back

Technical Memorandum 33-675, April 1, 1974

The feasibility and application of an explosive propulsion concept capable of supporting future unmanned missions in the post-1980 era were examined and recommendations made for advanced technology development tasks. The Venus large lander mission was selected as the first major undertaking in which the explosive propulsion concept can find application. A conceptual design was generated and its performance, weight, costs, and interaction effects with other spacecraft subsystems determined. Comparisons were made with conventional propulsion alternatives, primarily on the basis of performance and spacecraft interaction effects. The results of this study verified the feasibility of the explosive propulsion system for planetology experiments within the dense atmosphere of Venus as well as those of the outer planets. Additionally, it was determined that the Venus large lander mission could be augmented ballistically with significant delivery margin in which added mission capability could be exploited.

NAKASHIMA, A. M.

N002 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

For abstract, see Mondt, J. F.

N003 A Homogeneous Heat Pipe Design Code

A. M. Nakashima and G. M. Kikin

Technical Memorandum 33-663, January 15, 1974

A computer program was developed to facilitate parametric performance evaluation of heat pipes in lightweight heat-rejection systems. This memorandum contains a description of the program along with a user's manual and sample input. The program is limited to the analysis and design of homogeneous wick heat pipes, although an annular-heat-pipe program previously developed is included as part of the heat-pipe-radiator subroutine.

NANCE, H. E.

N004 Short Baseline QVLBI Doppler Demonstrations—Part II

C. C. Chao, R. A. Preston, and H. E. Nance

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 20–26, April 15, 1974

For abstract, see Chao, C. C.

NASH, D. B.

N005 Visible and Near-Infra-Red Transmission and Reflectance Measurements of the Luna 20 Soil

J. B. Adams (Fairleigh Dickinson University, Virgin Islands), P. M. Bell (Carnegie Institution of Washington), J. E. Conel, H. K. Mao (Carnegie Institution of Washington), T. B. McCord (Massachusetts Institute of Technology), and D. B. Nash

Geochim. Cosmochim. Acta, Vol. 37, No. 4, pp. 731–743, April 1973

For abstract, see Adams, J. B.

N006 Spectral Reflectance Systematics for Mixtures of Powdered Hypersthene, Labradorite, and Ilmenite

D. B. Nash and J. E. Conel

J. Geophys. Res., Vol. 79, No. 11, pp. 1615–1621, April 10, 1974

Spectral reflectance measurements in the range 0.4–2.5 μm were made for synthetic powder mixtures of a single set of plagioclase, pyroxene, and ilmenite, which are the principal mineral phase types making up virtually all lunar surface materials studied to date. Binary and ternary data plots of albedo, band depth, and red-to-blue ratios versus mixture composition show how variation in the concentration of each mineral phase in a mixture affects changes in the overall reflectance spectrum of the mixture. Principal mixing effects noted are (1) the disproportionate darkening effect of opaque ilmenites and (2) the persistence, the wavelength stability, and the depth-versus-concentration proportionality of the 1-μm band of pyroxene. These results indicate that by comparing the albedo and band depth of an unknown spectrum with calibration data obtained with laboratory standards one can determine the ratio of crystalline phases in the material producing the spectrum obtained telescopically from small areas on lunar and planetary surfaces.

N007 Vitrification Darkening of Rock Powders: Implications for Optical Properties of the Lunar Surface

D. B. Nash and J. E. Conel

The Moon, Vol. 8, No. 3, pp. 346–364, September 1973

Laboratory experiments show that albedoes as low as those on the Moon can be produced by vacuum vitrification and associated chemical fractionation of ordinary terrestrial basaltic material. Vitrification is established as an unequivocal process that can account for the low albedo and apparent local darkening with age of the lunar surface. The spectral reflectance curves of glass powders are significantly different than those of the parent rock mineralogy; thus, the presence of ubiquitous glass in lunar surface material complicates compositional determinations by interpretation of spectral reflectance curves. Vitrification of rocks on the Moon may highly modify the chemical composition of the resulting glass; thus, glass fragments found in lunar fines cannot be assumed to represent bulk parent-rock material. Progressive impact vitrification of lunar surface material throughout the Moon's history may have led to a fine-grain, opaque, refractory-rich material we call "ultimate glass". This unidentified and, at this point, hypothetical component may exist in dark regolith material; if found, it may be a useful indicator of regolith maturity.

NATHAN, R.

N008 TEM Data Retrieval for Computer Electron Micrograph Processing

H. Alsberg, R. E. Hartman, and R. Nathan

Seminar Proceedings on Optical Instrumentation in Medicine II, Vol. 43, pp. 235–241, Chicago, November 1973

For abstract, see Alsberg, H.

NEUGEBAUER, G.

N009 Preliminary Infrared Radiometry of Venus From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), and G. Neugebauer (California Institute of Technology)

Science, Vol. 183, No. 4131, pp. 1291–1292, March 29, 1974

For abstract, see Chase, S. C., Jr.

N010 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

For abstract, see Chase, S. C., Jr.

NEUGEBAUER, M.

N011 Shock System of February 2, 1969

T. W. J. Unti, M. Neugebauer, and C.-S. Wu (University of Maryland)

J. Geophys. Res., Space Physics, Vol. 78, No. 31, pp. 7237–7256, November 1, 1973

For abstract, see Unti, T. W. J.

N012 Observations of the Internal Structure of the Magnetopause

M. Neugebauer, C. T. Russell (University of California, Los Angeles), and E. J. Smith

J. Geophys. Res., Space Physics, Vol. 79, No. 4, pp. 499–510, February 1, 1974

Magnetic field, plasma flux, and extremely-low-frequency (ELF) wave data have been studied for several encounters of Ogo 5 with the Earth's magnetopause. In one case of a crossing in the near-Earth region of the geomagnetic tail, the structure agreed closely with a simple Chapman–Ferraro type of model with nearly complete neutralization of the charge separation electric field. The proton turning region was 4 times thicker than the electron turning region. The magnetic pressure was linearly related to the ion flux throughout most of the structure; this relation implies that pressure balance was maintained principally by a variation of proton number density across much of the field strength gradient. The computed gas dynamic constant of 0.77 ± 0.23 is in agreement with the value of 0.83 predicted for such cases of aligned flow. This linear relation between B^2 and ion flux was not observed at all of the crossings studied, and other departures from the simple structure were observed at other magnetopause crossings.

NEWTON, J. F.

N013 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

NG, E. W.

N014 A Comparison of Computational Methods and Algorithms for the Complex Gamma Function

E. W. Ng

Technical Memorandum 33-686, May 1, 1974

This memorandum presents a survey and comparison of some computational methods and algorithms for gamma and log-gamma functions of complex arguments. These methods and algorithms, reported recently in the open literature, include Chebyshev approximations, Padé expansion, and Stirling's asymptotic series. The comparison leads to the conclusion that Algorithm 421, published in the *Communications of ACM* by H. Kuki, is the best program either for individual application or for the inclusion in subroutine libraries.

N015 Symbolic Integration of a Class of Algebraic Functions

E. W. Ng

Technical Memorandum 33-713, October 15, 1974

This memorandum presents an algorithm, based on a series of analyses by Carlson, for the symbolic integration of a class of algebraic functions. This class consists of functions made up of rational expressions of an integration variable x and square roots of polynomials, trigonometric and hyperbolic functions of x. The algorithm is made up of four major components: (1) reduction of input integrand to canonical form, (2) intermediate internal representation of integral, (3) classification of output, and (4) reduction and simplification of output to well-known functions.

NISHIMURA, H. G.

N016 DSN Progress Report for November–December 1973: S/X Open-Loop Receiver

H. G. Nishimura

Technical Report 32-1526, Vol. XIX, pp. 71–76, February 15, 1974

An operational DSN S-band receiver having two independent channels was modified to provide a capability for coherent simultaneous reception at S- and X-bands. Coherence at both bands was accomplished by using a base-frequency multiplier which was common to both the S- and X-band local-oscillator multiplier chains.

NORRIS, D. D.

N017 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

NORTON, R. H.

N018 Abundance and Rotational Temperature of Telluric Methane as Determined From the $2\nu_3$ Band

J. S. Margolis, J. V. Martonchik, R. Beer, and R. H. Norton

J. Atmos. Sci., Vol. 31, No. 3, pp. 823–827, April 1974

For abstract, see Margolis, J. S.

NULL, G. W.

N019 Gravity Results From Pioneer 10 Doppler Data

J. D. Anderson, G. W. Null, and S. K. Wong

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3661–3664, September 1, 1974

For abstract, see Anderson, J. D.

O'HANDLEY, D. A.

0001 Computer Determination of Depth Maps

M. D. Levine, D. A. O'Handley, and G. M. Yagi

Comput. Graph. Image Process., Vol. 2, No. 2, pp. 131–150, October 1973

For abstract, see Levine, M. D.

0002 Scene Analysis in Support of a Mars Rover

D. A. O'Handley

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 281–297, December 1973

The NASA/JPL breadboard mobile robot is a test system for developing adaptive, variably autonomous capabilities in support of future missions to the planets. A vision subsystem is a part of this breadboard development. Scene analysis software has been developed and experiments have been conducted in order to segment a scene with irregular objects in it and to develop an algorithmic definition of the scene and relationships in that scene. The results at present have used simulated real-time TV inputs. The scenes which have been used are both contrived and natural. The results presented in this article will form the basis for implementation of the vision software on the mobile robot.

0003 Picture Analysis Applied to Biomedicine

D. A. O'Handley, E. S. Beckenbach, K. R. Castleman, R. H. Selzer, and R. J. Wall

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 417–432, December 1973

The application of digital image-processing techniques to medical problems has been under development at JPL since 1966. The initial research concentrated on medical X-ray films and included: (1) image restoration, i.e., using digital techniques to retrieve information partially lost in the imaging system which generated the pictures, (2) image enhancement to emphasize features or remove useless data, and (3) image mensuration to provide more quantitative measurements and analyses than are available through visual inspection techniques. Research in biomedical image processing has now been expanded to include a system for the automated analysis of images

from light and electron microscopes. The Automated Light Microscope System, around which the chromosome analysis system has been developed, allows direct scanning of specimen images into a computer for subsequent analysis.

The applications of digital image processing to biomedicine at JPL encompass 15 separate research projects. The areas selected for discussion in this article give some indication of the types of picture analysis that are being performed. The current trend in biomedical image processing is toward more human interaction in the research setting.

O'LEARY, B.

0004 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

0005 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

O'NEIL, W. J.

0006 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

This report, divided into six articles, provides a final, comprehensive description of the navigation of the Mariner Mars 1971 spacecraft—the first U.S. spacecraft to orbit another planet. The Mariner 9 navigation function included not only precision flight-path control but also pointing of the spacecraft's scientific instruments mounted on a two-degrees-of-freedom scan platform. To the extent appropriate, each article describes the pre-flight analyses on which the operational strategies and performance predictions were based. The in-flight results are then discussed and compared with the pre-flight predictions. Post-flight analyses, which were primarily concerned with developing a thorough understanding of unexpected in-flight results, are also presented.

The articles and their authors are:

"Introduction," W. J. O'Neil

"Interplanetary Orbit Determination," J. W. Zielenbach, C. H. Acton, G. H. Born, W. G. Breckenridge, C. C. Chao, T. C. Duxbury, D. W. Green, N. Jerath, J. F. Jordan, N. A. Mottinger, S. J. Reinbold, K. H. Rourke, G. L. Sievers, and S. K. Wong

"Satellite Orbit Determination," J. F. Jordan, D. H. Boggs, G. H. Born, E. J. Christensen, A. J. Ferrari, D. W. Green, R. K. Hylkema, S. N. Mohan, S. J. Reinbold, and G. L. Sievers

"Maneuver Analysis," R. T. Mitchell, G. R. Hintz, and G. Preston

"Trajectory Description," W. A. Webb

"Science Sequence Design," P. E. Koskela, W. E. Bollman, J. E. Freeman, M. R. Helton, R. J. Reichert, E. S. Travers, and S. J. Zawacki

O'REILLY, B. D.

0007 An Evaluation of QVLBI OD Analysis of Pioneer 10 Encounter Data in the Presence of Unmodeled Satellite Accelerations

B. D. O'Reilly and C. C. Chao

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 66–77, August 15, 1974

Quasi-very-long-baseline interferometry (QVLBI) has been used to predict Pioneer 10 flyby B-plane coordinates from simultaneous two- and three-way doppler data in the presence of unmodeled accelerations due to the four massive satellites of Jupiter. This article concludes that the QVLBI technique for processing simultaneous two- and three-way doppler data is capable of predicting the encounter to within ~2000 km in the presence of unmodeled accelerations as large as 10^{-8}

km/s^2. Calculations using two-way doppler data alone for the same nominal trajectory and a priori parameter statistics yielded systematic B-plane errors of the order of 100,000 km, with consequently meaningless formal uncertainties.

ODLYZKO, A. M.

0008 On DSN Antenna Scheduling

L. H. Harper, R. J. McEliece, and A. M. Odlyzko

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 53–56, April 15, 1974

For abstract, see Harper, L. H.

OGILVIE, K. W.

0009 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

A fully developed bow shock and magnetosheath were observed by the Mariner Venus/Mercury 1973 spacecraft near Mercury, providing unambiguous evidence for a strong interaction between Mercury and the solar wind. Inside the sheath there is a distinct region analogous to the magnetosphere or magnetotail of Earth, populated by electrons with lower density and higher temperature than the electrons observed in the solar wind or magnetosheath. At the time of encounter, conditions were such that a perpendicular shock was observed on the inbound leg and a parallel shock was observed on the outbound leg of the trajectory, and energetic plasma-electron events were detected upstream from the outbound shock crossing. The interaction is most likely not atmospheric, but the data clearly indicate that the obstacle to solar wind flow is magnetic, either intrinsic or induced. The particle fluxes and energy spectra showed large variations while the spacecraft was inside the magnetosphere, and these variations could be either spatial or temporal.

OHLSON, J. E.

0010 A Tracking Polarimeter for Measuring Solar and Ionospheric Faraday Rotation of Signals From Deep Space Probes

J. E. Ohlson (Naval Postgraduate School), G. S. Levy, and C. T. Stelzried

IEEE Trans. Instr. Meas., Vol. IM-23, No. 2, pp. 167–177, June 1974

A tracking polarimeter implemented on the 64-m-diameter NASA/JPL paraboloid antenna at Goldstone, Calif., is described. Its performance is analyzed and compared with measurements. The system was developed to measure Faraday rotation in the solar corona of the telemetry carrier from the Pioneer 6 spacecraft as it was occulted by the sun. It also measures rotation in the Earth's ionosphere and provides an accurate method of determining spacecraft orientation. The new feature of this system is its use of a pair of quarter-wave plates to allow the synthesis of a rotating feed system, while requiring the rotation of only a single section of waveguide. Since the polarization sensing is done at RF and the receiver operates essentially as a null detector, the system's accuracy is superior to other polarization tracking schemes. In addition, the antenna size and maser preamplifier provide unsurpassed sensitivity. The associated instrumentation used in the Pioneer 6 experiment is also described.

OHTAKAY, H.

0011 Mariner Mars 1971 Optical Navigation Demonstration Final Report

G. H. Born, T. C. Duxbury, W. G. Breckenridge, C. H. Acton, Jr., S. N. Mohan, N. Jerath, and H. Ohtakay

Technical Memorandum 33-683, April 15, 1974

For abstract, see Born, G. H.

0012 Mariner IX Optical Navigation Using Mars Lit Limb

N. Jerath and H. Ohtakay

J. Spacecraft Rockets, Vol. 11, No. 7, pp. 505–511, July 1974

For abstract, see Jerath, N.

ONDRASIK, V. J.

0013 Orbit Determination Capability Analysis for the Mariner-Jupiter-Saturn 1977 Mission

G. A. Ransford, C. E. Hildebrand, and V. J. Ondrasik

J. Spacecraft Rockets, Vol. 11, No. 9, pp. 658–663, September 1974

For abstract, see Ransford, G. A.

ORMONDE, S.

0014 Quantum-Mechanical and Experimental Study of the Excitation of the 2 ^{1}P State of He by Electron Impact at 29–40 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, W. Williams, S. Ormonde (Quantum Systems, Inc.), and B. Torres (Quantum Systems, Inc.)

Phys. Rev., Pt. A: Gen. Phys., Vol. 8, No. 5, pp. 2475–2482, November 1973

For abstract, see Truhlar, D. G.

OSBORN, G. R.

0015 Planetary Ranging Operational Software

G. R. Osborn

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 87–91, June 15, 1974

The Planetary Ranging Operational Program is now in use at the Echo Deep Space Station, Ballima Deep Space Station, and Rio Cofio Deep Space Station. It provides ranging capability to several AU. The program also monitors changes in the charged particle density due to diurnal variations in Earth's ionosphere and solar outbursts. The charged particle measurement is used to correct the doppler data. Both outputs contribute to the more precise orbit determination required for multiple-encounter and orbiter missions.

0016 Continuous Spectrum Planetary Ranging Operational Software

G. R. Osborn

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 127–131, December 15, 1974

The Planetary Ranging Operational Software has been expanded to provide continuous spectrum ranging in addition to the already existing discrete spectrum mode. The new functions are considered in this article.

OTOSHI, T. Y.

0017 S/X Experiment: A New Configuration for Ground System Range Calibrations With the Zero Delay Device

T. Y. Otoshi and C. T. Stelzried

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 57–63, April 15, 1974

This article describes a new configuration for ground system range calibrations with the zero-delay device (ZDD) which was recently implemented at the Mars Deep Space Station for the S/X-band experiment. In this new configuration, the original ZDD horns and associated air paths are eliminated. The uplink test signal is now coupled out of the transmitter waveguide path and brought directly to the ZDD by calibrated cables of known delays. The downlink signals generated by the ZDD are injected directly into the masers via calibrated cables and waveguide couplers. Preliminary tests on the new system indicate that, in the absence of the air path, the ground system range change as a function of antenna elevation angle is typically less than 3 ns at S-band and X-band.

0018 S/X-Band Experiment: Zero Delay Device Antenna Location

C. T. Stelzried, T. Y. Otoshi, and P. D. Batelaan

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 64–68, April 15, 1974

For abstract, see Stelzried, C. T.

0019 S/X Experiment: DSS 14 Pre- and Post-Track Ranging Calibrations for Mariner 10 Tracking Passes and Associated Problems

T. Y. Otoshi

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 81–89, August 15, 1974

Ground system ranging calibration data for the Mars Deep Space Station are presented for 1974, Day 12 through Day 150. Associated ranging problems are discussed and recommendations for calibration improvements are presented.

0020 S/X Experiment: DSS 14 S/X Ground System Ranging Tests

T. Y. Otoshi and P. D. Batelaan

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 90–100, August 15, 1974

This article presents special ranging test data obtained on the S/X-band ground system at the Mars Deep Space Station. The test data consist of ground system range as functions of (1) uplink 100-kW transmitter power, (2) downlink S- and X-band signal levels, and (3) antenna elevation and azimuth angles via the cable path and via the air path.

0021 S/X Experiment: A Study of the Effects of Ambient Temperature on Ranging Calibrations

T. Y. Otoshi

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 45–51, October 15, 1974

A study has been made of the effects of the outside air temperature at the Mars Deep Space Station on ground system range calibrations. Some correlation was found on range data obtained with the 20-kW transmitter system configuration, but no correlation was found for the 100-kW transmitter system configuration.

0022 S/X-Band Experiment: A Study of the Effects of Multipath on Group Delay

T. Y. Otoshi

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 40–50, December 15, 1974

This article presents an analytical expression for calculating the effects of multipath on group delay. The expression was experimentally verified by tests made at the Telecommunications Development Laboratory using the Mariner Venus/Mercury 1973 Radio Frequency Subsystem, Block 3 receiver, and the Mu 1 ranging machine.

PALUKA, J. R.

P001 Redesign of High-Power Transmitter Control and Indicator Cards

J. R. Paluka and S. F. Moore (Resdel Engineering)

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 41–43, April 15, 1974

This article describes the control and indicator printed-circuit cards used in the DSN high-power transmitter and the high-power X-band radar transmitter which have been redesigned to incorporate short-circuit protection into their outputs. This redesign will increase the overall reliability of these transmitters by eliminating transistor burnouts resulting from shorted interconnection lines, inadvertent shorts while troubleshooting, and other overloads.

PARHAM, O. B.

P002 DSN Progress Report for November–December 1973: The Design and Performance of a Programmed Controller

O. B. Parham

Technical Report 32-1526, Vol. XIX, pp. 105–109, February 15, 1974

A programmed controller has been designed for operation with a noise-adding radiometer (NAR) for the automatic control of certain deep space station functions. These functions include the operation of the NAR, the operation of waveguide switches, and the control of the pointing of the 26-m-diameter antenna. This article describes the design and operation of the programmed controller.

PARKER, R. H.

P003 Jupiter's Radiation Belts and Their Effects on Spacecraft

R. H. Parker, E. L. Divita, and G. Gigas

Technical Memorandum 33-708, October 15, 1974

The effects of electron and proton radiation on spacecraft which will operate in the trapped radiation belts of the planet Jupiter are considered, and the techniques and results of the testing and simulation used in the radiation effects program at JPL are discussed. Available data from the Pioneer 10 encounter of Jupiter are compared with pre-encounter models of the Jupiter radiation belts. The implications that the measured Jovian radiation belts have for future missions are considered.

PARTHASARATHY, S. P.

P004 Comparison of Results Obtained With Various Sensors Used To Measure Fluctuating Quantities in Jets

S. P. Parthasarathy, P. F. Massier, and R. F. Cuffel

Preprint 73-1043, AIAA Aero-Acoustics Conference, Seattle, Washington, October 15–17, 1973

An experimental investigation has been conducted to compare the results obtained with six different instruments that sense fluctuating quantities in free jets. These sensors are typical of those that have recently been used

by various investigators who are engaged in experimental studies of jet noise. Intensity distributions and two-point correlations with space separation and time delay were obtained. The static pressure, density, and velocity fluctuations are well correlated over the entire cross-section of the jet and the cross-correlations persist for several jet diameters along the flow direction. The eddies appear to be flattened in the flow direction by a ratio of 0.4.

P005 Evaluation of Jet Noise Sources by Cross-Correlation of Far Field Microphone Signals

S. P. Parthasarathy

AIAA J., Vol. 12, No. 5, pp. 583–590, May 1974

The objective of this article is the evaluation of the noise sources of jet noise from the far-field measurements. A one-dimensional model is envisioned in which noise sources move along the axis of the jet downstream of the nozzle. The autocorrelation function of the noise sources in the moving frame of reference is a function of time and time delay. A theory is developed for stationary sources and then extended to moving sources. The method of obtaining the autocorrelation through a least-squares inversion method is illustrated for a high-temperature subsonic jet flow. This method can be extended to supersonic flows.

PASSAMANECK, R. S.

P006 Viscous, Radiating Hypersonic Flow About a Blunt Body

R. S. Passamaneck

Technical Memorandum 33-687, May 1, 1974

The viscous, radiating hypersonic flow past an axisymmetric blunt body is analyzed based on the Navier–Stokes equations, plus a radiative equation of transfer derived from the Milne–Eddington differential approximation. The fluid is assumed to be a perfect gas with constant specific heats, a constant Prandtl number of order unity, a viscosity coefficient varying as a power of the temperature, and an absorption coefficient varying as the first power of the density and as a power of the temperature. The gray gas assumption is invoked, thereby making the absorption coefficient independent of the spectral frequency; and limiting forms of the solutions are studied. The method of matched asymptotic expansions is used in the analysis. Various regions of the flow system are described, and their governing equations and characteristics are presented.

PATTERSON, R. E.

P007 Solar Array Study for Solar Electric Propulsion Spacecraft for the Encke Rendezvous Mission

E. A. Sequeira and R. E. Patterson

Technical Memorandum 33-668, February 1, 1974

For abstract, see Sequeira, E. A.

PAUL, C. K.

P008 The Availability of Local Aerial Photography in Southern California

W. Allen III, B. Sledge, C. K. Paul, and A. J. Landini (City of Los Angeles)

Special Publication 43-14, December 1, 1974

For abstract, see Allen, W., III

PEELGREN, M. L.

P009 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

For abstract, see Mondt, J. F.

P010 Advanced Design Concepts in Nuclear Electric Propulsion

M. L. Peelgren and J. F. Mondt

Technical Memorandum 33-664, August 1, 1974

This memorandum represents the final documentation of several conceptual design efforts which were in progress at the time the nuclear propulsion programs were terminated in January 1973. Three major areas of investigation were: (1) design efforts on spacecraft configuration and heat rejection subsystem, (2) high-voltage thermionic reactor concepts, and (3) dual-mode spacecraft configuration study. No conclusions will be drawn since none of the efforts were completed. Rather, the goal is to archive the material in a concise, complete, and logical manner so that it is available for any future developments or application of nuclear thermionic reactor power or nuclear–electric propulsion.

PETERS, C. F.

P011 Accuracy Analysis of the Ephemerides of the Galilean Satellites

C. F. Peters

Astron. J., Vol. 78, No. 9, pp. 951–956, November 1973

Known discrepancies between Sampson's theory and observations of the Galilean satellites produce in-plane errors of about 1200 km. Since the mean longitude is responsible for most of the discrepancy, a simple time correction may be used to significantly reduce these errors. An analysis of the time corrections derived for Sampson's theory concludes that the dominant error in the mean longitudes results from Sampson's definition of time, which was determined by the observations which he used in constructing the theory. Imposition of the libration constraint results in changes to the time corrections which are less than the standard deviation of those quantities. The individual eclipse observational errors are shown to be proportional to the square root of the period. With improved star catalogs, the attainable accuracy of the ephemerides of the Galilean satellites is about 100 km from photographic plates versus about 200 km for eclipse observations.

P012 Table Mountain Satellite Observations: 1971–72

C. F. Peters

Astron. J., Vol. 78, No. 9, pp. 957–958, November 1973

This paper presents reduced photographic plate observations for some of the satellites of Jupiter and Saturn. These observations were taken with the 24-in. (61-cm) reflector at Table Mountain Observatory during 1971–1972.

PETERSON, L. E.

P013 Some Correlations Between Measurements by the Apollo Gamma-Ray Spectrometer and Other Lunar Observations

J. I. Trombka (Goddard Spaceflight Center), J. R. Arnold (University of California, San Diego), R. C. Reedy (University of California, San Diego), L. E. Peterson (University of California, San Diego), and A. E. Metzger

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2847–2853

For abstract, see Trombka, J. I.

P014 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

For abstract, see Harrington, T. M.

PETERSSON, G.

P015 Tunneling Through Thin MOS Structures: Dependence on Energy ($E - \kappa$)

J. Maserjian and G. Petersson

Appl. Phys. Lett., Vol. 25, No. 1, pp. 50–52, July 1, 1974

For abstract, see Maserjian, J.

P016 Saturation Capacitance of Thin Oxide MOS Structures and the Effective Surface Density of States of Silicon

J. Maserjian, G. Petersson (Chalmers University of Technology, Sweden), and C. Svensson (Chalmers University of Technology, Sweden)

Solid-State Electron., Vol. 17, No. 4, pp. 335–339, April 1974

For abstract, see Maserjian, J.

PETRIE, R. G.

P017 NCS Minicomputer Systems Status Report

R. G. Petrie

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 152–159, August 15, 1974

Implementation of the Network Control System (NCS) requires the use of 17 minicomputer systems. The functional requirements for these systems within the NCS are discussed; and details of the minicomputer block diagrams, mechanical configuration, interface characteristics, and software support are presented.

PHILLIPS, R. J.

P018 Techniques in Doppler Gravity Inversion

R. J. Phillips

J. Geophys. Res., Vol. 79, No. 14, pp. 2027–2036, May 10, 1974

The types of doppler gravity data available for local, as opposed to planetwide, geophysical modeling are reviewed. Those gravity fields that are determined dynamically in orbit-determination programs yield a smoothed representation of the local gravity field that may be used for quantitative modeling. An estimate of the difference between smoothed and true fields can be considered as a noise limitation in generating local gravity models. A nonlinear inversion for the geometry, depth, and density of the Mare Serenitatis mascon using an ellipsoidal model yielded a global least-squares minimum in horizontal dimensions, depth, and thickness–density contrast product. It was subsequently found, by using a linear model, that there were an infinite number of solutions corresponding to various combinations of depth and lateral inhomogeneity.

Linear modeling was performed by means of generalized inverse theory. Criteria for constructing the inverse were: (1) casting out eigenvectors that were approximately orthogonal to the data vector and (2) confirming that the model thus generated had a reasonable variance. The solutions found by such techniques were consistent with subsequently obtained higher-resolution data for the boundaries of the Serenitatis mascon as well as the areal distribution of mass. The significance of the eigenvectors of the generalized inverse in terms of resolution and information density is discussed.

P019 The Apollo 17 Lunar Sounder

R. J. Phillips et al.

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2821–2831

The Apollo Lunar Sounder Experiment, a coherent radar operated from lunar orbit during the Apollo 17 mission, had the scientific objectives of mapping lunar subsurface structure, surface profiling, surface imaging, and galactic noise measurement. Representative results from each of the four areas are presented. Subsurface reflections are interpreted in both optically and digitally processed data. Images and profiles yield detailed selenomorphological information, and the preliminary galactic noise results are consistent with earlier measurements by other workers.

Contributors to this article include:

Jet Propulsion Laboratory: R. J. Phillips, W. E. Brown, Jr., R. Jordan, and T. W. Thompson

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U.S. Geological Survey: R. E. Eggleton and G. Schaber

University of Utah: W. J. Peeples, J. R. Ryu, W. R. Sill, and S. H. Ward

PHILLIPS, W. M.

P020 Nuclear Electric Propulsion Stage Requirements and Description

J. F. Mondt, M. L. Peelgren, A. M. Nakashima, T. M. Hsieh, W. M. Phillips, and G. M. Kikin

Technical Memorandum 33-647, August 1, 1974

For abstract, see Mondt, J. F.

PICKERING, W. H.

P021 Stardust on the Bar: Space Fallout in Criminalistics

W. H. Pickering

J. Forensic Sci., Vol. 19, No. 2, pp. 227–232, April 1974

This article describes applications of space technology to forensic sciences, such as criminalistics, toxicology, and medicine. Specific areas covered are: thermoluminescence, used to determine the commonality of origin of evidence materials; film scanning and digital computer processing techniques, used to improve the quality of photographic evidence; automation of crime laboratories; educational interchange between crime laboratories and centers of high technology; and application of systems-management techniques to forensic sciences and the crime problem. Included is a summary of the U.S. space program and its achievements.

PIERCE, S.

P022 Numerical Orbit Integration Efficiency of the Delaunay-Similar Elements

S. Pierce

Technical Memorandum 33-710, October 15, 1974

This memorandum investigates orbit equations with a set of conservative and a set of non-conservative perturbing potentials. Scheifele's Delaunay-similar (DS) formulation of these equations has dependent variables similar to Delaunay's orbital elements with the true anomaly as the independent variable. Efficiency curves of computing cost vs accuracy are constructed for Adams integrators of orders 2 through 15 with several correcting algorithms and for a Runge–Kutta integrator. Considering stability regions, choices are made for the optimally efficient integration modes for the DS elements. Integrating in these modes reduces computing costs for a specified accuracy.

PINIZZOTTO, R. F., JR.

P023 Reactions of Fragment Ions in Methane: Ion–Molecule Reactions in Methane and Helium–Methane Mixtures

W. T. Huntress, Jr., J. B. Laudenslager, and R. F. Pinizzotto, Jr.

Int. J. Mass Spectr. Ion Phys., Vol. 13, No. 4, pp. 331–341, April 1974

For abstract, see Huntress, W. T., Jr.

P024 Product Distributions and Rate Constants for Ion–Molecule Reactions in Water, Hydrogen Sulfide, Ammonia, and Methane

W. T. Huntress, Jr. and R. F. Pinizzotto, Jr.

J. Chem. Phys., Vol. 59, No. 9, pp. 4742–4756, November 1, 1973

For abstract, see Huntress, W. T., Jr.

POTTER, P. D.

P025 DSN Progress Report for November–December 1973: Improved Dichroic Reflector Design for the 64-m Antenna S- and X-Band Feed Systems

P. D. Potter

Technical Report 32-1526, Vol. XIX, pp. 55–62, February 15, 1974

In support of the Mariner Venus/Mercury 1973 (MVM'73) X-band experiment and future Mariner missions, the 64-m-diameter antenna network is being supplied with S- and X-band reflex feed systems. The initial installation, for MVM'73, was implemented at the Mars Deep Space Station and provides satisfactory performance for that mission. The X-band performance of the dichroic reflector is, however, not acceptable for future missions which have more stringent X-band performance requirements. A new dichroic reflector which greatly reduces the X-band ellipticity and noise temperature degradation has been designed. This article reports the theory and experimental performance of this new design.

P026 Shaped Antenna Designs and Performance for 64-m Class DSN Antennas

P. D. Potter

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 92–111, April 15, 1974

Significant DSN antenna performance enhancement is possible through the use of shaped dual-reflector antenna techniques. A detailed study has been performed to optimize configurations for maximum performance. Four designs in the antenna-diameter range of 64 to 72 m were carried out and are reported in this article. Complete performance predictions and mechanical configurations are given.

POWERS, W. F.

P027 Iterative Explicit Guidance for Low Thrust Spaceflight

R. A. Jacobson and W. F. Powers (University of Michigan)

J. Spacecraft Rockets, Vol. 11, No. 7, pp. 494–497, July 1974

For abstract, see Jacobson, R. A.

PRESCOTT, S. N.

P028 Investigation of Pyrotechnic Shock

S. N. Prescott

Proceedings of the Twentieth International Instrumentation Symposium, Albuquerque, New Mexico, May 21–23, 1974, pp. 181–186

The comparative pyrotechnic shock outputs of various electroexplosive release devices have been obtained in tests on an instrumented spacecraft structure. Accelerometer data were recorded and reduced by computer analyses to shock spectra. Correlations were obtained between shock severity and actual degradation or damage to spacecraft equipment.

The spacecraft structure was of semimonocoque construction with longerons and chem-milled shear web skin. There was a simulated electronic chassis attached by the same means that would be used on actual space vehicles. Relays and other circuit components mounted in these boxes were electrically monitored for chatter, transfer, or other shock effects. High-frequency crystal shock accelerometers were mounted on the structure and chassis. Data were obtained on both nearby shock effects, and on the shock transmitted through realistic structural paths. The accelerometer data were recorded on analog tape. The reduction of analog data from the accelerometers to shock spectra was accomplished by digitizing and transforming it by a Fortran program on the Univac 1108 computer. The transformation was assigned a Q value representative of the structure. Both "primary" and "residual" shock spectra were obtained.

PRESTON, R. A.

P029 Short Baseline QVLBI Doppler Demonstrations—Part II

C. C. Chao, R. A. Preston, and H. E. Nance

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 20–26, April 15, 1974

For abstract, see Chao, C. C.

P030 Dual-Spacecraft Radio Metric Tracking

R. A. Preston

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 51–65, August 15, 1974

When two interplanetary spacecraft lie along similar geocentric lines of sight, navigational advantages may be achieved by navigating one spacecraft with respect to the other. Opportunities to employ this technique will become more common: the two Viking spacecraft will be within two degrees of each other for the last seven months of their cruise phase; the two Mariner Jupiter/Saturn 1977 spacecraft will be within three degrees of each other for the last three years of their mission. This article describes the advantages of this technique in both conceptual and mathematical terms and discusses the various data types that might be formulated. The opportunities for testing and utilizing this technique are also outlined.

PRICE, A. L.

P031 Faraday Rotation Experiment

A. L. Price

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 170–175, August 15, 1974

Very high frequency polarimeters, working in conjunction with the Applications Technology Satellites, form a useful tool for monitoring ionospheric weather conditions. This article describes the installation of two such polarimeters at the Venus Deep Space Station.

P032 DSN Research and Technology Support

E. B. Jackson and A. L. Price

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 78–84, December 15, 1974

For abstract, see Jackson, E. B.

PUCHALSKI, M.

P033 Software Modification to the Traceability and Reporting System

M. Puchalski

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 108–114, June 15, 1974

The Traceability and Reporting System (TRS) is a Network Information Control function that stores, maintains, and reports on data collected during each tracking period. This article explains the TRS, the improvements made on the software, and the reasons for the software modifications.

QUINN, R. B.

Q001 Low-Noise Receivers: Microwave Maser Development

R. B. Quinn

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 41–44, October 15, 1974

Low-pass microwave filters have been built and tested in the laboratory and are now ready for installation in the 14.3- to 16.3-GHz traveling-wave maser presently being used on the 64-m-diameter antenna at the Goldstone Deep Space Communications Complex. These filters, when placed in the input and output lines of the traveling-wave maser, will prevent possible calibration errors caused by traveling-wave maser gain changes resulting from pump frequency radiation into the signal waveguides. These filters are matched at the signal frequency of the traveling-wave maser, have low insertion loss, and will operate at 4.5 K; therefore, no significant degradation in system performance should result with their installation.

RANSFORD, G. A.

R001 Orbit Determination Capability Analysis for the Mariner-Jupiter-Saturn 1977 Mission

G. A. Ransford, C. E. Hildebrand, and V. J. Ondrasik

J. Spacecraft Rockets, Vol. 11, No. 9, pp. 658–663, September 1974

Delivering a spacecraft to the outer planets with high precision ($1\sigma \approx 200$ km) and supporting the desired high accuracy instrument pointing near a planetary encounter place great demands on a navigation system. This article describes a combined Earth-based radio tracking/onboard optical data navigation system designed to meet these goals. Some results of applying this navigation system to the preliminary Mariner Jupiter/Saturn 1977 mission trajectories (the Jupiter approach of the JSX-flight and the Saturn approach of the JST-flight) are presented.

It is shown that this system is capable of providing target planet centered orbit determination accuracies in the range of 100 km, and accuracies relative to closely encountered satellites of about 200–250 km, provided there is accurate modeling of the natural satellite motions. Analytical theories of the satellite motions would be attractive from the cost and time usage standpoint as alternatives to numerical integration of the equations of motion. An analytical theory (ignoring the mutual perturbations) is investigated for this role. It is concluded that further development of these theories will have to be undertaken before they can be used for high precision navigation.

RAPER, O. F.

R002 Detection of Nitric Oxide in the Lower Stratosphere

R. A. Toth, C. B. Farmer, R. A. Schindler, O. F. Raper, and P. W. Schaper

Nature Phys. Sci., Vol. 244, No. 131, pp. 7–8, July 2, 1973

For abstract, see Toth, R. A.

R003 Measurement of the Abundance of Several Natural Stratospheric Trace Constituents From High Altitude Aircraft

C. B. Farmer, P. W. Schaper, O. F. Raper, R. A. Schindler, and R. A. Toth

Proceedings of the Second Joint Conference on Sensing of Environmental Pollutants, Washington, D.C., December 10–12, 1973, pp. 9–15

For abstract, see Farmer, C. B.

RASOOL, S. I.

R004 Exploring Jupiter and Its Satellites With an Orbiter

J. C. Beckman, J. R. Hyde, and S. I. Rasool (NASA Office of Space Sciences)

Astronaut. Aeronaut., Vol. 12, No. 9, pp. 24–35, September 1974

For abstract, see Beckman, J. C.

REEDY, G. K.

R005 Microwave Doppler Shift Technique for Determining Solid Propellant Transient Regression Rates

L. D. Strand, A. L. Schultz, and G. K. Reedy

J. Spacecraft Rockets, Vol. 11, No. 2, pp. 75–83, February 1974

For abstract, see Strand, L. D.

REEDY, R. C.

R006 Some Correlations Between Measurements by the Apollo Gamma-Ray Spectrometer and Other Lunar Observations

J. I. Trombka (Goddard Spaceflight Center), J. R. Arnold (University of California, San Diego), R. C. Reedy (University of California, San Diego), L. E. Peterson (University of California, San Diego), and A. E. Metzger

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2847–2853

For abstract, see Trombka, J. I.

REID, M. S.

R007 DSN Progress Report for November–December 1973: Radio Metric Applications of the New Broadband Square Law Detector

R. A. Gardner, C. T. Stelzried, and M. S. Reid

Technical Report 32-1526, Vol. XIX, pp. 89–92, February 15, 1974

For abstract, see Gardner, R. A.

R008 DSN Progress Report for November–December 1973: System Noise Temperature Calibrations of the Research and Development Systems at DSS 14

M. S. Reid and R. A. Gardner

Technical Report 32-1526, Vol. XIX, pp. 100–104, February 15, 1974

This article reports recent precision system-noise-temperature measurements made with the S- and X-band systems as they will be used for the Mariner Venus/Mercury 1973 mission. Elevation and azimuth profiles for both the S-band and X-band systems are also presented. A summary of the zenith system-noise-temperature measurements for calendar year 1973 for the diplexed S-band systems at the Mars Deep Space Station is presented and plotted.

R009 Preliminary S-Band Noise Temperature Statistics at DSS 14 for 1971 and 1972

R. W. D. Booth, M. S. Reid, and T. J. Cullen

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 84–91, April 15, 1974

For abstract, see Booth, R. W. D.

R010 Low-Noise Microwave Receiving Systems in a Worldwide Network of Large Antennas

M. S. Reid, R. C. Clauss, D. A. Bathker, and C. T. Stelzried

Proc. IEEE, Vol. 61, No. 9, pp. 1330–1335, September 1973

The DSN consists of a world-wide network of 26-and 64-m antennas spaced approximately 120 deg apart around the world. The DSN is a precision communication system designed to communicate with and control unmanned spacecraft traveling at interplanetary ranges. The ever increasing complexity and distances of spacecraft missions require that the network capability be kept at the state of the art of telecommunications. To meet this objective, a continuing development program on large antennas, low-noise maser, phase-locked receiving systems, and high-power transmitters has been underway for some years. Recent developments in the performance and evaluation of the antennas and maser receivers are discussed, and developments which have contributed to radio science projects, such as planetary radar astronomy, very long baseline interferometry, pulsar, and other astronomical observations are described. It is also shown how these radio science measurements have been used to evaluate the performance of the antenna-receiver systems.

REINBOLD, S. J.

R011 DSN–MVM'73 S/X Dual-Frequency Doppler Demonstration

F. B. Winn, K. W. Yip, and S. J. Reinbold

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 28–50, August 15, 1974

For abstract, see Winn, F. B.

R012 The Determination of the Satellite Orbit of Mariner 9

G. H. Born, E. J. Christensen, A. J. Ferrari, J. F. Jordan, and S. J. Reinbold

Celest. Mech., Vol. 9, No. 3, pp. 395–414, May 1974

For abstract, see Born, G. H.

REMBAUM, A.

R013 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

Polyether polyurethanes containing positive charges in the backbone or in the side chains were synthesized from commercially available diisocyanates. These cationic polyurethanes were reacted with sodium heparin to yield polyurethane heparin complexes (heparin content: 16%) soluble in specific organic solvent systems. The homogeneous solutions were used to produce thromboresistant coatings on commercial tubing.

R014 Biological Activity of Ionene Polymers

A. Rembaum

Polymeric Materials for Unusual Service Conditions (proceedings of 22nd Applied Polymer Symposia, Ames Research Center, Nov. 29–Dec. 1, 1972), pp. 299–317, John Wiley & Sons, N. Y., 1973

Ionene polymers are polyammonium salts with positive nitrogens in the backbone, resulting from the polycondensation of diamines with dihalides or from the polycondensation of halo amines. The mechanism of formation of ionene polymers of different structures and their biological activity is reviewed. The antimicrobial and antifungal properties are compared with low molecular weight ammonium salts. Ionenes were found to combine with DNA by means of ionic bonds to yield similar complexes to those obtained with polyamines (spermine and spermidine). They also combine with nerve cell receptors and exercise a more powerful and longer duration ganglionic blocking action than their monomeric analogs. The antiheparin activity of ionenes and the thromboresistance of elastomeric ionene heparin coatings is described. The enhanced biological activity of ionenes as compared with low molecular weight compounds is attributed to a co-operative effect of a large number of positive charges on the polymeric chains.

RENZETTI, N. A.

R015 DSN Progress Report for November–December 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XIX, pp. 1–4, February 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

R016 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 1–4, April 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

R017 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 1–4, June 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

R018 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 1–4, August 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

R019 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 1–4, October 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

R020 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 1–4, December 15, 1974

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Instrumentation Facility, the Ground Communications Facility, and the Network Control System are described.

REY, R. D.

R021 DSN Progress Report for November–December 1973: Network Telemetry System Performance Tests in Support of the MVM'73 Project

R. D. Rey and E. T. Lobdell

Technical Report 32-1526, Vol. XIX, pp. 196–206, February 15, 1974

System performance tests are executed throughout the DSN whenever a modification is made to the Network Telemetry System that affects its performance. This arti-

cle describes the telemetry performance tests executed in support of the Mariner Venus/Mercury 1973 Project, the test procedures involved, and the test software. A summary of the test results and the status of the Network Telemetry System are presented.

RHEE, M. Y.

R022 Effects of Lognormal Amplitude Fading on Bit Error Probability for Uncoded Binary PSK Signaling

B. K. Levitt and M. Y. Rhee

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 45–54, June 15, 1974

For abstract, see Levitt, B. K.

RHO, J. H.

R023 Fluorometric Search for Porphyrins in Apollo 15 Exhaust-Contaminated Surface Fines and Deep Drill Cores and Apollo 16 Surface Fines

J. H. Rho, A. J. Bauman, and E. A. Cohen

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 2, pp. 2261–2265

Portions of Apollo 15 surface fines (15013,1) from an area contaminated by landing vehicle exhaust were Soxhlet-extracted with benzene:methanol 3:2 v/v both in air and in argon. Only the argon extract contained a compound (about 1 part per billion) which fluoresced at 660 and 725 nm with maximal excitation at 425 nm, absorbed at 425 nm, and partitioned into benzene in 6 N HCl. Its emission spectrum was porphyrin-like but with a maximum shifted about 50 nm toward the red relative to that of porphyrins. Similarly, argon-extracted cores 15002 (160–200 cm down) and 15001 (200–240 cm down), each 3 g, yielded extracts free of porphyrins, as was also the case for an Apollo 16 surface fines sample 65500,10 (5 g) collected at Station 5.

RICE, R. F.

R024 RM2: Transform Operations

R. F. Rice

Technical Memorandum 33-680, March 1, 1974

This memorandum introduces the two-dimensional transform used in the research TV source encoder, RM2. It is shown that both conceptually and in terms of the number of required computations, the RM2 transform is considerably simpler than the Fast Hadamard Transform. The latter can in fact be generated by extending the RM2 transform.

R025 Channel Coding and Data Compression System Considerations for Efficient Communication of Planetary Imaging Data

R. F. Rice

Technical Memorandum 33-695, June 15, 1974

This memorandum presents end-to-end system considerations involving channel coding and data compression which could drastically improve the efficiency in communicating pictorial information from future planetary spacecraft. In addition to presenting new and potentially significant system considerations, this memorandum attempts to fill a need for a comprehensive tutorial which makes much of this very subject accessible to readers whose disciplines lie outside of communication theory.

R026 Channel Coding and Data Compression System Considerations for Efficient Communication of Planetary Imaging Data

R. F. Rice

Technical Memorandum 33-695, Rev. 1, September 1, 1974

This memorandum presents end-to-end system considerations involving channel coding and data compression which could drastically improve the efficiency in communicating pictorial information from future planetary spacecraft. In addition to presenting new and potentially significant system considerations, this memorandum attempts to fill a need for a comprehensive tutorial which makes much of this very subject accessible to readers whose disciplines lie outside of communication theory.

RIGGINS, M. C.

R027 Portability of the MBASIC Machine-Independent Design

M. C. Riggins

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 100–107, December 15, 1974

Part of the current work of the DSN Software Standards Project concerns the machine-independent design of the MBASIC processor. This article describes a study effort toward a portable implementation of the machine-independent design. The method made use of the STAGE2 portable, general-purpose macro processor, by means of which it was possible to invent a set of seemingly machine-independent macro templates for translation into an arbitrary target assembly language. The conclusions reached by this study are that the macros defined seem to

form an adequate program MBASIC processor design language, that it is possible to carry structured programming concepts to the assembly language level, and that implementation by machine-independent macros may not be quite as efficient as hand coding but may yield significantly lower implementation costs.

RINKER, G. C.

R028 Terminal Navigation Analysis for the 1980 Comet Encke Slow Flyby Mission

R. A. Jacobson, J. P. McDanell, and G. C. Rinker

J. Spacecraft Rockets, Vol. 11, No. 8, pp. 590–596, August 1974

For abstract, see Jacobson, R. A.

ROBERTSON, D. S.

R029 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

ROBINSON, E. Y.

R030 Development of a Unique Graphite/Epoxy Antenna Subreflector

E. Y. Robinson, R. A. Stonier (Boeing Company Aerospace Group), and C. L. Lofgren (Boeing Company Aerospace Group)

Composite Materials: Testing and Design (Third Conference), Special Technical Publication 546, pp. 632–650, American Society for Testing and Materials, Philadelphia, 1974

Advanced concepts for large, furlable space antennas have led to an extensive development program at JPL with configurations utilizing conical main reflectors. The antenna subreflectors for these conical configurations have unusual geometries and new structural requirements. Structural efficiency of the conical antennas is improved through the use of fiber composites and, as part of JPL's development program, a subreflector was designed and fabricated with graphite/epoxy material. This was sized to fit a subscale, 6-ft-diameter model.

The subreflector is a cylindrical paraboloid with demanding criteria for contour surface precision, high thermal stability, and sufficient structural capacity for inertial launch loads in axial and transverse directions (12 to 18 g). In addition, dynamic launch environments impose constraints on allowable natural frequencies. This application presents broad design requirements and novel fabrication constraints. The paper describes the design, analysis, and fabrication of the subreflector.

ROCKWELL, S. T.

R031 A New Angular Tropospheric Refraction Model

A. L. Berman and S. T. Rockwell

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 144–164, December 15, 1974

For abstract, see Berman, A. L.

RODEMICH, E. R.

R032 DSN Progress Report for November–December 1973: Optimal Station Location for Two-Station Tracking

E. R. Rodemich

Technical Report 32-1526, Vol. XIX, pp. 116–121, February 15, 1974

Three tracking stations cannot be placed on the globe to provide total coverage of the celestial sphere, but they can cover all celestial declinations that are less than a fixed amount. Typically, there is a great deal of overlap in the coverage of the celestial sphere, and this overlap can be used for two-station tracking. Since two-station tracking improves doppler and tracking data and provides interferometric data, tracking stations should be placed to maximize double coverage of the celestial sphere. This article formulates and solves the problem of the optimal placement of three tracking stations to maximize two-station tracking.

ROGERO, S.

R033 Miniaturized Piezoelectric Transducer Electronics Versus Charge Amplifiers—A Comparison of the Two Systems in Vibration and Pressure Applications

S. Rogero

Proceedings of the Eighteenth International Aerospace Instrumentation Symposium, Miami, Florida, May 15–17, 1972, pp. 223–229

Conventional charge amplifier systems have long been used in conjunction with piezoelectric pressure transducers and accelerometers by JPL's Edwards Test Station on propulsion system test programs that require the measurement of vibration or dynamic pressure. Recent developments in piezoelectric transducer electronics have resulted in compact, low cost devices, which appear to increase the versatility of existing transducers.

An analysis of some of the applications of piezoelectric transducer electronics as related to the measurement of vibration and dynamic pressures is presented. Piezoelectric transducer electronics are compared with charge amplifier systems, specifically in the areas of frequency response, signal-to-noise ratios over long and short transmission lines, and ease of installation. Samples of data used to illustrate the two systems' capabilities and limitations include: pressure measurements made with helium-cooled quartz pressure transducers during tests of propulsion systems utilizing space storable propellants, vibration testing and engine firings of the Mariner Mars 1971 propulsion subsystem, shock-tube tests to evaluate high-response pressure measuring systems, and semi-dynamic calibration facility for determining measurement-system time constants and sensitivity.

ROSCHKE, E. J.

R034 Size Comparisons of Commercial Prosthetic Heart Valves

E. J. Roschke and E. C. Harrison (University of Southern California Medical Center)

Med. Instrum., Vol. 7, No. 5, pp. 277–282, November–December 1973

Prosthetic heart valves currently manufactured in the U.S. are compared by size according to both the tissue-annulus, or mounting, diameter and the primary orifice area. This information, presented in both graphical and tabular form for a wide variety of protheses, will be useful to thoracic surgeons, cardiologists, valve designers, and research engineers. Also discussed is the geometric stenosis factor (GSF) defined here as the ratio of the tissue-annulus area to the primary orifice area. Average values of GSF for commercial valves are presented. It is concluded that a standardized method of expressing valve sizes, more uniform than that which exists presently, would be very beneficial to users, such as surgeons and physicians, and to the patient as well. A means of achieving this is through manufacturer participation in the Association for the Advancement of Medical Instrumentation Cardiac Valve Prostheses Standards Subcommittee.

ROSE, J. R.

R035 A Design for a Venus Orbital Imaging Radar Mission

J. R. Rose and L. D. Friedman

Preprint 74-222, AIAA Twelfth Aerospace Sciences Meeting, Washington, D.C., January 30–February 1, 1974

This paper discusses a planetary exploration mission to map the surface of Venus. A review of the Venus exploration program provides a basis for determining the probable scientific requirements for resolution, planetary coverage, etc., for such a mission. From these requirements, the range of possible mission, radar, and spacecraft functional requirements is determined and a single "point" design is investigated in some detail. This point design, which provides full planet mapping at resolutions better than 200 m, is based on Mariner-class spacecraft technology, including a conventional bipropellant propulsion system, currently under development, capable of delivering the required payload into a 500-km circular Venus orbit. The technology investigated here is fundamentally state-of-the-art, with use of current systems capabilities satisfying the mission requirements.

ROSENTHAL, L. A.

R036 Thermal Coupling Measurement Method

L. A. Rosenthal (Rutgers University) and V. J. Menichelli

J. Spacecraft Rockets, Vol. 11, No. 5, pp. 282–286, May 1974

Heat flow from an embedded heated wire responds to a change in the ambient environment. The wire is part of a self-balancing bridge system and heat flow is measured directly in watts. Steady-state and transient thermal coupling can be measured directly and is an indication of the thermal resistance and diffusivity for the system under study. The method is applied to an aerospace electroexplosive component.

ROURKE, K. H.

R037 Resolution of an Inconsistency in Deep Space Station Longitude Solutions

K. H. Rourke and N. A. Mottinger

The Deep Space Network: September and October 1974, DSN Progress Report 42-24, pp. 132–143, December 15, 1974

This article presents analysis and results that lead to the resolution of a discrepancy in deep space station (DSS) longitude estimates that had been obtained in 1971 and

1972 from spacecraft near-encounter radio metric data. A 21-m discrepancy between the Mariner 4 and Mariner 9 DSS longitude solutions is shown to be reduced to within 3 m with the application of improved solution strategies. The resulting agreement between all encounter-arc longitude solutions for Mariners 4, 5, 6, and 9 is within 5 m.

R038 Application of Sequential Filtering to Estimation of the Interplanetary Orbit of Mariner 9

K. H. Rourke and J. F. Jordan

J. Spacecraft Rockets, Vol. 10, No. 12, pp. 773–778, December 1973

This paper presents the results of the application of sequential filtering to the determination of the interplanetary orbit of the Mariner Mars 1971 spacecraft. The technique is a specific extension of the Kalman filter. The special problems associated with applying this technique are discussed and the particular algorithmic implementations are outlined. The method is compared against the weighted-least-squares filters of conventional application. The results reveal that relatively simple sequential-filter configurations yield solutions superior to those of the conventional method when applied to radio measurements of the Mariner Mars 1971 spacecraft.

RUSCH, W. V. T.

R039 Double Aperture Blocking by Two Wavelength-Sized Feed-Support Struts

W. V. T. Rusch (University of Southern California)

Electron. Lett., Vol. 10, No. 15, pp. 296–297, July 25, 1974

Feed-system support structures for large-aperture ground antennas generally consist of a tripod or quadripod framework, each leg of which is made from a number of smaller structural members. The complexity of these support structures has defied rigorous attempts to analyze their effects on the rf performance of the antenna. This article reports some induced-field ratio calculations for "double-blocking" configurations (one strut lies within the shadow of another). It is shown that the effective rf blocking from composite structures may be as large as if the multiple members were placed side by side.

RUSSELL, C. T.

R040 Observations of the Internal Structure of the Magnetopause

M. Neugebauer, C. T. Russell (University of California, Los Angeles), and E. J. Smith

J. Geophys. Res., Space Physics, Vol. 79, No. 4, pp. 499–510, February 1, 1974

For abstract, see Neugebauer, M.

SAVAGE, J. E.

S001 DSN Progress Report for November–December 1973: An Algorithm for the Computation of Linear Forms

J. E. Savage

Technical Report 32-1526, Vol. XIX, pp. 82–88, February 15, 1974

Many problems, including matrix-vector multiplication and polynomial evaluation, involve the computation of linear forms. This article presents an algorithm that offers a substantial improvement on the conventional algorithm for this problem when the coefficient set is small. In particular, this implies that every polynomial of degree n with at most s distinct coefficients can be realized with $O(n/\log_s n)$ operations. It is demonstrated that the algorithm is sharp for some problems.

SCHAPER, P. W.

S002 Detection of Nitric Oxide in the Lower Stratosphere

R. A. Toth, C. B. Farmer, R. A. Schindler, O. F. Raper, and P. W. Schaper

Nature Phys. Sci., Vol. 244, No. 131, pp. 7–8, July 2, 1973

For abstract, see Toth, R. A.

S003 Measurement of the Abundance of Several Natural Stratospheric Trace Constituents From High Altitude Aircraft

C. B. Farmer, P. W. Schaper, O. F. Raper, R. A. Schindler, and R. A. Toth

Proceedings of the Second Joint Conference on Sensing of Environmental Pollutants, Washington, D.C., December 10–12, 1973, pp. 9–15

For abstract, see Farmer, C. B.

SCHATZ, W. J.

S004 Development of the Propulsion Subsystem for the Viking 75 Orbiter

F. C. Vote and W. J. Schatz

AIAA Preprint 73-1208, AIAA/SAE Ninth Propulsion Conference, Las Vegas, Nevada, November 5–7, 1973

For abstract, see Vote, F. C.

SCHINDLER, R. A.

S005 Detection of Nitric Oxide in the Lower Stratosphere

R. A. Toth, C. B. Farmer, R. A. Schindler, O. F. Raper, and P. W. Schaper

Nature Phys. Sci., Vol. 244, No. 131, pp. 7–8, July 2, 1973

For abstract, see Toth, R. A.

S006 Measurement of the Abundance of Several Natural Stratospheric Trace Constituents From High Altitude Aircraft

C. B. Farmer, P. W. Schaper, O. F. Raper, R. A. Schindler, and R. A. Toth

Proceedings of the Second Joint Conference on Sensing of Environmental Pollutants, Washington, D.C., December 10–12, 1973, pp. 9–15

For abstract, see Farmer, C. B.

SCHROEDER, M.

S007 Preliminary Infrared Radiometry of the Night Side of Mercury From Mariner 10

S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, D. Morrison (University of Hawaii), G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and M. Schroeder (California Institute of Technology)

Science, Vol. 185, No. 4146, pp. 142–145, July 12, 1974

For abstract, see Chase, S. C., Jr.

SCHULTZ, A. L.

S008 Microwave Doppler Shift Technique for Determining Solid Propellant Transient Regression Rates

L. D. Strand, A. L. Schultz, and G. K. Reedy

J. Spacecraft Rockets, Vol. 11, No. 2, pp. 75–83, February 1974

For abstract, see Strand, L. D.

SCHWARTZ, R. L.

S009 An Interrupt Timing Simulation

V. D. Jones and R. L. Schwartz

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 183–189, August 15, 1974

For abstract, see Jones, V. D.

SCUDDER, J. D.

S010 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

SELZER, R. H.

S011 Picture Analysis Applied to Biomedicine

D. A. O'Handley, E. S. Beckenbach, K. R. Castleman, R. H. Selzer, and R. J. Wall

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 417–432, December 1973

For abstract, see O'Handley, D. A.

SEQUEIRA, E. A.

S012 Solar Array Study for Solar Electric Propulsion Spacecraft for the Encke Rendezvous Mission

E. A. Sequeira and R. E. Patterson

Technical Memorandum 33-668, February 1, 1974

This memorandum describes the work performed during 1973 on the design, analysis, and performance of a 20-kW rollup solar array capable of meeting the design requirements of a solar-electric spacecraft for the 1980 comet Encke rendezvous mission. To meet the high power requirements of the proposed electric propulsion mission, solar arrays on the order of 186.6 m^2 have been defined. Because of the large weights involved with arrays of this size, consideration of array configurations is

limited to lightweight, large-area concepts with maximum power-to-weight ratios. Items covered include solar array requirements and constraints, array concept selection and rationale, structural and electrical design considerations, and reliability considerations. The study was concluded by identifying the areas which require further work.

SERNAS, V.

S013 Heat Transfer Model for Predicting Squib Ignition Times

V. Sernas

Technical Memorandum 33-655, January 15, 1974

This memorandum describes a squib-ignition model based on transient heat conduction from the hot bridgewire to the pyrotechnic. No Arrhenius-type chemical reaction is included. Instead, a thermal contact resistance is postulated to exist between the hot bridgewire and the pyrotechnic. Ignition is assumed to occur when a 2.5-μm layer of pyrotechnic next to the bridgewire reaches a characteristic ignition temperature for that pyrotechnic.

This model was applied to the JPL squib, which uses a 50-μm (0.002-in.) diameter Tophet A bridgewire to ignite a boron–potassium perchlorate mix. A computer program was utilized that solves the transient heat condition problem with the boundary conditions stipulated by the model. The thermal contact conductance at the interface was determined by trial and error so that the experimentally determined ignition time for one firing condition would be properly predicted by the model. With this value of the thermal contact conductance, ignition times for other test conditions were predicted and compared with experimental data. The agreement was quite good for tests run between -129°C and +93.3°C at current levels of 3.5 and 5 A. The resultant radial temperature profiles within the bridgewire–pyrotechnic system are presented for a few test conditions. Axial heat conduction along the bridgewire is shown to be negligible.

S014 The Role of Thermal Contact Resistance in Pyrotechnic Ignition

V. Sernas (Rutgers University) and A. J. Murphy

AIAA Preprint 74-694, AIAA/ASME (American Society of Mechanical Engineers) 1974 Thermophysics and Heat Transfer Conference, Boston, Massachusetts, July 15–17, 1974

This paper describes a pyrotechnic ignition model based on transient heat conduction from a heated bridgewire to a pyrotechnic that is placed in contact with it. The boundary condition used at the interface was a thermal contact conductance estimated at 31,200 W/m^2-K between the wire and the pyrotechnic. Ignition was assumed to occur when a 2.5 μm layer of pyrotechnic next to the bridgewire reached a critical ignition temperature. The times to ignition predicted by this model for constant-current firings were in good agreement with experimentally observed times to fire at 3.5 and 5 A current levels and ambient temperatures from 144 to 366 K.

SHAPIRO, I. I.

S015 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

SHIMA, R.

S016 Composite Film Interface Control by Sequential Sputtering

R. Shima

J. Vacuum Sci. Technol., Vol. 11, No. 1, p. 71, January–February 1974

Contamination at the interface between layers of a multilayer metal structure can be a source of serious reliability problems, such as variable ohmic contacts and poor adhesion. This contamination can occur during the transfer from one metallization step to the next, depending on operating procedure and the residual partial pressures of gases in the system. To avoid this problem, a process has been developed for sequentially sputtering metals with virtually no interruption between layers. A commercial 8-in.-diam dc or rf-diode sputtering system has been modified by attaching three 3-in.-diam sputtering targets of selected materials and adding a special configuration of shields, baffles, bias grids, and a rotating substrate holder.

Results obtained from sequentially sputtered Ti/Mo/Au metallizations is described in detail. Backscattering of He ions provides data on the composition of the layers following deposition and after heat treatment at different temperatures. The results provide information on the stability of the structures and their usefulness in actual

systems, where, for example, high-temperature packaging is required. (Only the abstract is printed in this issue.)

SHOWS, O. B.

S017 DSN Tracking System Predictions

W. D. Chaney and O. B. Shows (Philco-Ford Corporation)

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 11–14, October 15, 1974

For abstract, see Chaney, W. D.

SHUMATE, M. S.

S018 Air Pollution: Remote Detection of Several Pollutant Gases With a Laser Heterodyne Radiometer

R. T. Menzies and M. S. Shumate

Science, Vol. 184, No. 4136, pp. 570–572, May 3, 1974

For abstract, see Menzies, R. T.

SIMON, M. K.

S019 Data-Derived Symbol Synchronization of MASK and QASK Signals

M. K. Simon

Technical Memorandum 33-720, December 15, 1974

Much has been said in the literature with regard to the problem of establishing symbol synchronization in binary baseband digital communication systems. By comparison, the literature is virtually devoid of information relating to the extraction of symbol synchronization from multilevel baseband data. With the recent interest in multilevel amplitude-shift-keying (MASK) and quadrature amplitude-shift-keying (QASK) as signaling techniques for multilevel digital communications systems, the problem of providing symbol synchronization in the receivers of such systems becomes paramount.

This memorandum presents a technique for extracting symbol synchronization from an MASK or QASK signal. The scheme is essentially a generalization of the data transition tracking loop which has heretofore been used in phase-shift-keying systems. The performance of the loop is analyzed in terms of its mean-squared symbol synchronization jitter and its effects on the data detection process in MASK and QASK systems.

S020 Carrier Synchronization and Detection of QASK Signal Sets

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-22, No. 2, pp. 98–106, February 1974

This article describes a carrier regeneration loop which generates highly coherent quadrature reference signals for quadrature amplitude-shift-keying (QASK) demodulation. The loop employs the principle of decision feedback and has a structure analogous to a decision feedback loop for quadriphase signals suggested earlier in the literature. The error probability performance of QASK is computed in the presence of the noisy carrier reference signals provided by the above loop. It is demonstrated that when the ratio of data rate to loop bandwidth is 50 or greater, then for all practical purposes, ideal QASK error probability performance is achieved.

S021 Offset Quadrature Communications With Decision-Feedback Carrier Synchronization

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-22, No. 10, pp. 1576–1584, October 1974

This article focuses on the decision-feedback approach to carrier synchronization of offset quadrature phase-shift-keyed (QPSK) and, more generally, offset quadrature amplitude-shift-keyed (QASK) systems. In particular, two decision-feedback loops for tracking offset QPSK and offset QASK are presented, which are modifications of comparable loops previously given in the literature for carrier synchronization of QPSK and QASK, respectively. The performance gains obtained using such synchronization techniques are discussed. The use of offset-quadrature communications rather than conventional quadrature communications permits a doubled loop bandwidth at fixed data rate, signal-to-noise ratio, and probability of error. However, the more efficient phase-tracking loop (decision-feedback as opposed to phase-locked loop) substantially reduces the total signal-to-noise ratio required.

SISCOE, G. L.

S022 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

SJOGREN, W. L.

S023 Lunar Gravity via the Apollo 15 and 16 Subsatellites

W. L. Sjogren, R. N. Wimberly, and W. R. Wollenhaupt (NASA–Lyndon B. Johnson Space Center)

The Moon, Vol. 9, Nos. 1/2, pp. 115–128, January 1974

Dense doppler tracking coverage of the Apollo 15 and 16 subsatellites over ten and eighteen day periods when periapsis altitudes were 15–50 km has provided detailed gravity mapping of the lunar frontside. Many new gravity features were revealed including one that does not correlate with any visible topographic structure. All unfilled craters sampled are negative anomalies. The mascons consistently produce gravity highs that load the surface with $\approx$800 kg cm^{-2} excess mass. The Orientale region is represented with a solution grid of 177 point masses that clearly show the ringed structure. The eastern limb is also displayed with a solution grid of point masses. The gravity variations over the central portion of the front-face are shown as line-of-sight acceleration contours in milligals.

S024 Lunar Gravity: Apollo 15 Doppler Radio Tracking

P. M. Muller, W. L. Sjogren, and W. R. Wollenhaupt

The Moon, Vol. 10, No. 2, pp. 195–205, June 1974

For abstract, see Muller, P. M.

SKJERVE, L.

S025 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

S026 DSN Progress Report for November–December 1973: Radio Interferometry Measurements of a 16-km Baseline With 4-cm Precision

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, D. J. Spitzmesser, and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 36–54, February 15, 1974

For abstract, see Thomas, J. B.

SLADE, M. A.

S027 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

Differential very-long-baseline-interferometry (VLBI) experiments were conducted in 1972 between the Mariner Mars 1971 spacecraft and various quasars. The objective of these experiments was to determine the position of Mars in the VLBI reference frame. This article gives background information and describes experimental procedures.

S028 Lunar Physical Librations and Laser Ranging

J. G. Williams, M. A. Slade, D. H. Eckhardt (Air Force Cambridge Research Laboratories), and W. M. Kaula (University of California, Los Angeles)

The Moon, Vol. 8, No. 4, pp. 469–483, October 1973

For abstract, see Williams, J. G.

SLEDGE, B.

S029 The Availability of Local Aerial Photography in Southern California

W. Allen III, B. Sledge, C. K. Paul, and A. J. Landini (City of Los Angeles)

Special Publication 43-14, December 1, 1974

For abstract, see Allen, W., III

SLEKYS, A. G.

S030 Open-Loop Receiver/Predetection Recording System for the DSN

S. S. Kent and A. G. Slekys

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 139–148, April 15, 1974

For abstract, see Kent, S. S.

SMITH, E. J.

S031 Postmidnight Chorus: A Substorm Phenomenon

B. T. Tsurutani and E. J. Smith

J. Geophys. Res., Space Physics, Vol. 79, No. 1, pp. 118–127, January 1, 1974

For abstract, see Tsurutani, B. T.

S032 Observations of the Internal Structure of the Magnetopause

M. Neugebauer, C. T. Russell (University of California, Los Angeles), and E. J. Smith

J. Geophys. Res., Space Physics, Vol. 79, No. 4, pp. 499–510, February 1, 1974

For abstract, see Neugebauer, M.

S033 Plasmaspheric Hiss Intensity Variations During Magnetic Storms

E. J. Smith, A. M. A. Frandsen, B. T. Tsurutani, R. M. Thorne (University of California, Los Angeles), and K. W. Chan (University of California, Los Angeles)

J. Geophys. Res., Space Physics, Vol. 79, No. 16, pp. 2507–2510, June 1, 1974

The storm time intensity variations of extremely-low-frequency electromagnetic emissions have been studied by using the Ogo 6 search coil magnetometer. Low-latitude signals exhibit a sharp low-frequency cutoff and are identified as plasmaspheric hiss. Such waves show pronounced intensification during the recovery phase of magnetic storms but remain close to background levels during the storm main phase. This behavior is consistent with cyclotron resonant generation within the plasmasphere as the latter expands into the intensified belt of outer zone electrons during the storm recovery.

S034 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

Data obtained by the Pioneer 10 vector helium magnetometer are presented along with models of the intrinsic magnetic field of Jupiter and its magnetosphere. Data acquired between 2.84 and 6.0 R_J, where the intensity of the planetary field ranged between 1900 and 18,400 γ, were used to develop a six-parameter eccentric dipole model of the field. The dipole so derived has a moment of 4.0 G R_J^3 and a tilt angle with respect to Jupiter's rotation axis of 11 deg. The system III (epoch 1957) longitude of the magnetic pole in the northern hemisphere, which is a north-seeking pole, is 222 deg. The dipole is displaced from the center of Jupiter by 0.11 R_J in the direction of latitude 16 deg and system III longitude 176 deg. The dipole tilt and the longitude of the pole are in good agreement with values inferred from radio astronomy measurements.

A model of the Jovian magnetosphere is presented in which the essential feature is an eastward current sheet that forms an annulus with Jupiter at the center. At large distances from the planet the current sheet is nearly parallel to Jupiter's equator but, in general, does not lie in it. The current sheet is warped, so that it is above the equator on one side and below it on the other. The current sheet rotates with the planet, more or less like a rigid body; this behavior causes an apparent up and down motion and periodic crossings of the current sheet by Pioneer 10. The origin of the current sheet appears to be the very large centrifugal force, associated with Jupiter's great size and rapid rotation, acting on trapped low-energy magnetospheric plasma. The density of this plasma is estimated to be approximately 1 particle cm^{-3}. A retrograde spiraling of field lines out of meridian planes is also observed, presumably as a result of azimuthal drag forces exerted on the outer magnetosphere.

SMITH, J. G.

S035 Carrier Synchronization and Detection of QASK Signal Sets

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-22, No. 2, pp. 98–106, February 1974

For abstract, see Simon, M. K.

S036 Offset Quadrature Communications With Decision-Feedback Carrier Synchronization

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-22, No. 10, pp. 1576–1584, October 1974

For abstract, see Simon, M. K.

SMITH, R. E.

S037 DSN Progress Report for November–December 1973: The DSN Hydromechanical Service Program—A Second Look

R. E. Smith and O. Sumner

Technical Report 32-1526, Vol. XIX, pp. 221–223, February 15, 1974

The DSN hydromechanical service program has progressed satisfactorily along the lines originally intended. Oil sampling and analysis have been particularly rewarding, detecting early signs of wear and forestalling catastrophic failures.

SMITH, R. H.

S038 Fourth Harmonic Analyzer

R. H. Smith

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 121–123, April 15, 1974

The X-band downlink receiver frequency is situated very close to the fourth harmonic of the S-band high-power transmitter. When wideband modulation is applied to the high-power transmitter, the sidebands of the fourth harmonic are of such magnitude relative to the X-band receiver that they interfere with X-band downlink and may saturate the X-band maser. To alleviate this problem, a fourth-harmonic filter was added to the output of the high-power transmitter. No quantitative results of this experiment were obtained. To make an analytic measurement, a fourth-harmonic analyzer has been developed to measure the power at the fourth-harmonic of the S-band high-power transmitter with and without a fourth-harmonic filter.

SMITH, R. M.

S039 Short-Term Frequency Measurement Capability in DSN Equipment Maintenance Facilities

R. M. Smith, D. Crawford, and C. H. Fourtner

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 182–185, April 15, 1974

This article describes a short-term frequency-measuring capability that has been established at the Goldstone and Madrid DSN Complex Maintenance Facilities to afford rapid, complete service to DSN synthesizers. Future development of the capability may include the testing of station frequency standards.

SONETT, C. P.

S040 The Planetary Magnetic Field and Magnetosphere of Jupiter: Pioneer 10

E. J. Smith, L. Davis, Jr. (California Institute of Technology), D. E. Jones (Brigham Young University), P. J. Coleman, Jr. (University of California, Los Angeles), D. S. Colburn (Ames Research Center), P. Dyal (Ames Research Center), C. P. Sonett (University of Arizona), and A. M. A. Frandsen

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3501–3513, September 1, 1974

For abstract, see Smith, E. J.

SPITZMESSER, D. J.

S041 DSN Progress Report for November–December 1973: The Mariner 9 Quasar Experiment: Part I

M. A. Slade, P. F. MacDoran, I. I. Shapiro (Massachusetts Institute of Technology), D. J. Spitzmesser, J. Gubbay (Weapons Research Establishment, Australia), A. Legg (Weapons Research Establishment, Australia), D. S. Robertson (Weapons Research Establishment, Australia), and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 31–35, February 15, 1974

For abstract, see Slade, M. A.

S042 DSN Progress Report for November–December 1973: Radio Interferometry Measurements of a 16-km Baseline With 4-cm Precision

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, D. J. Spitzmesser, and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 36–54, February 15, 1974

For abstract, see Thomas, J. B.

SPRADLIN, G. L.

S043 Tracking Operations During the Mariner 10 Venus Encounter

A. L. Berman and G. L. Spradlin

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 95–107, June 15, 1974

For abstract, see Berman, A. L.

S044 Tracking Operations During the Mariner 10 Mercury Encounter

A. L. Berman and G. L. Spradlin

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 202–211, August 15, 1974

For abstract, see Berman, A. L.

STANDISH, E. M., JR.

S045 The Figure of Mars and Its Effect on Radar-Ranging

E. M. Standish, Jr.

Astron. Astrophys., Vol. 26, No. 3, pp. 463–466, August 1973

Formulae are given which indicate the errors made in computing the radar-range to a planet when one assumes the planet to have a spherical surface, centered at the center of mass. These formulae are evaluated for Mars, using an ellipsoidal fit of the Martian surface obtained from the occultation measurements of the Mariner Mars 1971 spacecraft. The secularlike part of the errors amounts to about 4 km in range over the past 3 oppositions, due mainly to the flattening of 0.006 and to a 3-km southerly displacement of the center of figure from the center of mass. The method of solution is given in the appendix along with a method for applying the ellipsoidal model to the reduction of radar-range data.

STARKS, G. T.

S046 Mariner Mars 1971 Inertial Reference Unit

G. T. Starks

Technical Memorandum 33-662, March 1, 1974

This memorandum presents the design concept of an inertial reference unit using a gyroscope in the rate mode in conjunction with a unique application of a drift-compensated and temperature-stabilized solid-state integrator for the inertial mode. A typical test program and the results for an inertial reference unit as applied to the Mariner Mars 1971 program to achieve highly reliable spacecraft operation are also described.

STELZRIED, C. T.

S047 DSN Progress Report for November–December 1973: Radio Metric Applications of the New Broadband Square Law Detector

R. A. Gardner, C. T. Stelzried, and M. S. Reid

Technical Report 32-1526, Vol. XIX, pp. 89–92, February 15, 1974

For abstract, see Gardner, R. A.

S048 S/X Experiment: A New Configuration for Ground System Range Calibrations With the Zero Delay Device

T. Y. Otoshi and C. T. Stelzried

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 57–63, April 15, 1974

For abstract, see Otoshi, T. Y.

S049 S/X-Band Experiment: Zero Delay Device Antenna Location

C. T. Stelzried, T. Y. Otoshi, and P. D. Batelaan

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 64–68, April 15, 1974

This article presents representative data for the original Block 3 and Block 4 zero-delay devices as a function of antenna elevation angle. Instabilities on the order of 33 ns as obtained with the original S-band Block 3 system are reduced by relocation of the zero-delay-device (ZDD) horn. However, unsatisfactory performance at X-band for the Mariner Venus/Mercury 1973 S/X-band experiment ZDD requires a reconfiguration eliminating the horns and associated air path.

S050 A Tracking Polarimeter for Measuring Solar and Ionospheric Faraday Rotation of Signals From Deep Space Probes

J. E. Ohlson (Naval Postgraduate School), G. S. Levy, and C. T. Stelzried

IEEE Trans. Instr. Meas., Vol. IM-23, No. 2, pp. 167–177, June 1974

For abstract, see Ohlson, J. E.

S051 Low-Noise Microwave Receiving Systems in a Worldwide Network of Large Antennas

M. S. Reid, R. C. Clauss, D. A. Bathker, and C. T. Stelzried

Proc. IEEE, Vol. 61, No. 9, pp. 1330–1335, September 1973

For abstract, see Reid, M. S.

STEVENS, G. L.

S052 A Re-Examination of the AGC Calibration Procedure

G. L. Stevens

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 197–201, August 15, 1974

In this article, a re-examination of automatic gain control (AGC) calibration errors was made to determine if an improvement in reported spacecraft carrier power could be obtained by modifying the signal-level tracking calibration procedure. The calibration errors (as a function of the number of independently obtained calibration points) were evaluated to determine if a new AGC calibration procedure using 15 independent calibration points should be adopted. Results of this study indicate that the improvement in calibration accuracy is insignificant and would not warrant a new calibration procedure requiring considerably more time and effort.

S053 AGC Calibration Accuracy

G. L. Stevens

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 104–110, October 15, 1974

Currently, measurement of received signal power at the DSN stations is performed by calibrating the automatic gain control (AGC) voltage as an indicator of received signal power level. Errors in the AGC voltage vs signal power level calibration are identified and the overall AGC calibration accuracy is estimated.

STICKFORD, G. H., JR.

S054 Radiative Relaxation Behind Strong Shock Waves in Hydrogen–Helium Mixtures

L. P. Leibowitz, W. A. Menard, and G. H. Stickford, Jr.

Recent Developments in Shock Tube Research, pp. 306–317, Stanford University Press, Stanford, 1973

For abstract, see Leibowitz, L. P.

STINNETT, W. G.

S055 DSN Progress Report for November–December 1973: DSN Command System Mark III-74

W. G. Stinnett

Technical Report 32-1526, Vol. XIX, pp. 5–9, February 15, 1974

This article presents a general description of the DSN Command System software changes that are being implemented to support the Helios and Viking missions. Comparisons are made between the present system (Mark III-71) and the new system (Mark III-74). Included are the reasons for the changes, and the DSN plans to phase all mission support over to the Mark III-74 system.

STONIER, R. A.

S056 Development of a Unique Graphite/Epoxy Antenna Subreflector

E. Y. Robinson, R. A. Stonier (Boeing Company Aerospace Group), and C. L. Lofgren (Boeing Company Aerospace Group)

Composite Materials: Testing and Design (Third Conference), Special Technical Publication 546, pp. 632–650, American Society for Testing and Materials, Philadelphia, 1974

For abstract, see Robinson, E. Y.

STRAND, L. D.

S057 Microwave Doppler Shift Technique for Determining Solid Propellant Transient Regression Rates

L. D. Strand, A. L. Schultz, and G. K. Reedy

J. Spacecraft Rockets, Vol. 11, No. 2, pp. 75–83, February 1974

A microwave doppler-shift system, with increased resolution over earlier microwave techniques, was developed for measuring the regression rates of solid propellants during rapid pressure transients (10^4 to 10^5 N/cm^2-s). The system was used in two different transient combustion experiments: a rapid depressurization bomb and the high-frequency acoustic pressure environment of a T-burner. In the rapid depressurization tests the measured regression rates generally fell near or below the

steady-state rate at the corresponding pressure and exhibited oscillations in tests near the critical depressurization rates for extinguishment. Unreasonably high oscillatory regression rates were obtained in the T-burner experiments. The results of a set of parametric calculations indicated that flame ionization effects could be of sufficient magnitude to account for these anomalies. A direct comparison of the analytical predictions and experimental results yielded the conclusions that flame ionization effects probably produced some errors in the absolute values, but not the general characteristics, of the rapid depressurization regression rate measurements.

STROM, R. G.

S058 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

S059 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

SUMNER, O.

S060 DSN Progress Report for November–December 1973: The DSN Hydromechanical Service Program—A Second Look

R. E. Smith and O. Sumner

Technical Report 32-1526, Vol. XIX, pp. 221–223, February 15, 1974

For abstract, see Smith, R. E.

SUOMI, V.

S061 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

S062 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

SVENSSON, C.

S063 Saturation Capacitance of Thin Oxide MOS Structures and the Effective Surface Density of States of Silicon

J. Maserjian, G. Petersson (Chalmers University of Technology, Sweden), and C. Svensson (Chalmers University of Technology, Sweden)

Solid-State Electron., Vol. 17, No. 4, pp. 335–339, April 1974

For abstract, see Maserjian, J.

TANG, C. C. H.

T001 Multiple Scattering From Finite Inhomogeneous Media

C. C. H. Tang

J. Appl. Phys., Vol. 45, No. 3, pp. 1115–1126, March 1974

This article presents a theoretical analysis on the multiple scattering of electromagnetic waves in finite inhomogeneous media by utilizing the characteristic information on the apparent phase constant difference between the electric and magnetic fields propagating in an inhomogeneous medium. The solution is obtained by first approximating the coefficients of a pair of exact, coupled, first-order differential equations and then solving the equations by first-order iteration. The present first-order approximate solution with multiple scattering considerations is shown to be more accurate than the WKB solution. Methods to improve the accuracy of the first-order solution further are discussed. Application of the solution to slowly varying finite media with periodic properties demonstrates the validity of the solution. The same approach can be extended to frequencies in the optical region by retaining additional terms in the coefficients of the coupled differential equations. Further investigations are required to treat the case of oblique incidence in proper perspective.

TAPPAN, R. W.

T002 DSN Progress Report for November–December 1973: Planetary Ranging

R. W. Tappan

Technical Report 32-1526, Vol. XIX, pp. 165–168, February 15, 1974

The planetary ranging assembly (PRA) determines the distance to spacecraft that are traveling at planetary distances from Earth by measuring the time required for a radio signal to travel to the spacecraft and back. The range data are used to improve the accuracy of the calculation of the spacecraft's trajectory and to provide information concerning the charged-particle content of space.

The PRA is able to operate at reduced signal levels because of improvements in the method of maintaining coder lock and detecting the signal in the presence of space noise. It is capable of operation with either S-band or X-band carrier frequencies and offers selectable code types to enable each project to specify the operating mode best suited to its particular mission.

TAUSWORTHE, R. C.

T003 Program Structures for Non-proper Programs

R. C. Tausworthe

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 69–81, June 15, 1974

Canonic structured programming forms the basis of an attractive software design and production methodology applicable to proper programs (programs having only one entry point and one exit point). Programs developed using this methodology tend to be easier to organize, understand, modify, and manage than are unstructured programs. However, there are notable examples in which programs either are inherently non-proper (usually, with more than one exit, rather than more than one entry), or else suffer when forced to be structured. This article addresses ways of extending the concept of structured programming to cover such cases; it is a report of an ongoing research activity to examine potential DSN software development standards.

T004 Control-Restrictive Instructions for Structured Programming (CRISP)

R. C. Tausworthe

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 134–151, August 15, 1974

This article presents a discipline and a set of control-logic statements to extend structured programming to arbitrary existing languages. These statements preempt and replace all control statements in a language, so that all programs written in Control-Restrictive Instructions for Structured Programming (CRISP) are automatically structured. Structures are provided for real-time, as well as nonreal-time programming. The principles set forth do not attempt to specify a standard programming language, but instead, a programming language standard—that is, a way of programming that contributes to stability, maintainability, readability (self-documentation), and understandability of the final product.

T005 Data Structure Design Guidelines

R. C. Tausworthe

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 68–73, October 15, 1974

Proper modularization of software designs is more than mere segmentation of a program into subfunctions as dictated by control-logic topologies, as might be suggested by classical structured programming, wherein a limited number of program control-logic structures are permitted. Analyzing data connectivity between program

segments can be far more complex than analyzing control flow, unless conscientious precautions are taken to avert this possibility. For this reason, data connectivity design should adhere to a discipline which minimizes both data and control-flow connections. This article discusses such considerations within a top-down, hierarchic, structured-programming approach to software design.

TAYLOR, F. W.

T006 Remote Temperature Sounding in the Presence of Cloud by Zenith Scanning

F. W. Taylor

Appl. Opt., Vol. 13, No. 7, pp. 1559–1566, July 1974

The principles of remote sounding of vertical temperature profiles in planetary atmospheres containing cloud layers are presented for an approach that uses measurements at different angles to the local vertical to eliminate the unknown cloud effects. A numerical example for a model of the Earth's atmosphere shows that soundings separated by 40 deg in zenith angle permit the recovery of the temperature profile with an error that is not significantly greater than that obtained in the clear atmosphere case, and without serious horizontal smear. It is proposed that the method will be valuable for the interpretation of measurements made by instruments on spin-stabilized spacecraft on planetary missions, since in these cases the required angular coverage is obtained automatically for most trajectories.

THEARD, L. P.

T007 Automatic Mass-Spectrometric Analysis: Preliminary Report on Development of a Novel Mass-Spectrometric System for Biomedical Applications

W. J. Dreyer (California Institute of Technology), A. Kuppermann (California Institute of Technology), H. G. Boettger, C. E. Giffin, D. D. Norris, S. L. Grotch, and L. P. Theard

Clinical Chem., Vol. 20, No. 8, pp. 998–1002, August 1974

For abstract, see Dreyer, W. J.

T008 Ion–Molecule Reactions and Vibrational Deactivation of H_2^+ Ions in Mixtures of Hydrogen and Helium

L. P. Theard and W. T. Huntress, Jr.

J. Chem. Phys., Vol. 60, No. 7, pp. 2840–2848, April 1974

Ion cyclotron resonance techniques have been used to determine the thermal energy rate constants for the ion–molecule reactions of H_2^+ ions in mixtures of hydrogen and helium. Rate constants are presented for a near-Franck–Condon distribution of initial vibrational states in H_2^+. Collisional deactivation of vibrationally excited H_2^+ ions is also shown to occur in nonreactive encounters with He atoms. The rate constant k_v for this process increases with increasing vibrational quantum number v and is approximately equal to k_2^v for H_2^+ ions in vibrational state v.

THOMAS, J. B.

T009 DSN Progress Report for November–December 1973: Radio Interferometry Measurements of a 16-km Baseline With 4-cm Precision

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, D. J. Spitzmesser, and L. Skjerve (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XIX, pp. 36–54, February 15, 1974

In order to demonstrate the feasibility of eventually using radio-interferometry techniques to measure tectonic motion, a series of interferometry experiments was conducted between two antennas at the Goldstone Deep Space Communications Complex. The primary objective of these experiments was to develop independent-station instrumentation capable of making three-dimensional baseline measurements with an accuracy of a few centimeters. To meet this objective, phase-stable instrumentation was developed to precisely measure the time delay by means of two-channel bandwidth synthesis. Delay measurements produced by this instrumentation lead to three-dimensional baseline measurements with a precision of 2–5 cm for the components of a 16-km baseline.

T010 A Reformulation of the Relativistic Transformation Between Coordinate Time and Atomic Time

J. B. Thomas

The Deep Space Network: March and April 1974, DSN Progress Report 42-21, pp. 18–26, June 15, 1974

In this article, the relativistic time transformation is reformulated to allow simpler time calculations relating analysis in a solar-system frame (using coordinate time) with Earth-fixed observations (using atomic time). After an interpretation of terms, this simplified formulation is used to explain the conventions required in the synchronization of a world-wide clock network. In addition, two synchronization techniques—portable clocks and radio interferometry—are discussed in terms of the relativistic time transformation.

THOMAS, R. F.

T011 A Dual Hybrid Mode Feedhorn for DSN Antenna Performance Enhancement

R. F. Thomas and D. A. Bathker

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 101–108, August 15, 1974

This article describes a new microwave horn suitable for use in selected DSN antenna feed applications. The new horn uses two hybrid modes propagating within a corrugated conical waveguide. Expected aperture efficiency improvement, when feeding DSN reflector antennas, as well as bandwidth information, is provided. It is concluded that the new horn provides 0.36 dB gain improvement when feeding a symmetrical Cassegrain antenna; and it is estimated that 0.29 dB improvement is available when feeding an asymmetric system such as the DSN 64-m antenna tricone configuration. Bandwidth considerations suggest that application at X-band is straightforward. The S-band uplink and downlink bands cannot both be covered at this time.

THOMPSON, E. D.

T012 Perturbation Theory for a Resistivity Shunted Josephson Element

E. D. Thompson

J. Appl. Phys., Vol. 44, No. 12, pp. 5587–5594, December 1973

This paper presents a systematic perturbation theory, extendable in principle to all orders of magnitude, for the solution of the equations of motion of an ideal Josephson element shunted by a resistance and driven by a dc current source and a small time-dependent source. Second-order results are presented for the case in which the time dependence is that of a single sinusoid, and these results are compared with other numerical and analytical calculations. Near, but not on, the first constant voltage step where the perturbation theory appears divergent, the current-voltage characteristic is calculated by means of a nonperturbative adiabatic procedure. The impedance and responsivity agree with earlier results.

THOMPSON, T. W.

T013 Atlas of Lunar Radar Maps at 70-cm Wavelength

T. W. Thompson

The Moon, Vol. 10, No. 1, pp. 51–85, May 1974

The intensity distribution of lunar radar echoes has been mapped for two-thirds of the Earth-visible lunar surface at a wavelength of 70 cm. The depolarizing effects of the lunar surface were observed by simultaneously receiving the radar echoes in opposite polarizations. These echoes were mapped with areal resolutions of 25–100 km^2. Mappings with this resolution confirmed that young craters have enhanced returns. A few craters were found to have enhanced echoes only from their rims. Backscattering differences were also observed between various areas within a mare, between different highland areas, and between maria and adjacent highlands. These scattering differences were interpreted with a simple model, which assumed that the surface backscattered with varying amounts of quasi-specular and diffuse power. Only an increase in the diffuse power was needed to give the numerical values of the enhancements.

THORMAN, H. C.

T014 Deep Space Network Test and Training System

H. C. Thorman

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 5–12, April 15, 1974

This article describes the Deep Space Station Test and Training Subsystem, the evolution and usages of the Simulation Conversion Assembly, capabilities of the present subsystem (Mark III-73) and planned expansion (Mark III-75) to meet Viking requirements. A brief discussion of present and planned capabilities of the Network Control Test and Training Subsystem is included. Both are subsystems of the Deep Space Network Test and Training System.

THORNE, R. M.

T015 Plasmaspheric Hiss Intensity Variations During Magnetic Storms

E. J. Smith, A. M. A. Frandsen, B. T. Tsurutani, R. M. Thorne (University of California, Los Angeles), and K. W. Chan (University of California, Los Angeles)

J. Geophys. Res., Space Physics, Vol. 79, No. 16, pp. 2507–2510, June 1, 1974

For abstract, see Smith, E. J.

THORNTON, C. L.

T016 Square-Root Algorithm for Evaluating Mismodeled Process Noise

C. L. Thornton and S. G. Finley

J. Spacecraft Rockets, Vol. 11, No. 4, pp. 223–230, April 1974

Unmodeled, random accelerations acting on spacecraft place severe limitations on the application of classical least-squares filters to interplanetary navigation. Various modified Kalman filters have been developed which attempt to model the random process affecting the spacecraft state. As the application of sequential filters has grown, the need has arisen to evaluate the sensitivity of these filters to mismodeling of the random process. In this article a numerically reliable square-root algorithm is presented for calculating the covariances of estimates from a sequential filter which incorrectly models process noise. Mismodeling is restricted to the correlation time and standard deviation of a random process represented as a first-order Gauss–Markov sequence. Using a computer program which employs this algorithm, a sensitivity analysis was performed for several types of Earth-based tracking data from an interplanetary spacecraft.

THORPE, T. E.

T017 Mariner 9 Photometric Observations of Mars From November 1971 Through March 1972

T. E. Thorpe

Icarus, Vol. 20, No. 4, pp. 482–489, December 1973

The large quantity of Mariner Mars 1971 television pictures taken at phase angles ranging up to twice those accessible from Earth has been used to describe integrated photometric properties of Mars. Although frame-to-frame variations emphasize the shortcomings of vidicon cameras when used in a photometric mode, statistical trends have yielded data comparable with Earth-based observations. Analysis of atmospheric parameters over a period of changing opacity, November 1971 through March 1972, has provided time-varying optical depths and light-scattering information. Linear function characterization of the Mars reflectance is inaccurate at large incidence or emission angles and at phase angles greater than 40 deg.

TORRES, B.

T018 Quantum-Mechanical and Experimental Study of the Excitation of the 2 ^1P State of He by Electron Impact at 29–40 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, W. Williams, S. Ormonde (Quantum Systems, Inc.), and B. Torres (Quantum Systems, Inc.)

Phys. Rev., Pt. A: Gen. Phys., Vol. 8, No. 5, pp. 2475–2482, November 1973

For abstract, see Truhlar, D. G.

TOTH, R. A.

T019 Linewidths of HCl Broadened by CO_2 and N_2 and CO Broadened by CO_2

R. A. Toth and L. A. Darnton (University of California, Santa Barbara)

J. Molec. Spectrosc., Vol. 49, No. 1, pp. 100–105, January 1974

High resolution measurements of the linewidths of HCl broadened by CO_2 and N_2 and the linewidths of CO broadened by CO_2 have been made in both the 1–0 and 2–0 bands of HCl and the 2–0 band of CO. The data were analyzed by the direct and the peak absorption methods, and the values of the linewidths obtained by the two methods are in generally good agreement. For $|m| \leq 3$, for the case of HCl + CO_2, the agreement is good for both bands of HCl. However for $|m| > 3$, the HCl + CO_2 linewidths in the 1–0 band are smaller than for the corresponding lines in the 2–0 band by as much as 11% for $|m| = 9$. Lines ($|m| \leq 3$) of the 1–0 and 2–0 bands of HCl broadened by CO_2 were also analyzed in terms of the super-Lorentzian line profile (proposed by Varanasi, Sarangi, and Tejwani) and the Lorentzian profile. The results indicate that near the line center (within 3γ), the shape of HCl + CO_2 lines are Lorentzian.

T020 Wavenumbers, Strengths, and Self-Broadened Widths of CO_2 at 3 μm

R. A. Toth

J. Molec. Spectrosc., Vol. 53, No. 1, pp. 1–14, October 1974

Measurements of the line strengths of the 13^10–00^00 and 14^20–01^10 bands of CO_2 have been made with high resolution. The line strengths in both bands are strongly perturbed by Coriolis interactions resulting in the R-branch strengths being, on the average, greater than the P-branch strengths for comparable values of J''. Measurements of the Q-branch strength of the 13^10–00^00 band were also made. The strength data were analyzed to determine the vibrational-band strengths and the coefficient ξ of the F factor. Line-center frequencies of the 14^20–01^10 band were measured and used to determine the band-center frequency and the rotational constants. The direct method was applied to determine the self-broadened line widths in the 13^10–00^00 band.

T021 Detection of Nitric Oxide in the Lower Stratosphere

R. A. Toth, C. B. Farmer, R. A. Schindler, O. F. Raper, and P. W. Schaper

Nature Phys. Sci., Vol. 244, No. 131, pp. 7–8, July 2, 1973

The reaction of stratospheric N_2O with $O(^1D)$ may provide a natural source of both NO and NO_2 which, in turn, may control the formation and destruction of stratospheric O_3. Although the presence of NO_2 in the stratosphere has been established, there have been no reports of the detection of stratospheric NO. This article describes the results of spectroscopic measurements made in the lower stratosphere, in which absorptions due to NO have been identified.

T022 Measurement of the Abundance of Several Natural Stratospheric Trace Constituents From High Altitude Aircraft

C. B. Farmer, P. W. Schaper, O. F. Raper, R. A. Schindler, and R. A. Toth

Proceedings of the Second Joint Conference on Sensing of Environmental Pollutants; Washington, D.C., December 10–12, 1973, pp. 9–15

For abstract, see Farmer, C. B.

TRACKING AND DATA ACQUISITION ORGANIZATION: TECHNICAL STAFF

T023 The NASA/JPL 64-Meter-Diameter Antenna at Goldstone, California: Project Report

Tracking and Data Acquisition Organization: Technical Staff

Technical Memorandum 33-671, July 15, 1974

This memorandum describes the significant management and technical aspects of the JPL project to develop and implement a 64-m-diameter antenna at the Goldstone Deep Space Communications Complex in California, which was the first of the Advanced Antenna Systems of the NASA/JPL Deep Space Network.

The original need foreseen for a large-diameter antenna to accomplish communication and tracking support of NASA's solar system exploration program is reviewed, and the translation of those needs into the technical specification of an appropriate ground station antenna is described. The antenna Project is delineated by phases to show the key technical and managerial skills and the technical facility resources involved. There is a brief engineering description of the antenna and its closely related facilities.

By virtue of its large aperture size and very-low-noise receiving systems, the 64-m antenna has provided unique communication and tracking support capability to many NASA space exploration missions. Its use in radio science and advanced engineering experiments has provided a number of scientific and technological accomplishments. Such ventures, and the philosophy of the use of the antenna, are described.

TRAJMAR, S.

T024 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of N_2O

R. I. Hall, A. Chutjian, and S. Trajmar

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 12, pp. L365–L368, December 1973

For abstract, see Hall, R. I.

T025 Elastic and Inelastic Electron Scattering at 20 and 60 eV From Atomic Cu

W. Williams and S. Trajmar

Phys. Rev. Lett., Vol. 33, No. 4, pp. 187–190, July 22, 1974

For abstract, see Williams, W.

T026 Quantum-Mechanical and Experimental Study of the Excitation of the 2 ^1P State of He by Electron Impact at 29–40 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, W. Williams, S. Ormonde (Quantum Systems, Inc.), and B. Torres (Quantum Systems, Inc.)

Phys. Rev., Pt. A: Gen. Phys., Vol. 8, No. 5, pp. 2475–2482, November 1973

For abstract, see Truhlar, D. G.

TRASK, N.

T027 Venus: Atmospheric Motion and Structure From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 183, No. 4131, pp. 1307–1315, March 29, 1974

For abstract, see Murray, B. C.

T028 Mercury's Surface: Preliminary Description and Interpretation From Mariner 10 Pictures

B. C. Murray (California Institute of Technology), M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, Jr., M. E. Davies (Rand Corporation), D. E. Gault (Ames Research Center), B. Hapke (University of Pittsburgh), B. O'Leary (Hampshire College), R. G. Strom (University of Arizona), V. Suomi (University of Wisconsin), and N. Trask (U.S. Geological Survey)

Science, Vol. 185, No. 4146, pp. 169–179, July 12, 1974

For abstract, see Murray, B. C.

TROMBKA, J. I.

T029 Some Correlations Between Measurements by the Apollo Gamma-Ray Spectrometer and Other Lunar Observations

J. I. Trombka (Goddard Spaceflight Center), J. R. Arnold (University of California, San Diego), R. C. Reedy (University of California, San Diego), L. E. Peterson (University of California, San Diego), and A. E. Metzger

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2847–2853

Observations by the Apollo 15 and 16 gamma-ray spectrometers are compared with those of a number of other experiments, both compositional and non-compositional. A general correspondence with topography is seen. The Van de Graaff area is a unique farside region with respect to observations by the laser altimeter, the subsatellite magnetometer, and the gamma-ray spectrometer. X-ray and alpha particle orbital measurements show a broad general agreement with gamma-ray data, though results from additional elements in the gamma-ray spectrum are needed to extend the comparison with X-ray data. A comparison of thorium concentrations with those found at various landing sites shows generally good agreement, with the orbital values tending to be somewhat higher.

T030 The Apollo Gamma-Ray Spectrometer

T. M. Harrington (MDH Industries, Inc.), J. H. Marshall (MDH Industries, Inc.), J. R. Arnold (University of California, San Diego), L. E. Peterson (University of California, San Diego), J. I. Trombka (Goddard Space Flight Center), and A. E. Metzger

Nucl. Instr. Methods, Vol. 118, No. 2, pp. 401–411, June 15, 1974

For abstract, see Harrington, T. M.

TRUBERT, M. R.

T031 A Shock Spectra and Impedance Method To Determine a Bound for Spacecraft Structural Loads

R. M. Bamford and M. R. Trubert

Technical Memorandum 33-694, September 1, 1974

For abstract, see Bamford, R. M.

TRUHLAR, D. G.

T032 Quantum-Mechanical and Experimental Study of the Excitation of the 2 ^1P State of He by Electron Impact at 29–40 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, W. Williams, S. Ormonde (Quantum Systems, Inc.), and B. Torres (Quantum Systems, Inc.)

Phys. Rev., Pt. A: Gen. Phys., Vol. 8, No. 5, pp. 2475–2482, November 1973

The close-coupling approximation (c.c.), the Vainshtein–Presnyakov–Sobelman approximation (VPS), and various first-order approximations, including the first Born approximation (B), are compared to accurate normalized experimental differential cross sections (estimated error less than 20%) for excitation of the 2 ^1P state of helium for impact energies 29.6, 34, and 40.1 eV, and scattering angles 3–138 deg. The most accurate new measurements are those at 29.6 and 40.1 eV. These measurements were normalized to the experimental integral cross sections of Donaldson *et al.* The experimental differential cross sections of Hall *et al.* are in good agreement with these present measurements. All the calculations except B include electron exchange. The VPS has the most accurate magnitude of the present calculations at small scattering angles but it is still too large (by a factor which at 45 deg is about 2.5 at 29.6 and 34 eV and is about 1.5 at 40.1 eV). The c.c. has the most accurate magnitude at large scattering angles and the most accurate angular dependence at all scattering angles, but it is not in good agreement with the measurements at the largest scattering angles.

TSAY, F.-D.

T033 Relaxation Times of Remanent Magnetisation in Lunar Fines

F.-D. Tsay

Nature Phys. Sci., Vol. 246, No. 153, pp. 76–78, December 3, 1973

On the basis of the observed equivalence between the remanence coercive force and the first-order crystalline anisotropy field for the Apollo 11–16 fines, it seems that the bulk of metallic Fe particles in the lunar fines are essentially spherical and have a short remanent relaxation time. These spherical metallic Fe particles could account for the apparently low blocking temperature observed for the unstable components of the natural remanent magnetisation (NRM) detected in the returned lunar samples. In view of the ease with which the electron-spin-resonance technique can distinguish between shape and crystalline anisotropy effects, it seems that the technique is particularly valuable for identifying the carriers of various NRM components having differing degrees of thermal stability.

T034 Metallic Fe Phases in Apollo 16 Fines: Their Origin and Characteristics as Revealed by Electron Spin Resonance Studies

F.-D. Tsay, S. L. Manatt, D. H. Live (California Institute of Technology), and S. I. Chan (California Institute of Technology)

Proceedings of the Fourth Lunar Science Conference, Houston, Texas, March 5–8, 1973 (Supplement 4, *Geochim. Cosmochim. Acta*), Vol. 3, pp. 2751–2761

The intense electron spin resonance (esr) signals (g = 2.08 ± 0.03) detected in the Apollo 16 fines from three sites (61141,4, Station 1; 64501,22, South Ray Crater; 67601,20, North Ray Crater) are found to be essentially similar in g-value, in lineshape asymmetry, and in temperature dependence to those previously observed for the Apollo 11–15 fines. On the basis of these similarities, it is concluded that these esr signals, like those detected in the Apollo 11–15 fines, are principally ferromagnetic in nature arising from metallic Fe phases having the body-centered cubic structure, and not from hematite, magnetite, or any other ferric oxides. It is shown that a quantitative correlation exists between the esr linewidth observed for the Apollo 11–16 fines and their average Ni contents in the metallic Fe phases as determined by other means.

For the three Apollo 16 fines investigated, the esr linewidths are found to be essentially identical. This together with a high Ni content in the metallic Fe phases of these samples as determined from esr linewidth correlation indicates a common source of meteoritic origin for the metallic Fe phases of these samples. Significant variations are observed in the metallic Fe content as well as in the total Ni content for these samples, in particular, between the fines from South Ray Crater and those from North Ray Crater. These variations appear to correlate with the surface-exposure ages of the samples. It is also shown that the first-order crystalline anisotropy energy determined from esr linewidth measurements is essentially equivalent to the remanence coercive force obtained in static magnetic susceptibility measurements for the lunar fines.

TSCHUIKOW-ROUX, E.

T035 Temperature Dependence of the Reactions of OH and HO_2 with O_3

W. B. DeMore and E. Tschuikow-Roux (University of Calgary, Canada)

J. Phys. Chem., Vol. 78, No. 15, pp. 1447–1451, July 18, 1974

For abstract, see DeMore, W. B.

TSURUTANI, B. T.

T036 Postmidnight Chorus: A Substorm Phenomenon

B. T. Tsurutani and E. J. Smith

J. Geophys. Res., Space Physics, Vol. 79, No. 1, pp. 118–127, January 1, 1974

The extremely-low-frequency (10–1500 Hz) electromagnetic emissions in the midnight sector of the outer magnetosphere have been studied using Ogo 5 search-coil-magnetometer data. Times and locations of occurrence of the postmidnight chorus and associated phenomena, such as magnetospheric substorms, are discussed; and chorus types and characteristics are described. Possible explanations of chorus phenomena are presented.

T037 Plasmaspheric Hiss Intensity Variations During Magnetic Storms

E. J. Smith, A. M. A. Frandsen, B. T. Tsurutani, R. M. Thorne (University of California, Los Angeles), and K. W. Chan (University of California, Los Angeles)

J. Geophys. Res., Space Physics, Vol. 79, No. 16, pp. 2507–2510, June 1, 1974

For abstract, see Smith, E. J.

TUCKER, T. K.

T038 DSN Progress Report for November–December 1973: Design of a High-Speed Reference Selector Switch Module for the Coherent Reference Generator Assembly

T. K. Tucker

Technical Report 32-1526, Vol. XIX, pp. 141–143, February 15, 1974

A design effort was started in April 1973 to develop and fabricate a high-speed switch module for the coherent reference generator assembly. The major design goal was to develop a high-speed switch capable of switching between frequency standards in less than 400 ns in the event of a primary standard failure, thus providing a constant failsafe 1-MHz reference signal to the station clocks. This article reviews the overall design and provides a general overview of the completed module.

UENO, S.

U001 Invariant Imbedding and Radiation Dosimetry: IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab

R. Bellman (University of Southern California), A. L. Fymat, S. Ueno (University of Southern California), and R. Vasudevan (University of Southern California)

Math. Biosci., Vol. 20, Nos. 3/4, pp. 315–325, April 1974

For abstract, see Bellman, R.

UNTI, T. W. J.

U002 Shock System of February 2, 1969

T. W. J. Unti, M. Neugebauer, and C.-S. Wu (University of Maryland)

J. Geophys. Res., Space Physics, Vol. 78, No. 31, pp. 7237–7256, November 1, 1973

The shock system observed in the solar wind by Pioneer 9 and Ogo 5 on February 2, 1969, consisted of the following major discontinuities: a forward slow shock, a forward fast shock, a tangential discontinuity at which the density dropped sharply and the flow direction changed, a tangential discontinuity at which the magnetic field strength jumped to an unusually high value, two closely spaced tangential discontinuities that bracketed a region of even greater field strength and that fronted a region of very cool, very dense, helium-enriched plasma, a reverse fast shock of low Mach number, and a second reverse fast shock of very low Mach number. The event had aspects of both corotating and flare-induced shock systems; it is suggested that the source of the disturbances was a flare occurring at or near an *M* region. The Ogo 5 search coil magnetometer detected a high level of turbulence throughout the event; a local enhancement of this turbulence at the front of the helium enrichment is believed to have been caused by a magnetic drift wave instability. Data are also presented for two other shock pair systems, both of which had density and flow direction profiles similar to those observed on February 2, 1969.

VARSI, G.

V001 Explosive Propulsion Applications

Y. Nakamura, G. Varsi, and L. H. Back

Technical Memorandum 33-675, April 1, 1974

For abstract, see Nakamura, Y.

V002 Detonation Propulsion for High Pressure Environments

L. H. Back and G. Varsi

AIAA J., Vol. 12, No. 8, pp. 1123–1130, August 1974

For abstract, see Back, L. H.

VASUDEVAN, R.

V003 Invariant Imbedding and Radiation Dosimetry: IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab

R. Bellman (University of Southern California), A. L. Fymat, S. Ueno (University of Southern California), and R. Vasudevan (University of Southern California)

Math. Biosci., Vol. 20, Nos. 3/4, pp. 315–325, April 1974

For abstract, see Bellman, R.

VOTE, F. C.

V004 Development of the Propulsion Subsystem for the Viking 75 Orbiter

F. C. Vote and W. J. Schatz

AIAA Preprint 73-1208, AIAA/SAE Ninth Propulsion Conference, Las Vegas, Nevada, November 5–7, 1973

The development of the Viking Mars 1975 Orbiter propulsion subsystem has been completed and qualification is under way. This development required an extension of the Mariner Mars 1971 propulsion subsystem technology to meet the Viking Mars 1975 requirements of three times the burn time and five times the number of burns. Modifications have been incorporated into the rocket engine to increase the cooling margin for the 2700-second Mars orbit insertion burn. This capability has been demonstrated in both engine firings and subsystem tests. A new surface tension device has been developed

to position the propellants (N_2O_4 and MMH) over the tank outlets during zero-g flight. Extensive scale model testing has been conducted to prove this propellant management concept. This subsystem will provide midcourse corrections, an orbit insertion burn and 20 orbit trims for the Viking Mars 1975 spacecraft. The Viking Project is managed by the Langley Research Center, National Aeronautics and Space Administration.

WADA, B. K.

W001 Modal Test of the Viking Orbiter

E. L. Leppert, B. K. Wada, and
R. Miyakawa (Martin Marietta Corporation)

Technical Memorandum 33-688, July 15, 1974

For abstract, see Leppert, E. L.

W002 Development and Correlation: Viking Orbiter Analytical Dynamic Model With Modal Test

B. K. Wada, J. A. Garba, and J. C. Chen

Technical Memorandum 33-690, June 1, 1974

The development of a mathematical dynamic model and its verification by a modal test is a significant milestone for many projects, including Viking Mars 1975 Orbiter (VO). Difficulties encountered include performing a modal test, establishing criteria for correlation of analysis with test, and modifying a large finite-element mathematical model to match test data if required. Often the modal test is performed near the end of the Project development schedule; consequently, the time alloted to obtain a verified mathematical model is minimal.

This memorandum describes the VO experience in the achievement of a good mathematical model. Success can be attributed to the coordination of analysis and tests using substructure modal coupling techniques. The experience would benefit the overall planning of any project, such as the Shuttle, especially if substructure modal coupling techniques are contemplated.

WAHLQUIST, H. D.

W003 Bäcklund Transformation for Solutions of the Korteweg–de Vries Equation

H. D. Wahlquist and F. B. Estabrook

Phys. Rev. Lett., Vol. 31, No. 23, pp. 1386–1390, December 3, 1973

This article presents a Bäcklund transformation operating on solutions of the Korteweg–de Vries equation. The transformation provides a unifying approach to the theory of solitary waves (solitons). Recursive application of the transformation to any solution of the Korteweg–de Vries equation generates a hierarchy of solutions for which an algebraic recursion relation is obtained. Every such hierarchy (one of which is the known family of pure multisoliton solutions) thus admits a nonlinear superposition principle.

WALL, R. J.

W004 Picture Analysis Applied to Biomedicine

D. A. O'Handley, E. S. Beckenbach,
K. R. Castleman, R. H. Selzer, and R. J. Wall

Comput. Graph. Image Process., Vol. 2, Nos. 3/4, pp. 417–432, December 1973

For abstract, see O'Handley, D. A.

WARDLE, M. D.

W005 Microbiological Aspects of Clean Room Technology as Applied to Surgery—With Special Reference to Unidirectional Airflow Systems

M. D. Wardle

Special Publication 43-7, July 9, 1974

This report, prepared for the NASA Applications Technology Office, reviews the microbiological aspects of clean room technology as applied to surgery. The following pertinent subject areas were examined: (1) clean room technology *per se* and its utilization for surgery, (2) microbiological monitoring of the clean room surgical environment, (3) clean rooms and their impact on operating room environmental microbiology, and (4) the effect of the technology on surgical wound infection rates. Conclusions were drawn for each topic investigated.

WEBB, W. A.

W006 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach,
S. K. Wong, R. T. Mitchell, W. A. Webb,
P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

WELCH, L. R.

W007 Simulation Study of a GCF Retransmission Scheme

L. R. Welch

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 125–128, August 15, 1974

This article discusses a study of a promising retransmission algorithm for correcting Ground Communications Facility (GCF) errors, using both actual GCF 4.8 kbps error data and Adeyemi's model. The results indicate that virtually all GCF error bursts can be corrected with a fairly simple scheme.

WHANG, M. M.

W008 Three-Spacecraft Simulation for Viking 1975

M. M. Whang

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 98–103, October 15, 1974

A telemetry simulation capability is provided at each deep space station, by way of the Simulation Conversion Assembly (SCA), for testing station equipment and training operations personnel prior to each mission. The simulation equipment provided the DSN for support of the Viking Mars 1975 mission has been substantially more complex than that provided for previous missions. No single DSN station has had the requirement of tracking three spacecraft for any previous flight project.

Deep space stations will be required to support the equivalent of four spacecraft (two orbiters and two landers) for the Viking Mars 1975 mission. However, any single station will have a view angle of a maximum three spacecraft at any given time (two orbiters and one lander). Since each spacecraft has two telemetry channels (one science and one engineering channel), the deep space stations must be prepared to process six channels of telemetry data and hence a six-channel simulation capability must be provided. This entails the generation of an additional two channels of simulated telemetry data over the present four-channel capability of the SCA. This article describes the SCA modification necessary to prepare for the Viking Mars 1975 mission.

WHITEHEAD, A. B.

W009 The Elevation of Olympus Mons From Limb Photography

A. B. Whitehead

Icarus, Vol. 22, No. 2, pp. 189–196, June 1974

Using a novel photogrammetric technique, the relative elevations of a set of control points on the Martian volcano Olympus Mons (Nix Olympica) have been measured from Mariner Mars 1971 limb pictures that include the volcano in the foreground. The summit of Olympus Mons is found to be 22 ± 1 km above the mean level of the surrounding plain by correlating the elevation results with previously reported planet radii at nearby occultation points. Vertical elevation differences as great as 5 km were measured between close points on the basal scarp.

WICK, M. R.

W010 DSN Programmed Oscillator

M. R. Wick

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 167–177, April 15, 1974

This article describes the programmed oscillator installed in the DSN Block III receiver/exciter subsystem at the Mars Deep Space Station and Ballima Deep Space Station for Pioneer 10 support during the Jupiter flyby. A brief description is given of the Block III receiver/exciter subsystem modifications required to implement the programmed oscillator and design changes in order to add the capability of providing timed linear frequency sweeps in the manual operating mode.

WIEBE, E.

W011 DSN Progress Report for November–December 1973: Low-Noise Receivers: Microwave Maser Development

R. C. Clauss and E. Wiebe

Technical Report 32-1526, Vol. XIX, pp. 93–99, February 15, 1974

For abstract, see Clauss, R. C.

W012 Microwave Maser Development: Automatic Monitoring of Closed Cycle Refrigerators for Masers

E. Wiebe

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 49–52, April 15, 1974

A method for automatically monitoring the reserve capacity of a closed-cycle refrigerator (CCR) has been developed and tested. The principal feature of the present design is that the measuring device adds negligible thermal load to the CCR. The instrumentation is particularly applicable to automated tracking station operation.

WILCHER, J.

W013 DSN Progress Report for November–December 1973: A Scaled-Time Telemetry Test Capability for Sequential Decoding

S. Butman, J. W. Layland, J. W. MacConnell, R. C. Chernoff, N. C. Ham, and J. Wilcher

Technical Report 32-1526, Vol. XIX, pp. 144–151, February 15, 1974

For abstract, see Butman, S.

WILLIAMS, J. G.

W014 Lunar Physical Librations and Laser Ranging

J. G. Williams, M. A. Slade, D. H. Eckhardt (Air Force Cambridge Research Laboratories), and W. M. Kaula (University of California, Los Angeles)

The Moon, Vol. 8, No. 4, pp. 469–483, October 1973

The analysis of lunar laser ranging data requires very accurate calculations of lunar physical librations. Libration terms are given which arise from the additive and planetary terms in the lunar theory. The large size of the recently discovered terms due to third degree gravitational harmonics will allow some of these harmonics to be measured, in addition to β and γ, by laser ranging to the Moon. Numerical integration promises to be an effective method of calculating librations. Comparison of numerical integrations with analytic series indicates that the calculation of the series due to third and fourth degree harmonics is not yet as accurate as the more extensively developed second degree terms.

WILLIAMS, W.

W015 Elastic and Inelastic Electron Scattering at 20 and 60 eV From Atomic Cu

W. Williams and S. Trajmar

Phys. Rev. Lett., Vol. 33, No. 4, pp. 187–190, July 22, 1974

Normalized differential and integral electron-impact cross sections for elastic scattering and for the excitation of the $^2D_{5/2}$, $^2D_{3/2}$, and $^2P_{3/2,1/2}$ levels of atomic copper have been determined at 20 and 60 eV. An unexpectedly large cross section was found for the excitation of the $^2P_{3/2,1/2}$ levels, which at certain angular and energy ranges surpasses the cross section for elastic scattering. The integral cross sections in units of 10^{-16} cm^2 at 20 and 60 eV, respectively, are: elastic, 91.0 and 59.0; $^2D_{5/2}$, 1.85 and 0.36; $^2D_{3/2}$, 1.26 and 0.26; and $^2P_{3/2,1/2}$, 77.2 and 36.5.

W016 Quantum-Mechanical and Experimental Study of the Excitation of the 2 ^{1}P State of He by Electron Impact at 29–40 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, W. Williams, S. Ormonde (Quantum Systems, Inc.), and B. Torres (Quantum Systems, Inc.)

Phys. Rev., Pt. A: Gen. Phys., Vol. 8, No. 5, pp. 2475–2482, November 1973

For abstract, see Truhlar, D. G.

WILLIAMS, W. F.

W017 Contoured Patterns From Reflector Systems: A Spherical Wave Expansion Solution

W. F. Williams

Preprint 74-487, AIAA Fifth Communications Satellite Systems Conference, Los Angeles, California, April 22–24, 1974

Any electromagnetic field (e.g., a contoured antenna pattern) may be expanded into a sum of spherical waves, similar to a one dimensional Fourier expansion. This expanded wave can then be scattered from a source reflector to determine a resulting required feed field in the vicinity of the focal region. This result is of questionable value and the more significant information would be the required feed pattern itself. Hence, the required contour pattern is instead scattered from the back of the reflector and the result is the required feed pattern with origin at the focus of the chosen reflector.

WILLIAMSON, A. D.

W018 Formation of HO_2^+ by Reaction of Metastable O_2^+ Ions With H_2

J. M. Ajello, W. T. Huntress, Jr., A. L. Lane, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 60, No. 4, pp. 1211–1213, February 15, 1974

For abstract, see Ajello, J. M.

W019 Photoionization and Ion Cyclotron Resonance Studies of the Reaction of Vibrationally Excited $C_2H_2^+$ Ions With H_2

S. E. Buttrill, Jr., J. K. Kim, W. T. Huntress, Jr., P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

J. Chem. Phys., Vol. 61, No. 5, pp. 2122–2128, September 1, 1974

For abstract, see Buttrill, S. E., Jr.

W020 Cross-Section for the Dissociative Photoionization of Hydrogen by 584 Å Radiation: The Formation of Protons in the Jovian Ionosphere

K. M. Monahan (University of California, Santa Barbara), W. T. Huntress, Jr., A. L. Lane, J. M. Ajello, J. M. Burke, P. R. LeBreton (California Institute of Technology), and A. D. Williamson (California Institute of Technology)

Planet. Space Sci., Vol. 22, No. 1, pp. 143–149, January 1974

For abstract, see Monahan, K. M.

WILLSON, R. C.

W021 Absolute Radiometry and the Solar Constant

R. C. Willson

Space Optics; Proceedings of the Ninth International Congress of the International Commission for Optics, Santa Monica, California, October 9–13, 1972, pp. 502–510

The definition of an absolute radiation scale, based on fundamental physical principles, can be effected by standard detectors or by standard sources of radiation. Standard sources, usually termed blackbody sources, are cavity radiators operated at high temperature. Calibration of secondary radiometers can be carried out in the laboratory by exposing them to the irradiance of a standard source. Measurements made in remote locations by the radiometer may then be reported on the absolute radiation scale as defined by the standard source.

The standard source method has some serious disadvantages. The calibration of secondary radiometers is an added experimental step with associated indeterminacies regarding the absolute temperature of the source and the radiative transfer between source and radiometer. The definition of the absolute radiation scale by standard detectors obviates many of the standard-source-associated problems. It is this approach that has been pursued at JPL in making absolute measurements of solar radiation. This paper describes a family of high-accuracy active-cavity radiometers developed at JPL.

WILSON, J. H.

W022 California Four Cities Program 1971–1973

H. L. Macomber and J. H. Wilson

Special Publication 43-4, May 15, 1974

For abstract, see Macomber, H. L.

WIMBERLY, R. N.

W023 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

W024 Lunar Gravity via the Apollo 15 and 16 Subsatellites

W. L. Sjogren, R. N. Wimberly, and W. R. Wollenhaupt (NASA–Lyndon B. Johnson Space Center)

The Moon, Vol. 9, Nos. 1/2, pp. 115–128, January 1974

For abstract, see Sjogren, W. L.

WINN, F. B.

W025 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

W026 DSN–MVM'73 S/X Dual-Frequency Doppler Demonstration

F. B. Winn, K. W. Yip, and S. J. Reinbold

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 28–50, August 15, 1974

Doppler charged-particle calibrations derived from S/X-band dual-doppler data have been demonstrated successfully. The accuracy of the S/X-band dual-doppler has been verified by comparisons to Faraday polarization data. This verification, limited by the accuracy of "mapped" Faraday data, is to the 10- to 30-cm level. The S/X-band dual-doppler exhibits subcentimeter resolution and, thus, its potential accuracy. The S/X-band dual-doppler calibrations are significant for the Mariner Venus/Mercury 1973 spacecraft (Mariner 10) Mercury-encounter orbit determination. The error of the estimate of

the Mariner 10 Mercury target plane coordinate was reduced by ~500 km (~80% improvement).

WOICESHYN, P. M.

W027 Global Seasonal Atmospheric Fluctuations on Mars

P. M. Woiceshyn

Icarus, Vol. 22, No. 3, pp. 325–344, July 1974

The Mariner Mars 1971 S-band radio-occultation measurements, which were taken over half a Martian year, were examined for seasonal variations in atmospheric pressures and temperatures. Seasonally related atmospheric pressure oscillations on a global scale were discovered when the pressures were compared on equipotential levels. There was a global increase in pressure of about 13% between northern winter and spring seasons, and a global decrease in pressure of nearly 14% between northern spring and summer seasons. The maximum global pressure occurred during the northern spring season approximately one Martian month prior to aphelion. These pressure oscillations were correlated with the seasonal growth and decay, and the total area of the polar caps.

Temperatures in the mid-latitude regions near the subsolar points were highest during the northern winter season when Mars was closest to the sun. In addition, high latitudinal temperature gradients (up to 2 K per degree latitude) were found. This has important atmospheric dynamical implications, especially for the growth of baroclinic waves.

Occultation observations also indicated that the average elevation of the southern hemisphere was nearly 4 km higher than the northern hemisphere when referenced to an equipotential level. The occultation measurements showed that the atmospheric pressures near the surface in the southern hemisphere were 33 to 43% lower than the atmospheric pressures near the surface in the northern hemisphere. In addition to other parameters, the asymmetry in the density of the Martian atmosphere and the hemispheric altitude differences are important in understanding the seasonal dynamic processes that exist in the polar cap regions and in the Martian atmosphere generally.

WOLLENHAUPT, W. R.

W028 Lunar Gravity via the Apollo 15 and 16 Subsatellites

W. L. Sjogren, R. N. Wimberly, and W. R. Wollenhaupt (NASA–Lyndon B. Johnson Space Center)

The Moon, Vol. 9, Nos. 1/2, pp. 115–128, January 1974

For abstract, see Sjogren, W. L.

W029 Lunar Gravity: Apollo 15 Doppler Radio Tracking

P. M. Muller, W. L. Sjogren, and W. R. Wollenhaupt

The Moon, Vol. 10, No. 2, pp. 195–205, June 1974

For abstract, see Muller, P. M.

WONG, S. K.

W030 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

W031 Gravity Results From Pioneer 10 Doppler Data

J. D. Anderson, G. W. Null, and S. K. Wong

J. Geophys. Res., Space Physics, Vol. 79, No. 25, pp. 3661–3664, September 1, 1974

For abstract, see Anderson, J. D.

WOO, R. T.

W032 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase II

R. T. Woo and W. Kendall

Technical Memorandum 33-702, August 15, 1974

This memorandum studies two problems related to the effects of turbulence in the atmosphere of Venus on the Pioneer Venus entry-probe radio link. In the first, the cross correlation between the log-amplitude and phase fluctuations of the Pioneer Venus communications link is examined. It is seen that for fluctuation frequencies above approximately 1 Hz there is little or no correlation. For lower frequencies, the correlation is weak and the square root of the coherence has a peak value close to 0.65.

The second problem consists of inferring the turbulence characteristics of the Venus atmosphere from the Mariner Venus 1967 spacecraft (Mariner 5) phase fluctuations. It is seen that with the data processing techniques currently available, the phase error due to oscillator drift, assumed trajectory delay, and spline-curve fit exceed the turbulence induced fluctuations. It is, therefore,

not possible to infer the turbulence characteristics from the Mariner 5 phase fluctuations.

W033 Effects of Turbulence in a Planetary Atmosphere on Radio Occultation

R. T. Woo and A. Ishimaru (University of Washington)

IEEE Trans. Anten. Prop., Vol. AP-22, No. 4, pp. 566–573, July 1974

There has been considerable interest in the amplitude and phase fluctuations of the radio signal received from a flyby spacecraft during occultation by a planetary atmosphere. For planetary flyby missions, the Fresnel-zone size exceeds the outer scale size of turbulence, and existing formulations for the frequency spectra of the amplitude and phase fluctuations are inadequate because they do not account for the inhomogeneity of the turbulence in the direction transverse to the propagation path. In this article, the formulation is given for the correlation functions for the log-amplitude and phase fluctuations is described by the product of a function of the average coordinate and a function of the difference coordinate.

The results are applied to radio occultation of a flyby space probe by the atmosphere of Venus, assuming that the turbulence in the atmosphere exists as a layer, that it is localized, isotropic, and smoothly varying, and that the localized turbulence is described by the Kolmogorov spectrum. Closed-form solutions for both variances and frequency spectra of the log-amplitude and phase fluctuations are obtained using Rytov's method, and it is seen that the shape of the frequency spectra depends a great deal on the characteristics and extent of the turbulence.

W034 Observations of Small-Scale Turbulence in the Atmosphere of Venus by Mariner 5

R. T. Woo, A. Ishimaru (University of Washington), and W. Kendall (Mark Resources, Inc.)

J. Atmos. Sci., Vol. 31, No. 6, pp. 1698–1706, September 1974

Information regarding small-scale turbulence in the atmosphere of Venus is important and desirable because it contributes to our understanding of the atmosphere's circulation. In this article, we demonstrate that the radio-occultation data of a flyby spacecraft such as Mariner Venus 1967 (Mariner 5) can provide valuable information on turbulence in the atmosphere of Venus. Unlike previous studies of the Mariner 5 data, this article is based on the frequency spectrum rather than the variance of the log-amplitude fluctuations. The excellent agreement between the processed and previously derived theoretical spectra furnishes strong evidence that the Mariner 5 fluctuations are primarily turbulence-induced. It is seen that above 35 km, turbulence is strongest in the vicinity of 45 and 60 km, and that the outer scale of turbulence is of the order of 100 m. Comparison with the results obtained from the Venera missions is also discussed.

W035 RF Voltage Breakdown and the Paschen Curve

R. T. Woo

Proc. IEEE, Vol. 62, No. 4, p. 521, April 1974

A representation based on the similarity relations for voltage breakdown is shown to be useful in combining RF and dc voltage breakdown data. The representation for the uniform field geometry is given.

WU, C.-S.

W036 Shock System of February 2, 1969

T. W. J. Unti, M. Neugebauer, and C.-S. Wu (University of Maryland)

J. Geophys. Res., Space Physics, Vol. 78, No. 31, pp. 7237–7256, November 1, 1973

For abstract, see Unti, T. W. J.

YAGI, G. M.

Y001 Computer Determination of Depth Maps

M. D. Levine, D. A. O'Handley, and G. M. Yagi

Comput. Graph. Image Process., Vol. 2, No. 2, pp. 131–150, October 1973

For abstract, see Levine, M. D.

YAKIMOVSKY, Y.

Y002 On the Recognition of Complex Structures: Computer Software Using Artificial Intelligence Applied to Pattern Recognition

Y. Yakimovsky

Technical Memorandum 33-693, May 1, 1974

This memorandum presents an approach to simultaneous interpretation of objects in complex structures so as to maximize a combined utility function. Results of the application of a computer software system to assign meaning to regions in a segmented image based on the principles described in this memorandum and on a special interactive sequential classification learning system, which is referenced, are demonstrated.

Y003 Boundary and Object Detection in Real World Images

Y. Yakimovsky

Technical Memorandum 33-709, November 15, 1974

This memorandum presents a solution to the problem of automatic location of objects in digital pictures by computer, and describes a self-scaling local edge detector which can be applied in parallel on a picture. Clustering algorithms and boundary-following algorithms which are sequential in nature process the edge data to locate images of objects.

YANG, L. C.

Y004 Stress Waves Generated in Thin Metallic Films by a Q-Switched Ruby Laser

L. C. Yang

J. Appl. Phys., Vol. 45, No. 6, pp. 2601–2608, June 1974

Vacuum-deposited thin films of B, C, Mg, Al, Si, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ge, Zr, Mo, Ag, In, Sn, Sb, Pt, Au, Pb, and Bi, in several thicknesses and confined between glass substrates, were irradiated by a uniform Q-switched ruby laser beam. The laser pulse was 15 ns in duration, with a maximum energy of 5 J in an area 6.35 mm in diameter. The stress waves were studied using the piezoelectric response of X-cut quartz-crystal disks of the same diameter. The peak stresses are presented as a function of the energy fluence, with possible interpretations of the phenomenon.

YASUI, R. K.

Y005 Lithium-Doped Solar Cell Pilot Line Fabrication and Test Programs

P. A. Berman and R. K. Yasui

Technical Memorandum 33-677, October 1, 1974

For abstract, see Berman, P. A.

YEATES, C. M.

Y006 Observations at Mercury Encounter by the Plasma Science Experiment on Mariner 10

K. W. Ogilvie (Goddard Space Flight Center), J. D. Scudder (Goddard Space Flight Center), R. E. Hartle (Goddard Space Flight Center), G. L. Siscoe (University of California, Los Angeles), H. S. Bridge (Massachusetts Institute of Technology), A. J. Lazarus (Massachusetts Institute of Technology), J. R. Asbridge (Los Alamos Scientific Laboratory), S. J. Bame (Los Alamos Scientific Laboratory), and C. M. Yeates

Science, Vol. 185, No. 4146, pp. 145–151, July 12, 1974

For abstract, see Ogilvie, K. W.

YEH, C.

Y007 Mode Conversion in Periodically Disturbed Thin-Film Waveguides

C. Elachi and C. Yeh (University of California, Los Angeles)

J. Appl. Phys., Vol. 45, No. 8, pp. 3494–3499, August 1974

For abstract, see Elachi, C.

YEH, Y.-C. M.

Y008 Optical Properties of Thin Gold Films Applied to Schottky Barrier Solar Cells

Y.-C. M. Yeh

Technical Memorandum 33-676, March 15, 1974

The Schottky-barrier solar cell is considered a possible candidate for converting solar to electrical energy both for space and terrestrial applications. Knowledge of the optical constants of the ultrathin metal film used in the cell is essential for analyzing and designing high efficiency Schottky-barrier cells. This memorandum presents the optical constants of 7.5-nm gold films on gallium-arsenide. In addition, the absolute collection efficiency of Schottky-barrier solar cells has been determined from measured spectral response and optical constants of the gold film.

YEN, S. P. S.

Y009 Platelet Adhesion to Heparin-Bonded and Heparin-Free Surfaces

A. Rembaum, S. P. S. Yen, M. Ingram, J. F. Newton, C. L. Hu, W. G. Frasher (University of Southern California Medical Center), and B. H. Barbour (University of Southern California Medical Center)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 99–119, 1973

For abstract, see Rembaum, A.

YIP, K. W.

Y010 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

Y011 DSN–MVM'73 S/X Dual-Frequency Doppler Demonstration

F. B. Winn, K. W. Yip, and S. J. Reinbold

The Deep Space Network: May and June 1974, DSN Progress Report 42-22, pp. 28–50, August 15, 1974

For abstract, see Winn, F. B.

YOUNG, A. T.

Y012 Seeing: Its Cause and Cure

A. T. Young

Astrophys. J., Vol. 189, No. 3, Pt. 1, pp. 587–604, May 1, 1974

Following Fried, the statistics of images formed by an annular telescope aperture looking through the turbulent atmosphere are calculated; the deleterious effect of a central obscuration is much larger in the presence of seeing than for the telescope alone. A method of optimizing resolution through the atmosphere is explained in detail, with particular attention to the requirements for image-motion compensation; under ideal conditions, about a factor-of-four increase in effective resolution over conventional photography can be obtained. The effective resolution can be larger or smaller than the "seeing disk," depending on the recorded signal-to-noise ratio. Some common misconceptions about image structure and motion, and various unsound proposals for beating the seeing, are criticized. For the range of turbulent spectra actually observed in the atmosphere, no large improvement in resolution can be obtained at infrared wavelengths. Furthermore, the optimum telescope aperture is rather small; the apparent advantages of large telescopes are due solely to a good signal-to-noise ratio, not good resolution.

ZAWACKI, B. E.

Z001 Quantitative Imagery in the Bio-Medical Sciences—II. Infrared Photography as a Diagnostic Tool for the Burn Wound

V. J. Anselmo and B. E. Zawacki (University of Southern California Medical Center)

Proceedings of the Society of Photo-optical Instrumentation Engineers, San Diego, California, August 27–29, 1973, Vol. 40, pp. 181–188

For abstract, see Anselmo, V. J.

ZIELENBACH, J. W.

Z002 Mariner 9 Navigation

W. J. O'Neil, J. F. Jordan, J. W. Zielenbach, S. K. Wong, R. T. Mitchell, W. A. Webb, P. E. Koskela, et al.

Technical Report 32-1586, November 13, 1973

For abstract, see O'Neil, W. J.

Z003 Tracking System Analytic Calibration Activities for the Mariner Mars 1971 Mission

G. A. Madrid, C. C. Chao, H. F. Fliegel, R. K. Leavitt, N. A. Mottinger, F. B. Winn, R. N. Wimberly, K. W. Yip, and J. W. Zielenbach

Technical Report 32-1587, March 1, 1974

For abstract, see Madrid, G. A.

Z004 Report of the Two-Station Doppler (VLBI) Demonstration Conducted With Mariner 9

B. D. Mulhall, C. C. Chao, D. E. Johnson, and J. W. Zielenbach

The Deep Space Network: January and February 1974, DSN Progress Report 42-20, pp. 27–40, April 15, 1974

For abstract, see Mulhall, B. D.

ŽMUIDZINAS, J. S.

Z005 Phonons in Quantum Solids With Defects

N. Jacobi and J. S. Žmuidzinas

Technical Memorandum 33-701, September 1, 1974

For abstract, see Jacobi, N.

ZOHAR, S.

Z006 Surface Features on Mercury

S. Zohar and R. M. Goldstein

Astron. J., Vol. 79, No. 1, pp. 85–91, January 1974

A high-resolution study of the surface of Mercury with a 2.388 GHz radar reveals the existence of hills and valleys with heights (depths) of about 1 km. There is also evidence supporting the existence of craters with diameters of about 50 km and depths of about 700 km.

Z007 The Solution of a Toeplitz Set of Linear Equations

S. Zohar

J. Assoc. Comp. Mach., Vol. 21, No. 2, pp. 272–276, April 1974

This article considers the solution of a set of m linear equations with a non-Hermitian Toeplitz associated matrix. Presently available fast algorithms solve this set with $4m^2$ "operations" (an "operation" is defined here as a set of one addition and one multiplication). An improved algorithm requiring only $3m^2$ "operations" is presented.

ZYGIELBAUM, A. I.

Z008 "Tutorial Input"—Standardizing the Computer/Human Interface

A. I. Zygielbaum

The Deep Space Network: July and August 1974, DSN Progress Report 42-23, pp. 78–86, October 15, 1974

This article describes a new technique for implementing a human/computer interface for computer-based subsystems for the DSN. Known as "tutorial input," this technique provides convenient short input procedures for the experienced operator and a helping hand for the novice. From the programmer's viewpoint, the technique is implemented in a compact, modular, easily modified, table-driven structure. The technique has been successfully used through two generations of R&D ranging machines.

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		M074
		M075
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		P030
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393	Systems Analysis	B003
		L062
410	TDA Planning Office	C019
		G021
420	DSN Operations Office	G019
		M050
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421	Network Operations Office	A007
		B023
		B024
		B025
		B026
		B032
		B052
		F001
		H022
		L030
		L031
		L032
		M071
		M072
		M075
		P033
		R021
		S027
		S052
		S053
		T009
422	DSN Facility Operations Office	S037
		S039
430	DSN Systems Engineering Office	B048

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	M048
	M049
	M051
	M052
	M071
	M072
	M073
	M074
	M075
	R015
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33-452, Vol. III	H019
33-585, Vol. I	C048
33-585, Vol. I, Addendum 1	C043
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33-654	J015
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33-662	S046
33-663	N003
33-664	P010
33-666	H017
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33-668	S012
33-669	B017
33-670	I003
33-671	T023
33-672	D014
33-673	A017
33-675	N001
33-676	Y008
33-677	B027
33-678	J021
33-679	L045
33-680	R024
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33-682	H001
33-683	B037
33-684	B022
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33-686	N014
33-687	P006

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Open Literature Reporting

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