NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Bibliography 39-15

Publications of the Jet Propulsion Laboratory: January Through December 1973

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

April 1, 1974

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II

Foreword

JPL Bibliography 39-15 describes and indexes the formalized technical reporting, released January through December 1973, 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) Articles from the bimonthly *Deep Space Network (DSN) Progress Report* (Technical Report 32-1526). Each volume's collection of articles presents a periodical survey of current accomplishments by the Deep Space Network.

(3) 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.

(4) Articles from the *JPL Quarterly Technical Review*. Each article summarizes a recent important development, interim or final results, or an advancement in the state of the art in a scientific or engineering endeavor. This publication has been discontinued, and the issues indexed in this bibliography are the last to be published.

(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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A001 Mascons: Progress Toward a Unique Solution for Mass Distribution

R. J. Phillips, J. E. Conel, E. A. Abbott, W. L. Sjogren, and J. B. Morton

J. Geophys. Res., Vol. 77, No. 35, pp. 7106–7114, December 10, 1972

For abstract, see Phillips, R. J.

ACTON, C. H., JR.

A002 Processing Onboard Optical Data for Planetary Approach Navigation

C. H. Acton, Jr.

J. Spacecraft Rockets, Vol. 9, No. 10, pp. 746–750, October 1972

The Mariner 9 science television camera provided an optical navigation experiment with TV pictures containing images of Martian natural satellites and background stars. Required TV and spacecraft engineering data were extracted from the spacecraft telemetry stream and successfully processed in this near-real time experiment designed to validate the navigation content of spacecraft-based optical data. The preparation of this optical data for use in a navigation filter included development and calibration of a TV error model, identification of detected signals, and estimation of the location of the center of each valid image, including associated statistics.

Ground and in-flight calibrations allowed subsequent celestially referenced camera pointing knowledge of better than 6 arc sec. An average of 3.5 images per picture was found in the 19 pictures allotted the experiment during the 72 h prior to Mars encounter. System performance was excellent, leading to very accurate trajectory estimates. The experiment provides a basis for the design of improved systems for future missions.

A003 On-Board Optical Navigation Data From Mariner 71

T. C. Duxbury and C. H. Acton, Jr.

Navigation: J. Institute Nav., Vol. 19, No. 4, pp. 295–307, Winter 1972–1973

For abstract, see Duxbury, T. C.

ADAMS, R. W.

A004 Ion Thruster Performance Calibration

E. V. Pawlik, R. Goldstein, D. J. Fitzgerald, and R. W. Adams

J. Spacecraft Rockets, Vol. 10, No. 6, pp. 327–332, May 1973

For abstract, see Pawlik, E. V.

ADEYEMI, O.

A005 DSN Progress Report for November–December 1972: An Information-Theoretic Model for the Ground Communications Facility Line

O. Adeyemi

Technical Report 32-1526, Vol. XIII, pp. 139–153, February 15, 1973

This article presents a three-state Markov chain as a model for the errors occurring on the Ground Communications Facility high-frequency wideband channel. An analytic expression for the capacity of the channel in terms of the model parameters is obtained, and comparison is made with the capacity of a binary symmetric channel with the same bit-error rate. For a better understanding of the channel's intrinsic behavior and for use in estimating the performances of different error-detecting and error-correcting codes, we obtain analytic expressions for three sets of channel parameters. These are the bit-error statistics, the block-error statistics, and the distribution of burst lengths and error-free (gap) intervals.

AJELLO, J.

A006 Ground Level Ultraviolet Solar Flux in Pasadena, California

J. Ajello, J. King, Jr., A. L. Lane, and C. W. Odd

Bull. Am. Meteorol. Soc., Vol. 54, No. 2, pp. 114–115, February 1973

Relative ultraviolet solar spectra were taken from Pasadena, California, as a function of solar zenith angle. The wavelength range extended from the cutoff wavelength at about 3000 Å to almost 3500 Å with a resolution of 15 Å. The cutoff wavelength was measured as a function of solar elevation angle and varies from 3160 Å at 4° solar elevation to 2955 Å at 41° solar elevation angle. This article displays calibrated spectra for four solar

elevation angles as well as the cutoff wavelength as a function of solar elevation angle.

A007 A Study of the Compatibility of Science Instruments With the Solar Electric Propulsion Space Vehicle

R. H. Parker, J. Ajello, A. Bratenahl, D. R. Clay, and B. Tsurutani

Technical Memorandum 33-641, October 15, 1973

For abstract, see Parker, R. H.

A008 Mariner 9 Ultraviolet Spectrometer Experiment: Afternoon Terminator Observations of Mars

J. Ajello, C. W. Hord (University of Colorado), C. A. Barth (University of Colorado), A. I. Stewart (University of Colorado), and A. L. Lane

J. Geophys. Res., Vol. 78, No. 20, pp. 4279–4290, July 10, 1973

Analysis of the Mariner 9 ultraviolet spectrometer twilight data of Mars indicates the presence of two characteristic types of atmospheric scattering properties as measured at 3050 Å. Measurements in the mid-latitudes from 15°S to 50°N require a scattering layer at an altitude of 60–90 km in order to explain the intensity variation with solar depression angle. A scattering layer of optical thickness 0.005 combined with a homogeneous lower atmosphere having a nominal 10-km scale height will explain the mid-latitude measurements. North of 50° latitude the terminator intensity is enhanced and decreases rapidly with increasing solar depression angle. The terminator scattering at northern latitudes can be explained by a homogeneous scattering medium with an optical thickness ≥ 0.1, a single scattering albedo of 0.3–0.5, and an effective scale height of 6–8 km. Atmospheric water ice or carbon dioxide ice probably accounts for both the mid-latitude scattering layer and the enhanced scattering in the northern latitude lower atmosphere.

ALLEN, J. E.

A009 DSN Progress Report for March–April 1973: Recent Modifications to the DSN Monitor and Control System

J. E. Allen and W. Honer

Technical Report 32-1526, Vol. XV, pp. 185–189, June 15, 1973

This article describes recent improvements to the monitor function of the DSN Monitor and Control System. The changes include the use of a new digital instrumentation subsystem computer program that will serve as a single monitor program for all deep space stations. The effects of the new or modified equipment on activities of operations personnel are also discussed.

ANDERSON, J. D.

A010 Measurement of General Relativistic Time Delay With Mariners 6 and 7

J. D. Anderson, P. B. Esposito, W. Martin, and D. O. Muhleman (California Institute of Technology)

Space Research XII, pp. 1623–1630, Akademie-Verlag, Berlin, 1971

Range and doppler data extending over the interval from August 1969 to December 1970 have been obtained at S-band from Mariners 6 and 7. The range data possess an accuracy of 0.1 μs and constitute the basis of the experimental determination of the relativistic time delay. At superior conjunction, this effect reached a maximum of approximately 200 μs for Mariner 6 and 180 μs for Mariner 7. The prediction of Einstein's theory of general relativity that the propagation of electromagnetic radiation is delayed due to the solar gravitational field has been verified to at least 4%. Non-gravitational forces acting on the spacecraft limit the accuracy of this result. Furthermore, since the solar corona also contributes to a delay in the signal propagation it is important to separate this effect from the relativistic delay. Analysis of the Mariner data indicates a coronal model consistent with those deduced by other methods. Uncertainties in this model as well as the influence of non-modeled forces acting on the spacecraft limit the ultimate precision of the relativity experiment to at best 1%.

ANDERSON, R.

A011 Isoluminous Additive Color Method for the Detection of Small Spectral Reflectivity Differences

E. Yost (Long Island University), R. Anderson (Long Island University), and A. F. H. Goetz

Photogr. Sci. Eng., Vol. 17, No. 2, pp. 177–182, March–April 1973

For abstract, see Yost, E.

ANDERSON, T. O.

A012 DSN Progress Report for November–December 1972: Optimum Control Logic for Successive Approximation Analog-to-Digital Converters

T. O. Anderson

Technical Report 32-1526, Vol. XIII, pp. 168–176, February 15, 1973

Optimum control logic is a popular subject with designers and manufacturers of high-resolution, high-speed, low-cost, modular analog-to-digital converters of the successive-approximation type which are found in abundance in today's module market. With miniaturization being a strong consideration, it may not be long before the complete control logic will be available in a single medium-scale integrated-circuit chip. This article describes designs that may be strong contenders for such chips. One novelty of these designs is found in their optimum logic and minimum component count, considering presently available components. Another novelty is that they are modular or iterative, i.e., the logic structure is the same for all bits. A high-resolution converter logic is then simply an extension of the logic for a low-resolution converter.

A013 DSN Progress Report for January–February 1973: Universal Parallel Analog-to-Digital Encoder Module

T. O. Anderson

Technical Report 32-1526, Vol. XIV, pp. 94–100, April 15, 1973

As more and higher frequency Deep Space Instrumentation Facility receiver operations become digitized, the DSN requires higher speed, simpler, and more cost-effective analog-to-digital converters. Besides meeting these requirements the converter described in this article is modular and lends itself to standardization.

The conversion method used is the all-parallel method that is optimum for high speed. One comparator–amplifier is used for each level of resolution and includes the digital-code converter that converts the output of the comparator–amplifier to binary code. The module contains four levels, so that an eight-level converter is made up of two externally connected modules, and a sixteen-level converter is made up of four externally connected modules.

A014 DSN Progress Report for March–April 1973: Bit Synchronizer for Sample Data Antenna Pointing System

T. O. Anderson, J. K. Holmes, and W. J. Hurd

Technical Report 32-1526, Vol. XV, pp. 128–132, June 15, 1973

In the continuous effort to computerize antenna-pointing and control systems at the deep space stations, sample data systems are required. As a result of modular subsystems being readily available commercially, the sample data systems are designed in accordance with a decentralized-system design philosophy. A number of smaller subsystems are located close to the data sources. The subsystems feed data to collection centers which in turn feed data to the computer. The only connection between subsystems, collection centers, and computer is a single coaxial cable. Since there is no separate clock signal, bit synchronization must be extracted from the data signal in order to recover the serial binary data.

This article describes a particularly simple bit-synchronizer phase-locked loop especially designed for this noise-free environment. The performance of the loop has been analyzed and qualitatively verified on a laboratory breadboard model.

ARENS, W. E.

A015 Solid Motor Diagnostic Instrumentation

Y. Nakamura, W. E. Arens, and W. S. Wuest

Technical Memorandum 33-656, December 1, 1973

For abstract, see Nakamura, Y.

ARNOLD, J. R.

A016 Lunar Surface Radioactivity: Preliminary Results of the Apollo 15 and Apollo 16 Gamma-Ray Spectrometer Experiments

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

Science, Vol. 179, No. 4075, pp. 800–803, February 23, 1973

For abstract, see Metzger, A. E.

ATKINS, K. L.

A017 SEP Thrust Subsystem Performance Sensitivity Analysis

K. L. Atkins, C. G. Sauer, Jr., and D. J. Kerrisk

Technical Memorandum 33-611, August 15, 1973

This is a two-part memorandum on solar electric propulsion (SEP) performance sensitivity analysis. The first part describes the preliminary analysis of the SEP thrust system performance for an Encke rendezvous mission. A detailed description of thrust subsystem hardware tolerances on mission performance is included together with nominal spacecraft parameters based on these tolerances.

The second part of this memorandum describes the method of analysis and graphical techniques used in generating the data for Part 1. Included is a description of both the trajectory program used and the additional

software developed for this analysis. Part 2 also includes a comprehensive description of the use of the graphical techniques employed in this performance analysis.

AVIŽIENIS, A.

A018 Arithmetic Algorithms for Error-Coded Operands

A. Avižienis

IEEE Trans. Computers, Vol. C-22, No. 6, pp. 567–572, June 1973

A set of arithmetic algorithms is described for operands that are encoded in the "*AN*" error-detecting code with the low-cost check modulus $A = 2^a - 1$. The set includes addition, additive inverse (complementation), multiplication, division, roundoff, and two auxiliary algorithms: "multiply by $2^a - 1$" and "divide by $2^a - 1$." The design of a serial radix-16 processor is presented in which these algorithms are implemented for the low-cost *AN* code with $A = 15$. This processor has been constructed for the JPL STAR computer. The adaptation of "two's complement" arithmetic for an inverse-residue code is also described.

BACK, L. H.

B001 Development of Propulsion for High-Atmospheric-Pressure or Dense Environments

G. Varsi, L. H. Back, and W. L. Dowler

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 45–52, July 1973

For abstract, see Varsi, G.

B002 Detonation Propulsion for High Pressure Environments

G. Varsi and L. H. Back

AIAA Preprint 73-1237, AIAA (American Institute of Aeronautics and Astronautics)/SAE (Society of Automotive Engineers) Ninth Propulsion Conference, Las Vegas, Nevada, November 5–7, 1973

For abstract, see Varsi, G.

B003 Transonic Laminar Boundary Layers With Surface Curvature

L. H. Back

Int. J. Heat Mass Transfer, Vol. 16, No. 9, pp. 1745–1761, September 1973

The effect of surface curvature (both longitudinal and transverse) and the associated pressure gradient across the flow is investigated analytically for a laminar boundary layer subjected to pressure gradients along the flow. Property variation which results from heat transfer and compressibility is taken into account. Numerical solutions of the boundary layer equations are obtained for locally similar sonic flow through the throat of a nozzle for a range of flow conditions and for various shaped nozzle surfaces with different amounts of wall cooling. A few solutions were also obtained for the analogous flow around the shoulder of a flat-faced body in a supersonic flow. The effect of various parameters that arise in the equations upon application of the Levy–Mangler transformation are investigated and discussed with respect to their influence on the velocity and total enthalpy profiles and the corresponding profile slopes at the surface to which the shear stress and heat transfer are related. An important finding is that at throat Reynolds numbers less than 10^5 the heat transfer parameter at a nozzle throat decreases as the throat radius of curvature decreases.

B004 Viscous Non-adiabatic Laminar Flow Through a Supersonic Nozzle: Experimental Results and Numerical Calculations

L. H. Back and P. F. Massier

Trans. ASME, Ser. C: J. Heat Transf., Vol. 94, No. 4, pp. 437–445, November 1972

Flow and thermal regimes found in relatively low Reynolds-number flows of high-temperature gases in cooled convergent–divergent nozzles used in propulsion systems and in research facilities are investigated by a combined experimental and numerical approach. The experiments were conducted with argon at temperatures up to 14,200°R, and the throat Reynolds number ranged from 2200 to 2800. The numerical calculations involved the laminar-flow equations in differential form. Taken together, the experiments and the numerical calculations provide information on the pressure, heat-flux, and shear-stress distributions along internal flows with heat transfer, and on the velocity and enthalpy distributions across the flow as well as along the flow. The influence of heat conduction and of the viscous shear extended to the centerline all along the nozzle.

B005 Non-isothermal Laminar Flow of Gases Through Cooled Tubes

L. H. Back

Trans. ASME, Ser. C: J. Heat Transf., Vol. 95, No. 1, pp. 85–92, February 1973

Numerical solutions of the laminar-flow equations in differential form are presented for gas flows through cooled tubes. For nearly isothermal flow there is good agreement with available experimental data, as is also found for the case of a large amount of wall cooling. This correspondence along with a check on the satisfaction of the global momentum and energy constraints allowed an appraisal of the effect of wall cooling on flow

through tubes. In general, the effect of wall cooling was to decrease the wall friction and the change in pressure along tubes, but the average heat-transfer coefficient did not vary much.

B006 Shear-Layer Flow Regimes and Wave Instabilities and Reattachment Lengths Downstream of an Abrupt Circular Channel Expansion

L. H. Back and E. J. Roschke

Trans. ASME, Ser. E: J. Appl. Mech., Vol. 39, No. 3, pp. 677–681, September 1972

This article describes an experimental investigation of water flow through an abrupt circular-channel expansion over a Reynolds number range between 20 and 4200. The shear layer between the central jet and the reverse flow region along the wall downstream behaved differently in the various flow regimes that were observed. With increasing Reynolds number these regimes changed progressively from a laminar flow to an unstable vortex sheetlike flow and then to a more random fluctuating flow. The distance between the step and the reattachment location downstream correspondingly increased, reached a maximum, and then decreased. Of particular significance are the shear layer wave instabilities observed in the shear flow and their relationship to reattachment which apparently has not received much attention previously. Visual observations aided in understanding the results.

BAISLEY, R. L.

B007 Helicopter Visual Aid System

R. L. Baisley

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 72–86, January 1973

The results of an evaluation of police helicopter effectiveness revealed a need for improved visual capability. A JPL program developed a method that would enhance visual observation capability for both day and night usage and demonstrated the feasibility of the adopted approach. This approach made use of remote pointable optics, a display screen, a slaved covert searchlight, and a coupled camera. The approach was proved feasible through field testing and by judgment against evaluation criteria.

BANTELL, M. H.

B008 Statistical Error Model for a Solar Electric Propulsion Thrust Subsystem

M. H. Bantell

Technical Memorandum 33-607, June 1, 1973

The statistical error model of the solar–electric-propulsion thrust subsystem was developed as a tool for investigating the effects of thrust-subsystem parameter uncertainties on navigation accuracy. The model is currently being used to evaluate the impact of electric-engine parameter uncertainties on navigation system performance for a baseline mission to Encke's Comet in the 1980s.

This memorandum presents data that represent the next generation in statistical error modeling for low-thrust applications. Principal improvements include the representation of thrust uncertainties and random-process modeling in terms of random parametric variations in the thrust-vector process for a multi-engine configuration.

BAR-DAVID, I.

B009 DSN Progress Report for November–December 1972: Performance of Coded, Noncoherent, Hard-Decision MFSK Systems

I. Bar-David and S. Butman

Technical Report 32-1526, Vol. XIII, pp. 82–91, February 15, 1973

The capacity of noncoherent multifrequency shift-keying (MFSK) systems that use a hard-decision receiver is determined as a function of the predetection signal-to-noise ratio (ST/N_0). For any given predetection signal-to-noise ratio there is an optimum number of frequencies that maximize the system capacity. This optimum number decreases as the predetection signal-to-noise ratio decreases. However, this article shows that this number is never less than 7. This means that binary-frequency shift keying, a commonly used modulation technique at very low data rates, is suboptimum by at least 2.2 dB, compared to the performance obtainable with 7 signals. Similar results are obtained for the computational cut-off R_{comp} when convolutional coding with sequential decoding is used over such an MFSK channel. Use of MFSK channels is expected for entry missions into thick atmospheres, such as those of Venus and Jupiter.

BARATH, F. T.

B010 Microwave Radiometric Measurements of Atmospheric Temperature and Water From an Aircraft

P. W. Rosenkranz, F. T. Barath, J. C. Blinn III, and E. J. Johnston

J. Geophys. Res., Vol. 77, No. 30, pp. 5833–5844, October 20, 1972

For abstract, see Rosenkranz, P. W.

B011 Microwave Radiometric Systems

F. T. Barath

Proceedings of the Fifth Symposium on Temperature, Washington, D.C., June 21, 1971, pp. 2271–2277

Microwave radiometry is a rapidly advancing field, both in its technology and in its applications. Lower noise, broader bandwidth, and higher and more stable gain receivers are constantly being introduced in smaller and more rugged packages. During the last few years, in particular, great potential for microwave radiometric techniques has been demonstrated in new areas such as remote earth characteristics sensing, oceanography and meteorology.

This article reviews the basic types of microwave radiometric systems, indicates their capabilities, and provides some insight into the performance tradeoffs available to the designer and user.

BARENGOLTZ, J. B.

B012 The Electric Field in the Vicinity of a Photo-Emitting Plate in a Plasma

J. B. Barengoltz and C. Bauerle

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 26–32, April 1973

Knowledge of the electric field in the vicinity of a spacecraft provides necessary corrections to measurements of ambient fields and charged-particle fluxes and a required parameter to understand the motion of dust particles and grains around the spacecraft. Although the surface potential is sufficient to correct field and particle values, the more complex problem of the entire electric field, needed for grain-transport calculations, is treated here for the one-dimensional case.

By approximations to the analysis of a photo-emitting plate immersed in a dilute plasma, performed by Guernsey and Fu, explicit expressions for the potential and the electric field have been derived. The two classes of implicit solutions for the potential reported by them are shown to yield essentially identical results for the electric field within the Debye length for photoelectrons from the plate, under the conditions in our solar system. The values were obtained following assumptions of a later paper by Guernsey and Fu, in which the emitted photoelectron distribution is taken as Maxwellian. These results are compared with a simple model, due to Grard and Tunaley, wherein the effect of the dilute plasma is neglected entirely.

BARNUM, P. W.

B013 Tracking and Data System Support for the Mariner Mars 1971 Mission: Orbit Insertion Through End of Primary Mission

P. W. Barnum, N. A. Renzetti, G. P. Textor, and L. B. Kelly

Technical Memorandum 33-523, Vol. III, May 15, 1973

This volume of the Tracking and Data System (TDS) support for the Mariner Mars 1971 Mission final report contains the deep-space-tracking and data-acquisition activities in support of orbital operations, which include the period from orbit insertion (November 14, 1971) to end of primary mission (April 1, 1972). Included are presentations of the TDS flight-support pass-chronology data for each of the deep space stations used, and performance evaluation for the DSN Telemetry, Tracking, Command, and Monitor Systems.

B014 Tracking and Data System Support for the Mariner Mars 1971 Mission: Extended Mission Operations

P. W. Barnum and N. A. Renzetti

Technical Memorandum 33-523, Vol. IV, December 15, 1973

This volume of the Tracking and Data System (TDS) Support of the Mariner Mars 1971 Mission final report contains the deep-space tracking and data-acquisition activities in support of extended operations, which include the period from the end of the primary mission (April 1, 1972) to spacecraft shutdown (October 27, 1972). Included are presentations of the TDS flight-support pass chronology data for each of the deep space stations used, and performance evaluations for the DSN Telemetry, Tracking, Command, and Monitor Systems.

BARTH, C. A.

B015 Mariner 9 Ultraviolet Spectrometer Experiment: Afternoon Terminator Observations of Mars

J. Ajello, C. W. Hord (University of Colorado), C. A. Barth (University of Colorado), A. I. Stewart (University of Colorado), and A. L. Lane

J. Geophys. Res., Vol. 78, No. 20, pp. 4279–4290, July 10, 1973

For abstract, see Ajello, J.

BARTOS, K.

B016 DSN Progress Report for November–December 1972: Hydrostatic Bearing Runner Damage at the Spain 64-m-Diameter Antenna

J. Chapman and K. Bartos

Technical Report 32-1526, Vol. XIII, pp. 219–226, February 15, 1973

For abstract, see Chapman, J.

BATELAAN, P. D.

B017 DSN Progress Report for January–February 1973: S/X-Band Experiment: Zero Delay Device

T. Y. Otoshi and P. D. Batelaan

Technical Report 32-1526, Vol. XIV, pp. 73–80, April 15, 1973

For abstract, see Otoshi, T. Y.

B018 DSN Progress Report for July–August 1973: S/X Experiment: Preliminary Tests of the Zero Delay Device

T. Y. Otoshi and P. D. Batelaan

Technical Report 32-1526, Vol. XVII, pp. 68–77, October 15, 1973

For abstract, see Otoshi, T. Y.

BATHKER, D. A.

B019 DSN Progress Report for January–February 1973: Dual Carrier Preparations for Viking

D. A. Bathker and D. W. Brown

Technical Report 32-1526, Vol. XIV, pp. 178–199, April 15, 1973

The problem of receive-band interference resulting from both single- and dual-carrier transmission from a deep space station has been synthesized and, to a large extent, resolved at the Venus Deep Space Station. Although there are remaining problems, this article discusses the application of this experience to 64-m-diameter-antenna stations, the Mars Deep Space Station in particular.

BAUERLE, C.

B020 The Electric Field in the Vicinity of a Photo-Emitting Plate in a Plasma

J. B. Barengoltz and C. Bauerle

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 26–32, April 1973

For abstract, see Barengoltz, J. B.

BAUMAN, A. J.

B021 Spectrofluorometric Search for Porphyrins in Apollo 14 Surface Fines

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

"Proceedings of the Third Lunar Science Conference," *Supplement 3, Geochimica et Cosmochimica Acta*, Vol. 2, pp. 2149–2155, 1972

For abstract, see Rho, J. H.

B022 Allende Meteorite Carbonaceous Phase: Intractable Nature and Scanning Electron Morphology

A. J. Bauman, J. R. Devaney, and E. M. Bollin (Bollin Scientific Laboratory)

Nature, Vol. 241, No. 5387, pp. 264–267, January 26, 1973

Meteorites, being solar nebula condensates, should carry information on the processes which led to formation of the planets. This article examines the ultrastructure of the Allende C-3 chondrite matrix by scanning electron microscopy and isolates the carbonaceous phase for study by mass spectrometry and oxidative thermal analysis. The morphology of the Allende matrix and its carbon phase revealed in this study suggests that the meteorite was formed by condensation from the gas phase in a complex series of events. The nature of the non-graphitic carbonaceous phase is not clear although its intractable solvent properties and thermal stability suggest that it is not a polymer in the classical sense.

B023 Analyses of the Returned Lunar Surface Fines for Porphyrins

J. H. Rho, A. J. Bauman, E. A. Cohen, T. F. Yen (University of Southern California), and J. Bonner (California Institute of Technology)

Space Life Sci., Vol. 3, No. 4, pp. 415–418, October 1972

For abstract, see Rho, J. H.

B024 A Search for Porphyrin Biomarkers in Nonesuch Shale and Extraterrestrial Samples

J. H. Rho, A. J. Bauman, H. G. Boettger, and T. F. Yen (University of Southern California)

Space Life Sci., Vol. 4, No. 1, pp. 69–77, January 1973

For abstract, see Rho, J. H.

BAUMERT, L. D.

B025 DSN Progress Report for May–June 1973: Weight Distributions of Some Irreducible Cyclic Codes

L. D. Baumert and J. Mykkeltveit (University of Bergen)

Technical Report 32-1526, Vol. XVI, pp. 128–131, August 15, 1973

Irreducible cyclic codes are one of the largest and most powerful known classes of block codes. For example, the celebrated Golay code now being studied for use on the Mariner Jupiter/Saturn Mission is an irreducible cyclic code. This article presents techniques for computing the weight enumerators of a large subclass of irreducible cyclic codes.

B026 DSN Progress Report for September–October 1973: A Golay–Viterbi Concatenated Coding Scheme for MJS'77

L. D. Baumert and R. J. McEliece

Technical Report 32-1526, Vol. XVIII, pp. 76–84, December 15, 1973

This article describes a proposed method of delivering the nonimaging science data on the Mariner Jupiter/Saturn 1977 mission at a bit-error probability which is substantially lower than the bit-error probability required for the imaging data. The method is a "pre-coding" of the nonimaging data with an interleaved (24,12) Golay code.

B027 A Note on the Griesmer Bound

L. D. Baumert and R. J. McEliece

IEEE Trans. Inform. Theor., Vol. IT-19, No. 1, pp. 134–135, January 1973

Griesmer's lower bound for the word length n of a linear code of dimension k and minimum distance d is shown to be sharp for fixed k, when d is sufficiently large. For $k \leq 6$ and all d the minimum word length is determined.

BECKER, R. A.

B028 Mariner 9 Television Pictures: Microfiche Library User's Guide: MTC/MTVS Real-Time Pictures

R. A. Becker

Technical Memorandum 33-595, February 15, 1973

This memorandum describes the content and organization of the Mariner 9 Mission Test Computer/Mission Test Video System microfiche library. This 775-card library is intended to supply the user with a complete record of the images received from Mars orbit during the Mariner 9 mission operations, November 15, 1971 to November 1, 1972.

BEER, R.

B029 The Abundance of CH_3D and the D/H Ratio in Jupiter

R. Beer and F. W. Taylor

Astrophys. J., Vol. 179, No. 1, Pt. 1, pp. 309–327, January 1, 1973

From observations of the ν_2 parallel band of monodeuterated methane (CH_3D) in the Jovian atmosphere, we have deduced a CH_3D abundance and mixing ratio and a value for the D/H ratio in this planet, with due regard to the problems of Jovian atmospheric structure and deuterium fractionation. We find the D/H ratio to be significantly less than the terrestrial value and discuss some of the implications to the early history of the solar system. This observation marks the first-ever detection of deuterium by any astronomical technique.

B030 The Equilibration of Deuterium in the Jovian Atmosphere

R. Beer and F. W. Taylor

Astrophys. J., Vol. 182, No. 3, Part 2, pp. L131–L132, June 15, 1973

Recent observations of deuterium in the Jovian atmosphere in the CH_3D and HD phases permit a re-examination of the mechanism of deuterium fractionation in Jupiter. It is shown that catalysis must play an important role in the reaction paths and that, most probably, the catalytic agents are embedded in the lower cloud deck.

B031 Observation of the OH Radical in Betelgeuse

R. Beer, R. H. Norton, R. B. Hutchinson, D. L. Lambert (University of Texas), and J. V. Martonchik (University of Texas)

Mém. Soc. Roy. Sci. Liège, Vol. III, No. 6, p. 145, 1972

This article analyzes spectra of the M supergiant α Orionis and reports that more than 80 of the approximately 100 absorptions unique to the star are due to the fundamental vibration-rotation bands of the diatomic free radical OH. In addition, OH abundance is computed and turbulence in the stellar atmosphere estimated.

BEHAR, J. V.

B032 Hydrocarbons in Air Samples From Antarctic Dry Valley Drilling Sites

J. V. Behar (University of California, Riverside), L. Zafonte (University of California, Riverside), R. E. Cameron, and F. A. Morelli

Antarctic J. U.S., Vol. VII, No. 4, pp. 94–96, July–August 1972

One important aspect in the study of polluted atmospheres is the determination of the lowest levels attainable for several contaminants of interest. It is necessary to define the levels of the minor atmospheric constituents present in the cleanest air samples obtainable. Therefore, studies have been initiated utilizing the unique environment provided by the Antarctic Continent, primarily with respect to the lack of anthropogenic processes carried on as in the more populated regions of the earth. This article presents and analyzes the results of air samples collected during these studies.

BENDER, D. F.

B033 Multiasteroid Comet Missions Using Solar Electric Propulsion

D. F. Bender and R. D. Bourke

J. Spacecraft Rockets, Vol. 10, No. 8, pp. 481–482, August 1973

Comets and asteroids are objects of growing scientific interest because they are likely to yield information on the early history of the solar system. To obtain a clear understanding of these bodies, several will have to be studied at close range. This can be done most economically if a spacecraft encounters several bodies in succession on a single trajectory. Techniques for the generation of such trajectories that are suitable for solar electric propulsion (SEP) and sample results are the subject of this article.

This work does not attempt to justify the SEP mission mode or the particular targets used in the examples as being programmatically attractive. Specifically, there is no discussion of the relative merits of SEP and ballistic flights from cost, practicality, performance or other standpoints. On the other hand, one programmatically significant conclusion was found: any SEP mission which traverses the asteroid belt should be considered a potential multicomet-multiasteroid mission, and the techniques presented in this article can be applied to find opportunities for encounters.

BERGSTRALH, J. T.

B034 The Planet Venus: A New Periodic Spectrum Variable

L. D. G. Young, A. T. Young, J. W. Young, and J. T. Bergstralh

Astrophys. J., Vol. 181, No. 1, Pt. 2, pp. L5–L8, April 1, 1973

For abstract, see Young, L. D. G.

B035 Methane Absorption in the Atmosphere of Saturn: Rotational Temperature and Abundance From the $3\nu_3$ Band

J. T. Bergstralh (University of Texas)

Icarus, Vol. 18, No. 4, pp. 605–611, April 1973

Three high-dispersion spectra of Saturn, in the methane $3\nu_3$ band at 1.1 μm, were obtained during September and October of 1970. Tracings of these spectra have been measured, and reduced by a curve of growth technique which assumes a reflecting-layer model and Lorentzian line profiles. The reductions yield a range of rotational temperatures from 122 to 142 K, and methane line-of-sight abundances, ηN, from 86 ± 14 to 51 ± 11 m amagat, depending on the value of the Lorentz half-width, α, used in computation of the curves of growth.

B036 Methane Absorption in the Jovian Atmosphere: II. *Absorption Line Formation*

J. T. Bergstralh (University of Texas)

Icarus, Vol. 19, No. 2, pp. 390–417, June 1973

The methane $3\nu_3$ band R-branch has been observed at high dispersion in the spectrum of Jupiter, at seven points along the planet's equator, and the equivalent widths of four lines, R(0), R(2), R(3), and R(5), have been measured. Three models for spectral line formation in the Jovian atmosphere have been tested by comparing variations in the equivalent widths of the methane lines predicted by the models with the observed variations. The reflecting-layer model, i.e., transparent gas above a diffusely reflecting opaque surface, has been used by almost all investigators to date to analyze molecular absorption bands in the Jovian spectrum quantitatively. It can be made to reproduce the observed behavior of the methane absorption lines across the Jovian disk only if rather artificial assumptions are made about the geometry of the reflecting surface, i.e., the Jovian cloud tops.

A simple inhomogeneous scattering model (IHSL) developed by R. E. Danielson and M. G. Tomasko to describe line formation in an atmosphere with alternating layers of transparent gas and scattering cloud, provides the most satisfactory description of the observed behavior of the methane lines. The results with the IHSL model are

encouraging; however, since the latter still involves certain simplifying assumptions, more elaborate analyses using somewhat more powerful radiative transfer techniques may be useful.

B037 Methane Absorption in the Jovian Atmosphere: I. The Lorentz Half-Width in the $3\nu_3$ Band at 1.1 μm

J. T. Bergstralh

Icarus, Vol. 19, No. 4, pp. 499–506, August 1973

The Lorentz half-width α_L, of the fine-structure components of the methane $3\nu_3$ R-branch in the Jovian spectrum, has been measured from photoelectric observations of the singlet R(1). A value of $\alpha_L = 0.088$ Å, or 0.072 cm^{-1}, has been found. Curves of growth for the $3\nu_3$ R-branch manifolds have been calculated, using the measured value of α_L and assuming a reflecting-layer atmosphere. Previously reported equivalent widths have been reanalyzed for rotational temperature and methane abundance. The half-width derived here is significantly different from a similar measurement made earlier. The source of the discrepancy remains obscure.

BERLEKAMP, E. R.

B038 DSN Progress Report for May–June 1973: The Golay–Viterbi Concatenation Scheme

E. R. Berlekamp

Technical Report 32-1526, Vol. XVI, pp. 125–127, August 15, 1973

This article examines in detail the Golay–Viterbi concatenation scheme which has been proposed for use for the nontelevision scientific data portion of the Mariner Jupiter/Saturn telemetry. The simplest form of the scheme makes no use of the memory in the noise caused by the Viterbi decoder; in this article we will demonstrate that it is possible to utilize this memory to obtain improved performance.

BERMAN, A. L.

B039 DSN Progress Report for November–December 1972: Mariner 9 Doppler Noise Study

A. L. Berman

Technical Report 32-1526, Vol. XIII, pp. 227–235, February 15, 1973

This article presents doppler-noise data, as calculated by and compiled from the near-real-time 360/75 pseudo-residual program during the Mariner Mars 1971 mission, as a function of uplink and downlink signal strength. Some observations are made about the nature of this relationship, as well as about the functional dependence of doppler noise on round-trip light time and ground frequency standards.

BERMAN, P. A.

B040 Development of a Thick-Film Silicon Ribbon Growth Technique for Application to Large-Area Solar Cells and Arrays

P. A. Berman

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 44–52, January 1973

This article describes a new technique for growth of large-area silicon ribbons. This technique is an edge-defined, film-fed growth process by which single crystals can be grown having a shape controlled by the *outside* dimensions of a shaping die, with growth taking place from an extremely thin film of liquid fed by capillary action from a crucible below. The material from which the die is fabricated is very critical to the process. The die must be wet by the silicon, but adverse impurities must not be introduced into the silicon, and the die must not become degraded by the molten silicon. A breakthrough in die fabrication that has allowed the growth of silicon ribbons having dimensions 1 × 30 cm with a thickness of 0.7 mm is described. The implications of this significant advancement with respect to development of photovoltaic solar arrays for wide-scale terrestrial solar-to-electric energy conversion systems are discussed.

B041 Study of Interaction Among Silicon, Lithium, Oxygen and Radiation-Induced Defects for Radiation-Hardened Solar Cells

P. A. Berman

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 33–44, April 1973

In order to improve reliability and the useful lifetime of solar-cell arrays for space use, a program was undertaken at JPL for development of radiation-hardened lithium-doped silicon solar cells. These cells have been shown to be significantly more resistant to degradation by ionized particles than the presently used n–p non-lithium-doped silicon solar cells. This article describes the results of various analyses performed to develop a more complete understanding of the physics of the interactions among lithium, silicon, oxygen, and radiation-induced defects. A discussion is given of those portions of the previous model of radiation-damage annealing which were found to be in error and those portions which were upheld by these extensive investigations.

BERWIN, R.

B042 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase I

R. Woo, W. Kendall, A. Ishimaru, and R. Berwin

Technical Memorandum 33-644, June 30, 1973

For abstract, see Woo, R.

BIERMAN, G. J.

B043 A Comparison of Discrete Linear Filtering Algorithms

G. J. Bierman

IEEE Trans. Aerosp. Electron. Sys., Vol. AES-9, No. 1, pp. 28–37, January 1973

This article compares the computational efficiency of filter algorithms reported earlier. It is shown that for problems with even moderately large amounts of data, the information matrix and square-root information matrix formulations are computationally more efficient than the other method considered. It is also pointed out that the matrix factorization-Householder transformation technique suggested in previous reporting leads to the same equations as those obtained via the Potter method discussed in this article. Several improvements in equation mechanization are given.

B044 Comments on "Linear Filtering in the Presence of Time-Varying Bias"

G. J. Bierman

IEEE Trans. Automat. Contr., Vol. AC-18, No. 4, p. 412, August 1973

An earlier article discussed the treatment of bias in recursive filtering. Results presented in that article were extended in a subsequent note for application in solving a filtering estimation problem. This article points out that the extension was in essence already contained in the original article.

B045 Fixed Interval Smoothing With Discrete Measurements

G. J. Bierman

Int. J. Control, Vol. 18, No. 1, pp. 65–75, July 1973

A recursive form of previously proposed smoothing equations for a linear continuous dynamic system with linear discrete measurements is presented. The new algorithm exhibits a duality with the Kalman filtering equations. As a result of this duality it is possible to convert existing Kalman filtering programs into smoothing programs by redefining variables. Storage and computational requirements for the new algorithm are less than those for certain continuous smoothers discussed in earlier reporting.

BILLINGSLEY, F. C.

B046 Digital Image Processing for Information Extraction

F. C. Billingsley

Int. J. Man-Mach. Stud., Vol. 5, No. 5, pp. 203–214, April 1973

In recent years the modern digital computer has been used to process images, to emphasize details, to sharpen pictures, to modify the tonal range, to aid picture interpretation, to remove anomalies, and to extract quantitative information. A price to be paid for this extreme flexibility in handling linear and non-linear operations is that a number of anomalies caused by the camera, such as geometric distortion, MTF roll-off, vignetting, and non-uniform intensity response must be taken into account or removed to avoid their interference with the information extraction process. Once this is done, computer techniques may be used to emphasize details, perform analyses, classify materials by multi-variate analysis (usually multi-spectral), detect temporal differences, etc. Digital processing may also be used to modify various aspects of pictures to enhance the ability of the human photo interpreter in extracting information. A number of these processes are illustrated in this article.

BIRD, E. F.

B047 DSN Progress Report for September–October 1973: GCF Wideband Switch Subassembly—Requirements and Design Concept

E. F. Bird

Technical Report 32-1526, Vol. XVIII, pp. 117–119, December 15, 1973

This article presents the basic requirements and design approach for the wideband switch subassembly (WBSS). The WBSS is a part of the Ground Communication Facility's wideband subsystem located in the Central Communications Terminal at JPL. It is used to support the 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 computer systems.

BJORKLUND, R. A.

B048 Performance Characterization Tests of Three 0.44-N (0.1-lbf) Hydrazine Catalytic Thrusters

P. I. Moynihan and R. A. Bjorklund

Technical Report 32-1584, September 1, 1973

For abstract, see Moynihan, P. I.

BLANDFORD, W. J.

B049 DSN Progress Report for September–October 1973: Sharing Range Capability at the Conjoint Stations

W. J. Blandford

Technical Report 32-1526, Vol. XVIII, pp. 125–129, December 15, 1973

Enhancement of the 26-m-diameter antenna subnet ranging coverage by sharing 64-m-diameter antenna ranging capability has been proposed in order to improve tracking capability. An analysis of the error sources contributing to the ranging system accuracy indicates that high-frequency noise and range-modulation group-delay instability are of primary concern, but that overall, the range error is virtually unaffected by the additional cabling.

BLANKENHORN, D. H.

B050 Prediction of Lipid Uptake by Prosthetic Heart Valve Poppets From Solubility Parameters

J. Moacanin, D. D. Lawson, H. P. Chin (University of Southern California), E. C. Harrison (University of Southern California), and D. H. Blankenhorn (University of Southern California)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 183–190, 1973

For abstract, see Moacanin, J.

BLINN, J. C., III

B051 Microwave Radiometric Measurements of Atmospheric Temperature and Water From an Aircraft

P. W. Rosenkranz, F. T. Barath, J. C. Blinn III, and E. J. Johnston

J. Geophys. Res., Vol. 77, No. 30, pp. 5833–5844, October 20, 1972

For abstract, see Rosenkranz, P. W.

BÖER, K. W.

B052 Photoconductor–Metal Contact at Higher Densities

G. A. Dussel (University of Delaware), K. W. Böer (University of Delaware), and R. J. Stirn

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1443–1454, February 15, 1973

For abstract, see Dussel, G. A.

B053 CdS–Metal Contact at Higher Current Densities

R. J. Stirn, K. W. Böer (University of Delaware), and G. A. Dussel (University of Delaware)

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1433–1443, February 15, 1973

For abstract, see Stirn, R. J.

BOETTGER, H. G.

B054 Negative Ion Mass Spectrometry—A New Analytical Method for Detection of Trinitrotoluene

J. Yinon, H. G. Boettger, and W. P. Weber (University of Southern California)

Anal. Chem., Vol. 44, No. 13, pp. 2235–2237, November 1972

For abstract, see Yinon, J.

B055 Modification of an AEI/GEC MS9 High-Resolution Mass Spectrometer for Electron Impact/Chemical Ionization Studies

J. Yinon and H. G. Boettger

Chem. Instr., Vol. 4, No. 2, pp. 103–113, 1972

For abstract, see Yinon, J.

B056 A Search for Porphyrin Biomarkers in Nonesuch Shale and Extraterrestrial Samples

J. H. Rho, A. J. Bauman, H. G. Boettger, and T. F. Yen (University of Southern California)

Space Life Sci., Vol. 4, No. 1, pp. 69–77, January 1973

For abstract, see Rho, J. H.

BOGDANOFF, D. W.

B057 Impinging Jet Separators for Liquid Metal Magnetohydrodynamic Power Cycles

D. W. Bogdanoff

Technical Memorandum 33-621, December 1, 1973

In many liquid-metal magnetohydrodynamic power cycles, it is necessary to separate the phases of a high-speed

liquid–gas (or liquid–vapor) flow. The usual method is to impinge the jet at a glancing angle against a straight or curved solid surface. These surface separators achieve good separation of the two phases at a cost of a large velocity loss due to friction at the separator surface. This memorandum deals with attempts to greatly reduce the friction loss by impinging two (or more) jets against each other. In the crude impinging-jet separators tested to date, friction losses were found to be greatly reduced, but the separation of the two phases was found to be much poorer than that achievable with surface separators. The separation was sufficiently poor that lithium–cesium power-generation cycle efficiencies using surface separators were estimated to be higher than those using the impinging-jet separators of the types tested to date.

However, analyses are presented which show many lines of attack which should yield much better separation for impinging-jet separators. Impinging-jet separators have been built, and others designed, to test these ideas. These untested separators are discussed at length in this memorandum. It is concluded that a well-designed impinging-jet separator can likely yield cycle efficiencies greater than those achievable with surface separators. Some theoretical discussion of the impinging-jet separation process and suggestions for further investigation into this process which may lead to further improvements in impinging-jet separator design are also presented.

BOGNER, R. S.

B058 Mariner Mars 1971 Battery Design, Test, and Flight Performance

R. S. Bogner

Technical Memorandum 33-591, April 15, 1973

This memorandum presents the design, development, manufacture, test, and flight performance of the battery used in the Mariner Mars 1971 spacecraft. The 20-A-h nickel–cadmium battery, capable of delivering over 800 W-h, weighed 29.4 kg and contained 26 cells in series.

BOLLIN, E. M.

B059 Allende Meteorite Carbonaceous Phase: Intractable Nature and Scanning Electron Morphology

A. J. Bauman, J. R. Devaney, and E. M. Bollin (Bollin Scientific Laboratory)

Nature, Vol. 241, No. 5387, pp. 264–267, January 26, 1973

For abstract, see Bauman, A. J.

BONNER, J.

B060 Analyses of the Returned Lunar Surface Fines for Porphyrins

J. H. Rho, A. J. Bauman, E. A. Cohen, T. F. Yen (University of Southern California), and J. Bonner (California Institute of Technology)

Space Life Sci., Vol. 3, No. 4, pp. 415–418, October 1972

For abstract, see Rho, J. H.

BOOTH, R. W. D.

B061 DSN Progress Report for March–April 1973: S-Band Microwave Weather Project Data for CY 1971

M. S. Reid and R. W. D. Booth

Technical Report 32-1526, Vol. XV, pp. 88–91, June 15, 1973

For abstract, see Reid, M. S.

BOSE, T. K.

B062 Anode Heat Transfer for a Flowing Argon Plasma at Elevated Electron Temperature

T. K. Bose

Int. J. Heat Mass Transfer, Vol. 15, No. 10, pp. 1745–1763, October 1972

Heat transfer from a pre-ionized gaseous plasma flowing over an anode surface at an elevated electron temperature in the presence of an electric field normal to the surface is investigated theoretically. A laminar boundary layer is considered in which only the velocity profile is locally similar and fluid properties are assumed to change uniformly in the gas flow direction. Results obtained by an approximation method show that for moderate current densities $|j_e| < 10^6$ A/m^2, the velocity and temperature distributions are insensitive to current. In addition, the effect of elevated electron temperature is negligible on convective heat transfer, but is significant for the overall heat transfer due to the enthalpy transport by current. Total heat flux to the anode is obtained by evaluating the Nusselt number and adding terms due to the potential drop in the sheath and the surface work function.

BOURKE, R. D.

B063 Mariner Jupiter/Saturn 1977—The Mission Frame

R. D. Bourke, R. F. Miles, Jr., P. A. Penzo, S. L. Van Dillen, and R. A. Wallace

Astronaut. Aeronaut., Vol. 10, No. 11, pp. 42–49, November 1972

Following cancellation of the Outer Planet Grand Tour Project, NASA and JPL examined alternative missions for exploring the outer planets during the latter 1970s. The alternate mission that proved most attractive scientifically, yet fits within the projected NASA budget, embraces dual flights to Jupiter and Saturn, with launch in 1977. NASA has implemented this mission as the Mariner Jupiter/Saturn 1977 Project. This article presents an evaluation of the various alternative launch opportunities as well as the scientific objectives, technical approach, and description of the Mariner Jupiter/Saturn 1977 mission.

B064 Multiasteroid Comet Missions Using Solar Electric Propulsion

D. F. Bender and R. D. Bourke

J. Spacecraft Rockets, Vol. 10, No. 8, pp. 481–482, August 1973

For abstract, see Bender, D. F.

BOWERS, M. T.

B065 Thermal Energy Charge Transfer Reactions of Rare-Gas Ions to Methane, Ethane, Propane, and Silane: The Importance of Franck–Condon Factors

M. T. Bowers (University of California, Santa Barbara) and D. D. Elleman

Chem. Phys. Lett., Vol. 16, No. 3, pp. 486–491, October 15, 1972

Thermal energy charge transfer rate constants from He^+, Ne^+, Ar^+, Kr^+, and Xe^+ to CH_4, CD_4, C_2H_6, C_3H_8, and SiH_4 have been measured using ion cyclotron resonance spectroscopy. The data are interpreted in terms of a model that presumes the magnitude of the rate constant is directly related to the magnitude of the Franck–Condon factor connecting the molecular neutral and ion. Additional measurements between N_2O^+, CO_2^+, CO^+, and N_2^+ charge transferring to SiH_4 indicate that the ion–neutral collision distorts the Franck–Condon manifold from that appropriate to sudden ionization processes (photon or electron impact).

B066 Reactions of Excited and Ground State H_3^+ Ions With Methyl Substituted Hydrides

W. T. Huntress, Jr., and M. T. Bowers (University of California, Santa Barbara)

Int. J. Mass Spectr. Ion Phys., Vol. 12, No. 1, pp. 1–18, August 1973

For abstract, see Huntress, W. T., Jr.

BRATENAHL, A.

B067 A Study of the Compatibility of Science Instruments With the Solar Electric Propulsion Space Vehicle

R. H. Parker, J. Ajello, A. Bratenahl, D. R. Clay, and B. Tsurutani

Technical Memorandum 33-641, October 15, 1973

For abstract, see Parker, R. H.

BREJCHA, A. J.

B068 Error Analysis for Mariner Venus/Mercury 1973 Conducted at the JPL Mesa West Antenna Range

N. L. Vincent, C. A. Smith, A. J. Brejcha, and H. A. Curtis

Technical Memorandum 33-625, June 1, 1973

For abstract, see Vincent, N. L.

BROKL, S. S.

B069 DSN Progress Report for July–August 1973: Digital DC Offset Compensation of Analog-to-Digital Converters

S. S. Brokl and W. J. Hurd

Technical Report 32-1526, Vol. XVII, pp. 45–47, October 15, 1973

This article presents a digital dc-offset restoration system for use with wide-bandwidth analog-to-digital converters (ADCs). The main feature of the system is that it compensates for offsets in the conversion device itself, as well as for analog-input offsets. A 1-bit ADC realization is described which operates at 40 MHz using transistor–transistor logic in the dc restore circuitry. Conversion rates of over 100 MHz can be achieved using emitter-coupled logic exclusively. This high-speed ADC is used in spectral analysis of planetary radar returns.

BROWN, D. W.

B070 DSN Progress Report for January–February 1973: Dual Carrier Preparations for Viking

D. A. Bathker and D. W. Brown

Technical Report 32-1526, Vol. XIV, pp. 178–199, April 15, 1973

For abstract, see Bathker, D. A.

B071 DSN Progress Report for September–October 1973: Signal Suppression in Bandpass Limiters

D. W. Brown

Technical Report 32-1526, Vol. XVIII, pp. 136–140, December 15, 1973

This article compares the results of numerous studies and applications of hard and soft limiters. A unifying approach is taken, with the result that the applications considered differ only in regard to the relative level of the input signal.

BRYAN, A. I.

B072 DSN Progress Report for March–April 1973: DSN System Testing: A Report on the DSN Pioneer G Compatibility Program

A. I. Bryan

Technical Report 32-1526, Vol. XV, pp. 29–31, June 15, 1973

The Pioneer G compatibility test program was nonstandard as no DSN/Pioneer G spacecraft testing was conducted prior to tests performed at Cape Kennedy on March 6, 1973. This article describes these compatibility tests and the test results for establishment of DSN/spacecraft compatibility.

B073 DSN Progress Report for May–June 1973: The Use of an Extended Mini-Computer as a Compatibility Test System Controller

A. I. Bryan

Technical Report 32-1526, Vol. XVI, pp. 5–7, August 15, 1973

The transfer of the Digital Instrumentation Subsystem from the Spacecraft Compatibility Station in Cape Kennedy to Deep Space Station 61/63 in the Madrid Deep Space Communication Complex necessitated the fabrication of a new system to utilize as a controller for the Compatibility Test System. An automatic data processing equipment acquisition plan for category B equipment was submitted in July 1972 for this purpose. Implementation of the new Compatibility Test System hardware and a discussion of the functional design considerations are presented.

BUCHANAN, H. R.

B074 DSN Progress Report for July–August 1973: X-Band Waveguide Step Transitions

H. R. Buchanan

Technical Report 32-1526, Vol. XVII, pp. 17–20, October 15, 1973

This article describes two types of waveguide-to-waveguide step transitions developed to permit accurate low-power laboratory tests on WR 125 waveguide components using more universally available WR 112 test equipment. A generally useful program for computer-aided analysis of tandem rectangular waveguide sections is being developed as a part of this effort.

B075 DSN Progress Report for July–August 1973: High-Power Microwave Transmitter Switch

C. P. Wiggins, H. R. Buchanan, and R. L. Leu

Technical Report 32-1526, Vol. XVII, pp. 21–27, October 15, 1973

For abstract, see Wiggins, C. P.

BURLAGE, H., JR.

B076 Unmanned Planetary Spacecraft Chemical Rocket Propulsion

H. Burlage, Jr., W. Gin, and R. W. Riebling

J. Spacecraft Rockets, Vol. 9, No. 10, pp. 729–737, October 1972

To optimize the performance and operational characteristics of an unmanned interplanetary spacecraft for a particular mission, and to achieve high cost effectiveness of the entire system (including launch vehicle), it is important that the type of spacecraft propulsion system to be used matches, as closely as possible, the various requirements and constraints. A universal chemical propulsion system that can do it all well does not seem possible. So a limited number of types that can satisfy the variety of needs anticipated for future interplanetary missions must be made available. Those that are discussed in this article are deemed to be the most promising candidates.

BURTON, R. K.

B077 Plasmaspheric Hiss

R. M. Thorne (University of California, Los Angeles), E. J. Smith, R. K. Burton (University of California, Los Angeles), and R. E. Holzer (University of California, Los Angeles)

J. Geophys. Res., Vol. 78, No. 10, pp. 1581–1596, April 1, 1973

For abstract, see Thorne, R. M.

BUTMAN, S.

B078 DSN Progress Report for November–December 1972: Performance of Coded, Noncoherent, Hard-Decision MFSK Systems

I. Bar-David and S. Butman

Technical Report 32-1526, Vol. XIII, pp. 82-91, February 15, 1973

For abstract, see Bar-David, I.

B079 DSN Progress Report for November–December 1972: Efficient Signal Generation for High-Power Dual-Spacecraft Command

S. Butman

Technical Report 32-1526, Vol. XIII, pp. 130-132, February 15, 1973

The possibility of transmitting to two spacecraft simultaneously from a single antenna has arisen in the forthcoming Viking 1975 Project due to mission requirements that will place two orbiters and two landers at Mars. Two of the spacecraft will be simultaneously controlled from the ground. Therefore, there is a requirement that two command signals be sent (on two separate carrier frequencies) from a single transmitter comprised of a single klystron power amplifier and antenna.

This article describes a frequency multiplex scheme that would meet this requirement, and be potentially 1.6 times as efficient (+2 dB) as the one currently under consideration, without exceeding the peak voltage rating of the klystron.

B080 DSN Progress Report for March–April 1973: Capacity for Noncoherent, Soft-Decision MFSK Signaling

S. Butman and B. K. Levitt

Technical Report 32-1526, Vol. XV, pp. 146-155, June 15, 1973

Planetary probes into the dense atmospheres of Venus, Jupiter, and Saturn may require noncoherent communication links to Earth. In this article, the capacity of noncoherent, multiple-frequency shift-keyed (MFSK) systems is determined as a function of the number of frequencies, receiver quantization, and signal-to-noise ratio. It is shown that the spacing of the quantizer levels is not critical, and that 8-level, uniform quantization is essentially as good as infinite quantization.

B081 DSN Progress Report for September–October 1973: Capacity of Noncoherent Channels

S. Butman and M. J. Klass (California Institute of Technology)

Technical Report 32-1526, Vol. XVIII, pp. 85-93, December 15, 1973

This article determines the wideband capacity limit for noncoherent Gaussian channels which are constrained to radiate signals with peak power equal to the average power. The capacity is a function of only two parameters, the predetection signal-to-noise ratio, ST/N_0, and the number of signals, M. It is shown that the capacity increases monotonically to a wideband limit as M increases. The role played by this limit for noncoherent Gaussian channels is similar to that played by the famous Shannon limit, S/N_0, for coherent channels. Numerical and graphical results are presented for parameters of interest. It was found that an excellent approximation to the wideband noncoherent limit is $S/N_0 \cdot ST/N_0/(2 + ST/N_0)$.

CAIN, D. L.

C001 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484-516, October 1972

For abstract, see Kliore, A. J.

C002 The Shape of Mars From the Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, and M. J. Sykes

Icarus, Vol. 17, No. 2, pp. 517-524, October 1972

The extinction time of the radio signal, as the Mariner 9 spacecraft was occultated by Mars, together with an accurate ephemeris of the spacecraft were used to determine radii from the mass center to the occulting feature. Similarly estimations were made of the radius to a point where the pressure reached a certain fixed value. Several simple models were proposed to fit both sets of radii data.

C003 Approximations to the Mean Surface of Mars and Mars Atmosphere Using Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4352-4354, July 10, 1973

The occultations of the Mariner 9 spacecraft yielded two sets of radial measurements. One set was the measurements to the occulting features, and the other set was inferred distances from the mass center of the planet to an arbitrary pressure level (6.1 mb). The latter was estimated from the occultation refraction profile and appropriate approximations. In this article both sets of radii are approximated by mathematical figures using least squares techniques.

CALLAHAN, P. S.

C004 DSN Progress Report for September–October 1973: Prediction of Tropospheric Wet-Component Range Error From Surface Measurements

P. S. Callahan

Technical Report 32-1526, Vol. XVIII, pp. 41–46, December 15, 1973

This article presents a new formula relating the surface temperature and water vapor pressure to the wet-component range error based on an empirical exponential model of the vapor pressure as a function of height. It is pointed out that wet-component models based on the hydrostatic equation are probably invalid. The range error is proportional to the first power of the surface vapor pressure, and the effective scale height varies with surface temperature and vapor pressure. Models are fit to 4 months of radiosonde measurements, and agreement to 1.4 cm (1 σ) is obtained. However, in 2 of the 4 months, the standard deviation of the daily values about the observed monthly average is only slightly greater than the rms difference between the model and the measurements.

C005 Plasma Column Changes at Small Solar Elongations

P. S. Callahan

J. Geophys. Res., Vol. 78, No. 20, p. 4330, July 10, 1973

By using the difference of phase and group velocities in a plasma, the changes in the columnar content between Earth and Mariner 9 have been measured for elongations of 3–16°. Rates of change were observed up to 2.5×10^{-15} el m^{-2} sec^{-1}. Structures of 3×10^6 km in size could be inferred.

C006 Near Sun Observations of the Solar Wind

P. S. Callahan, P. F. MacDoran, and A. I. Zygielbaum

Space Research XII, pp. 1529–1533, Akademie-Verlag, Berlin, 1972

A radio technique which exploits the opposite changes of group and phase velocity in a dynamic plasma has been used to study the solar wind during May, June, and July 1970, using the Mariner 6 and 7 spacecraft after their superior conjunctions. The spectrum of the solar wind turbulence in the range 1.6×10^{-4} to 2×10^{-3} Hz has been estimated. The average spectrum falls as $f^{-1.6}$ from 1.6×10^{4} to 6×10^{-4} Hz and then becomes flat. The spectrum shows significant changes from day to day at the low frequencies.

CAMERON, R. E.

C007 Monitoring of Antarctic Dry Valley Drilling Sites

F. A. Morelli, R. E. Cameron, D. R. Gensel, and L. P. Randall (Northern Illinois University)

Antarctic J. U.S., Vol. VII, No. 4, pp. 92–94, July–August 1972

For abstract, see Morelli, F. A.

C008 Hydrocarbons in Air Samples From Antarctic Dry Valley Drilling Sites

J. V. Behar (University of California, Riverside), L. Zafonte (University of California, Riverside), R. E. Cameron, and F. A. Morelli

Antarctic J. U.S., Vol. VII, No. 4, pp. 94–96, July–August 1972

For abstract, see Behar, J. V.

C009 Bacterial Species in Soil and Air of the Antarctic Continent

R. E. Cameron, F. A. Morelli, and R. M. Johnson (Arizona State University)

Antarctic J. U.S., Vol. VII, No. 5, pp. 187–189, September–October 1972

Increased emphasis has been given to monitoring aerial bacteria in the Antarctic, especially in regard to field party activities. As a Martian analogy, understanding of antarctic microbial ecology is of continuing interest as it applies to the Mars quarantine problem, selection of Martian landing sites for biological purposes, comparison with a possible Martian microbial ecology, and as a test model for the biological exploration of Mars. This article discusses the bacterial species identified to date, the common habitat of each, and the bacterial genera, while emphasizing the need to protect the Antarctic from contamination.

CAMPBELL, J. K.

C010 DSN Progress Report for September–October 1973: Spacecraft Orbit Determination Using Long Tracking Arcs

J. K. Campbell and K. H. Rourke

Technical Report 32-1526, Vol. XVIII, pp. 57–65, December 15, 1973

This article summarizes a study of the accuracy of planetary-approach orbit determination based on long, 100-day arcs. Long-arc orbit determination is an attractive means for improving the accuracy of radio metric based navigation in situations when conventional, 30-day "short-arc" orbit determination strategies are particularly

sensitive to bias from deep space station (DSS) location errors. The accuracy analysis is based on the Viking Mars 1975 Mission A and B trajectories; nevertheless, the results that are presented can be interpreted in a general way. Several error sources which are not usually included in short-arc orbit determination analysis have been evaluated in the study, namely, randomly time-varying (stochastic) DSS location errors, Earth-Moon barycenter ephemeris errors, and spacecraft maneuver errors.

The stochastic DSS location errors are included in order to model error effects arising from imperfect calibration of measurement system errors, e.g., troposphere, ionosphere, space plasma, timing, and polar motion. The inclusion of stochastic station errors in the orbit estimation strategies presented proved to be significant; these errors are shown to limit determination of the spacecraft orbit when the bias components of the station-location error are also estimated. Example results using the two Viking trajectories nevertheless indicate that long-arc radio orbit determination performs favorably in the presence of these and other errors, including conservative station-location bias errors.

CANNON, A. R.

C011 DSN Progress Report for May–June 1973: Faraday Rotation Observations During the 1970 Pioneer 9 Solar Occultation

A. R. Cannon (University of California, Berkeley), C. T. Stelzried, and J. E. Ohlson (Naval Postgraduate School)

Technical Report 32-1526, Vol. XVI, pp. 87–93, August 15, 1973

The Faraday rotation of the Pioneer 9 S-band signal was measured during the December 1970 solar occultation using the NASA/JPL 64-m Goldstone antenna. Steady-state Faraday rotation was significant over the region of 4–12 solar radii, reaching a maximum value of about 100° at 4 solar radii. Two transient Faraday rotation events were observed and related to solar phenomena. The Pioneer 9 steady-state Faraday rotation was similar to that observed during the November 1968 Pioneer 6 solar occultation. The first Pioneer 9 transient appears to be of the same form, magnitude, and duration as the three remarkable W-shaped Pioneer 6 transient events. The second Pioneer 9 transient was smaller in amplitude, had an S-shaped curve of longer duration, and in general was unlike the previous events. These two events occurred at approximately 6 solar radii. The Pioneer 6 observations did not extend beyond 12 solar radii, while Pioneer 9 was tracked to approximately 64 solar radii. No transient events were observed in this outer region.

CARPENTER, R. L.

C012 Search for Small-Scale Anisotropy in the 2.7° K Cosmic Background Radiation at a Wavelength of 3.56 Centimeters

R. L. Carpenter (California State University, Los Angeles), S. Gulkis, and T. Sato

Astrophys. J., Vol. 182, No. 2, Pt. 2, pp. L61–L64, June 1, 1973

Drift scans were made of a selected track on the sky to search for small-scale anisotropy in the microwave background radiation. The observations were made with the 64-m-diameter antenna at Goldstone, California, operating at 3.56 cm. The half-power beam width was 2.3. The scans were approximately 1° in length. The upper bound on the small anisotropy along our track is $\Delta T/T < 7.15 \times 10^{-4}$ (90% confidence). Some implications of this result are discussed.

CARTWRIGHT, D. C.

C013 Excitation of the $W^3\Delta_u$, $w^1\Delta_u$, $B'^3\Sigma_u^-$, and $a'^1\Sigma_u^-$ States of N_2 by Electron Impact

A. Chutjian, D. C. Cartwright (The Aerospace Corporation), and S. Trajmar

Phys. Rev. Lett., Vol. 30, No. 6, pp. 195–198, February 5, 1973

For abstract, see Chutjian, A.

CASSON, D.

C014 The Polymerization of 3-Dimethylamino-n-Propyl Chloride and the Formation of Star-Shaped and Branched Polyelectrolytes

S. P. S. Yen, D. Casson, and A. Rembaum

Water-Soluble Polymers, pp. 291–312, Plenum Publishing Corporation, New York, 1973

For abstract, see Yen, S. P. S.

CASTLEMAN, K.

C015 Pictorial Output for Computerized Karyotyping

K. Castleman

Perspectives in Cytogenetics: The Next Decade, pp. 316–323, Charles Thomas Press, Springfield, Illinois

The Automated Light Microscope System at JPL has been programmed to produce pictorial karyotypes of human metaphase chromosome spreads. In operation the instrument displays the contents of a standard micro-

scope slide to an operator via closed circuit television. The operator stops the slide search when a good metaphase spread is encountered and the spread image is focused, digitized by a high resolution data camera, and transferred into the computer. There the individual chromosome images are isolated, measured, and arranged in standard clinical karyotype format on the output picture.

CAUGHEY, T. K.

C016 Matrix Perturbation Techniques in Structural Dynamics

T. K. Caughey

Technical Memorandum 33-652, September 1, 1973

The purpose of the present memorandum is to develop certain matrix perturbation techniques which can be used in the dynamical analysis of structures where the range of numerical values in the matrices is extreme or where the nature of the damping matrix requires that complex valued eigenvalues and eigenvectors be used. The techniques can be advantageously used in a variety of fields such as earthquake engineering, ocean engineering, aerospace engineering and other fields concerned with the dynamical analysis of large complex structures or systems of second order differential equations. A number of simple examples are included to illustrate the techniques.

CHAFIN, R. L.

C017 DSN Progress Report for May–June 1973: Pioneer F and G Telemetry and Command Processor Core Dump Program

R. L. Chafin and M. Pancino

Technical Report 32-1526, Vol. XVI, pp. 174–177, August 15, 1973

The Pioneer F and G Telemetry and Command Processor Assembly Core Dump Program, DOI-5365-SP-A, provides the tracking stations with the capability of obtaining a core dump of a faulted Telemetry and Command Processor operational program with a minimum loss of track time. The program dumps core onto the Spacecraft Telemetry and Command data tape. When the dump is completed, the operational program can be reloaded. The dump can be transferred from the data tape at a later time, and can be used to diagnose the program faulting condition.

CHAN, S. I.

C018 Magnetic Phases in Lunar Fines: Metallic Fe or Ferric Oxides

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

Geochim. Cosmochim. Acta, Vol. 37, No. 2, pp. 1201–1211, May 1973

For abstract, see Tsay, F.-D.

CHANEY, W. D.

C019 DSN Progress Report for November–December 1972: DSN Tracking System: Conversion to High-Speed Radio Metric Data

W. D. Chaney and H. E. Nance

Technical Report 32-1526, Vol. XIII, pp. 5–6, February 15, 1973

At the present time, radio metric data are transmitted from the deep space stations via the teletype mode. To meet future requirements, and to update the transmission mode, the operational concept is scheduled to be changed to utilize the high-speed data transmission facilities. This article outlines the implementation schedule and the testing requirements for providing this new capability.

CHAO, C. C.

C020 DSN Progress Report for January–February 1973: A New Method to Predict Wet Zenith Range Correction From Surface Measurements

C. C. Chao

Technical Report 32-1526, Vol. XIV, pp. 33–41, April 15, 1973

A study of the radiosonde-balloon data measured in 1967 and 1968 indicates that during local noon the wet zenith-range correction of troposphere refraction is strongly correlated with surface vapor pressure. A simple analytical expression connecting the wet zenith-range correction with surface temperature and vapor pressure was found based on an adiabatic-atmosphere model. The agreement (1σ) between the surface prediction and balloon data is good to 2 cm.

C021 DSN Progress Report for September–October 1973: Short Baseline QVLBI Demonstrations—Part I

C. C. Chao, S. K. Wong, and A. Lubeley (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XVIII, pp. 47–56, December 15, 1973

During the period between February 16 and April 11, 1973, three passes of simultaneous two-way and three-way doppler from Pioneers 10 and 11 were obtained

from the Pioneer, Echo, and Mars Deep Space Stations at the Goldstone complex. The residuals of the differenced doppler (quasi-very-long-baseline interferometry), which are free from process noises and effects of transmission media, provide a good way to check the stabilities of the tracking system using new rubidium standards for two-station tracking demonstrations.

Results indicate that the short-term (minute) and medium-term (hour) stabilities agree with expected values of about 7 and 3 parts in 10^{13}, respectively. The long-term (month) stability, which is computed from the last two passes of data, exceeds the limited level ($\Delta f/f < 10^{-12}$) required for two-station tracking demonstrations. There are not enough data for a conclusive statement about whether the current system is capable of supporting two-station tracking demonstrations. Further investigation with more data is proposed.

CHAOTE, R.

C022 Spacecraft Techniques for Lunar Research

L. D. Jaffe, R. Chaote, and R. B. Coryell

The Moon, Vol. 5, Nos. 3–4, pp. 348–367, November–December 1972

For abstract, see Jaffe, L. D.

CHAPMAN, J.

C023 DSN Progress Report for November–December 1972: Hydrostatic Bearing Runner Damage at the Spain 64-m-Diameter Antenna

J. Chapman and K. Bartos

Technical Report 32-1526, Vol. XIII, pp. 219–226, February 15, 1973

On November 12, 1972 the rear pad of the 64-m-diameter antenna in Spain grounded upon a foreign object in the hydrostatic-bearing-runner oil trough. The rear pad and the runner were damaged. The antenna was being operated by the contractor, Collins Radio, Dallas, Texas, while conducting final analog pointing-accuracy tests. This article describes the damage incurred by the three hydrostatic-bearing pads and the runner surfaces and the methods of repair used by the contractor to return the antenna to testing status.

CHEN, C. J.

C024 Double-Discharge Copper Vapor Laser With Copper Chloride as a Lasant

C. J. Chen, N. M. Nerheim, and G. R. Russell

Appl. Phys. Lett., Vol. 23, No. 9, pp. 514–515, November 1, 1973

A copper vapor laser utilizing copper chloride as a lasant in a heated discharge tube has been studied. The lasing action was observed only when two successive discharge current pulses at suitable time intervals were applied. The first pulse is considered to be a dissociation pulse to produce copper and chlorine atoms, the second to be a pumping pulse to produce population inversion. The maximum energy density measured to date was 17 $\mu J/cm^3$.

C025 Measurement of Electron Distribution Function in a Cesium Plasma

C. J. Chen, J. Wu (State University of New York), and F. T. Wu (State University of New York)

J. Appl. Phys., Vol. 43, No. 11, pp. 4570–4573, November 1972

A conventional plane Langmuir probe with dc superimposed on a small sinusoidal signal is used to measure the electron-energy distribution in a cesium discharge tube. The current-voltage characteristics and second-derivative characteristics are obtained for various discharge conditions. The electron-energy distribution at different gas-particle densities and electric fields in the positive column is calculated. The deviation from a Maxwellian distribution is observed for a low gas density and high electric field plasma. The calculation of the distribution function is also carried out by solving numerically the Boltzmann equation with electric field, including the effects of the elastic and inelastic collisions.

C026 Measurement of Electron-Ion Recombination Rate of a Dense High-Temperature Cesium Plasma

C. J. Chen, J. Wu (State University of New York), F. T. Wu (State University of New York), and D. T. Shaw (State University of New York)

J. Appl. Phys., Vol. 44, No. 7, pp. 3052–3054, July 1973

The result of the measurement of the electron-ion recombination rate of cesium plasma in a discharge tube is presented. The electron temperature has been extended to 5000 K and the electron density to 10^{15} cm^{-3}. The comparison of the experimental data with the calculated values is considered to be satisfactory.

C027 Manganese Laser

C. J. Chen

J. Appl. Phys., Vol. 44, No. 9, pp. 4246–4247, September 1973

This article reports some results of a parametric study of a manganese vapor laser. The metallic manganese is

vaporized in an alumina tubing in a tantalum heater. The vapor is pumped by utilizing a pulsed current through the tube. The laser power output, laser pulse width, and energy density in the lasant as functions of temperatures of the metal are measured and presented.

CHIN, H. P.

C028 Prediction of Lipid Uptake by Prosthetic Heart Valve Poppets From Solubility Parameters

J. Moacanin, D. D. Lawson, H. P. Chin (University of Southern California), E. C. Harrison (University of Southern California), and D. H. Blankenhorn (University of Southern California)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 183–190, 1973

For abstract, see Moacanin, J.

CHIRIVELLA, J. E.

C029 ATS-F Radiant Cooler Contamination Test in a Hydrazine Thruster Exhaust

J. E. Chirivella

Technical Memorandum 33-592, April 15, 1973

A test was conducted under simulated space conditions to determine the potential thermal degradation of the Applications Technology Satellite-F radiant cooler from contaminants generated by a 0.44-N (0.1-lbf) hydrazine thruster. The radiant cooler, an aluminum plate simulating the satellite interface, and a 0.44-N (0.1-lbf) hydrazine engine were assembled to simulate their flight configuration. The cooler was provided with platinum sensors for measuring temperature, and its surfaces were instrumented with six quartz-crystal microbalance (QCM) units to measure contaminant mass deposits. The whole assembly was tested in the molecular-sink vacuum facility at JPL.

This was the first time that a radiant cooler and a hydrazine engine were tested together in a very-high-vacuum space simulator. The engine was subjected to an accelerated duty cycle of 1 pulse/min, and after 2 h of operation, the QCMs began to shift in frequency. The tests continued for several days and, although there was considerable activity in the QCMs, the cooler never experienced thermal degradation. Identification of the contaminants has not been completed to date, but considering the temperature of the radiant cooler surface (greater than 150 K), certain species of gases are immediately eliminated from consideration. Included among the remaining candidates are water, unreacted hydrazine, and ammonium hydrates. The test was the first successful measurement of detectable deposits from hydrazine-rocket-engine plumes in a high vacuum.

C030 Molecular Flux Measurements in the Back Flow Region of a Nozzle Plume

J. E. Chirivella

Technical Memorandum 33-620, June 15, 1973

A series of tests were conducted to measure the mass flux in the far field of a nozzle plume in a high vacuum with emphasis on the back-flow region. Existing theories to predict the far field of a plume are not adequate for large angular departures from the plume axis. The measurements presented in this memorandum provide fairly accurate data for off-axis angles as large as 140° (i.e., in the back-flow region.)

The tests, which utilized five different nozzles, were performed at the JPL Molsink facility. Parameters such as expansion ratio, throat diameter, nozzle lip shape, and plenum (chamber) pressure were varied. Carbon dioxide and nitrogen gases were flowed, and mass-flux measurements were taken using quartz-crystal microbalances in as many as nine different locations. The resulting data were correlated and compared to the Hill and Draper flow-prediction theory.

C031 Operation of Small Rocket Engines in the JPL High-Vacuum Molecular Space Simulator (Molsink)

J. E. Chirivella

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 1–13, April 1973

The feasibility of operating small rocket engines in the JPL Molsink facility has been demonstrated. A 0.44-N (0.1-lbf) hydrazine engine and a 0.18-N (0.04-lbf) thruster using cold gas from a hydrazine plenum system were operated for both flight duty cycles and off-nominal conditions. The exhaust gases from these thrusters contain NH_3, N_2 and H_2. The chamber was also calibrated for larger bipropellant engines using nitrogen tetroxide/monomethyl hydrazine. The exhaust products of these engines contain CO_2, CO, N_2, H_2O, and H_2. A mixture of cold gases simulating the engine exhaust was injected through a nozzle under conditions simulating thrust levels up to 26.7 N (6 lbf). Pulsing and continuous operations were investigated. The chamber background-pressure traces were compared with the traces obtained for the same thrusters operated with pure nitrogen at approximately equivalent thrust. Satisfactory recuperation times were encountered in all the pulsing modes. Test times greater than 20 s were obtained in steady-state operation before the vacuum chamber back pressure climbed to prohibitive values.

CHRISTENSEN, S.

C032 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist, S. Christensen (University of Texas), B. DeWitt (University of Texas), L. Smarr (University of Texas), and E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

For abstract, see Estabrook, F. B.

CHUTJIAN, A.

C033 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

Technical Memorandum 33-646, July 15, 1973

For abstract, see Hall, R. I.

C034 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 9, pp. L264–L267, September 1973

For abstract, see Hall, R. I.

C035 Vibrational Excitation in CO by Electron Impact in the Energy Range 10–90 eV

A. Chutjian, D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

Phys. Rev. Lett., Vol. 29, No. 24, pp. 1580–1583, December 11, 1972

The ratio of the scattering intensity for the $v'' = 1$ excitation to the elastic scattering intensity at 40° and 80° scattering angles has been determined for 10- to 90-eV impact energies for electron scattering by CO. These ratio curves exhibit broad peaks near 20-eV impact energy which cannot be accounted for by plane-wave calculations based on potential scattering models. The peaks are indicative of a resonant excitation process (or processes) in the $v'' = 1$ channel in the range 15–25 eV.

C036 Excitation of the $W^3\Delta_u$, $w^1\Delta_u$, $B'^3\Sigma_u^-$, and $a'^1\Sigma_u^-$ States of N_2 by Electron Impact

A. Chutjian, D. C. Cartwright (The Aerospace Corporation), and S. Trajmar

Phys. Rev. Lett., Vol. 30, No. 6, pp. 195–198, February 5, 1973

Electron energy-loss spectra have been obtained for N_2 at 20.6 eV impact energy and scattering angles of 10–138°. These spectra have been analyzed to yield the first identification of excitation to the $W^3\Delta_u$, $w^1\Delta_u$, $B'^3\Sigma_u^-$, and $a'^1\Sigma_u^-$ states in electron impact spectroscopy, and the angular dependence of the excitations from 10 to 130°. The differential cross section for excitation of the $W^3\Delta_u$ state is the largest triplet-state cross section at all scattering angles, and is the largest inelastic cross section at angles greater than 70°.

CLAUSS, R. C.

C037 DSN Progress Report for March–April 1973: Low Noise Receivers: Theory of "Noise Bursts" on Large Antennas

W. H. Higa, R. C. Clauss, and P. Dachel

Technical Report 32-1526, Vol. XV, pp. 80–83, June 15, 1973

For abstract, see Higa, W. H.

CLAY, D. R.

C038 A Study of the Compatibility of Science Instruments With the Solar Electric Propulsion Space Vehicle

R. H. Parker, J. Ajello, A. Bratenahl, D. R. Clay, and B. Tsurutani

Technical Memorandum 33-641, October 15, 1973

For abstract, see Parker, R. H.

C039 Solar Wind Observations on the Lunar Surface With the Apollo-12 ALSEP

M. Neugebauer, C. W. Snyder, D. R. Clay, and B. E. Goldstein

Planet. Space Sci., Vol. 20, No. 20, pp. 1577–1591, October 1972

For abstract, see Neugebauer, M.

COFFIN, R. C.

C040 DSN Progress Report for January–February 1973: Block IV Ranging Demodulator Assembly

R. C. Coffin

Technical Report 32-1526, Vol. XIV, pp. 161–166, April 15, 1973

The Block IV Ranging Demodulator Assembly is a 10-MHz ranging receiver operating on the automatic-gain-

controlled output of either a Block III or Block IV Deep Space Instrumentation Facility receiver. It demodulates the 10-MHz carrier that has been phase modulated with range code to provide two range-correlation voltages to the Planetary Ranging Assembly. The design of the Ranging Demodulator Assembly is compatible with either composite or sequential range-code schemes. Manual control of the Block IV Ranging Demodulator Assembly is straightforward and easy to comprehend, minimizing operator expense and operator errors. Computer-control capability is provided and may be implemented as soon as a suitable interface is developed.

C041 DSN Progress Report for March–April 1973: Reference Distribution Amplifier for the Block IV Subcarrier Demodulator Assembly

R. C. Coffin

Technical Report 32-1526, Vol. XV, pp. 177–180, June 15, 1973

This article describes a reference distribution amplifier designed for the Block IV Subcarrier Demodulator Assembly. From one 10-MHz input, the unit generates three 10-MHz reference outputs. The references are variable in phase, and their level is fixed at 0 dBm. The control of phase and monitoring of output levels facilitate computer operation.

COHEN, E. A.

C042 Spectrofluorometric Search for Porphyrins in Apollo 14 Surface Fines

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

"Proceedings of the Third Lunar Science Conference," *Supplement 3, Geochimica et Cosmochimica Acta*, Vol. 2, pp. 2149–2155, 1972

For abstract, see Rho, J. H.

C043 Analyses of the Returned Lunar Surface Fines for Porphyrins

J. H. Rho, A. J. Bauman, E. A. Cohen, T. F. Yen (University of Southern California), and J. Bonner (California Institute of Technology)

Space Life Sci., Vol. 3, No. 4, pp. 415–418, October 1972

For abstract, see Rho, J. H.

COLLINS, D. J.

C044 An Inexpensive Technique for the Fabrication of Two-Dimensional Wind Tunnel Models

D. J. Collins

Rev. Sci. Instr., Vol. 44, No. 7, pp. 855–856, July 1973

Details of a new and inexpensive technique are described for the production of thin airfoil models for aerodynamic testing. Using this technique, spanwise uniform models of arbitrary cross-section may be fabricated with a high density of instrumentation.

CONEL, J. E.

C045 Mascons: Progress Toward a Unique Solution for Mass Distribution

R. J. Phillips, J. E. Conel, E. A. Abbott, W. L. Sjogren, and J. B. Morton

J. Geophys. Res., Vol. 77, No. 35, pp. 7106–7114, December 10, 1972

For abstract, see Phillips, R. J.

C046 Mars: Crustal Structure Inferred from Bouguer Gravity Anomalies

R. J. Phillips, R. S. Saunders, and J. E. Conel

J. Geophys. Res., Vol. 78, No. 23, pp. 4815–4820, August 10, 1973

For abstract, see Phillips, R. J.

COOPER, M. A.

C047 Evidence for a Steric Effect on Directly Bonded Carbon–Fluorine and Carbon–Proton Nuclear Magnetic Resonance Couplings

S. L. Manatt, M. A. Cooper, C. W. Mallory (Bryn Mawr College), and F. B. Mallory (Bryn Mawr College)

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 975–977, February 7, 1973

For abstract, see Manatt, S. L.

CORK, M. J.

C048 From Earth to Mars Orbit—Mariner 9 Propulsion Flight Performance With Analytical Correlations

M. J. Cork, R. L. French, C. J. Leising, and D. D. Schmit

AIAA Preprint 72-1185, AIAA/SAE Eighth Joint Propulsion Specialist Conference, New Orleans, Louisiana, November 29–December 1, 1972

The Mariner 9 spacecraft finished its primary mission as the first man-made satellite of another planet in March 1972. Propulsion performance during the 10-month mission and four maneuvers was perfect. Analytical models used to predict performance and analyze flight data are described. Flight data are presented, and analytical correlations are discussed for overall performance, zero-g heat transfer, and nitrogen permeation and diffusion within the propellant tanks. Orbit-insertion burn time, thrust, and specific impulse were within 1/2% of preburn predictions. Correlations between predictions and flight data demonstrated the validity of the analytical models used.

CORYELL, R. B.

C049 Spacecraft Techniques for Lunar Research

L. D. Jaffe, R. Chaote, and R. B. Coryell

The Moon, Vol. 5, Nos. 3–4, pp. 348–367, November–December 1972

For abstract, see Jaffe, L. D.

COULBERT, C. D.

C050 Long-Time Dynamic Compatibility of Elastomeric Materials With Hydrazine

C. D. Coulbert, E. F. Cuddihy, and R. F. Fedors

Technical Memorandum 33-650, September 1, 1973

The tensile property surfaces for two elastomeric materials, EPT-10 and AF-E-332, have been generated in air and in liquid hydrazine environments using constant strain rate tensile tests over a range of temperatures and elongation rates. These results have been used to predict the time-to-rupture for these materials in hydrazine as a function of temperature and amount of strain covering a span of operating times from less than a minute to 20 years. The results of limited sheet-folding tests and their relationship to the tensile failure boundary are presented and discussed.

COYNER, J. V., JR.

C051 RUSAP—A Computer Program for the Calculation of Roll-up Solar Array Performance Characteristics

R. G. Ross, Jr. and J. V. Coyner, Jr.

Technical Memorandum 33-634, October 1, 1973

For abstract, see Ross, R. G., Jr.

CRAMER, P. W., JR.

C052 Conical Quadreflex Antenna Analytical Study

P. W. Cramer, Jr.

Technical Report 32-1591, December 15, 1973

Conical antennas have recently been shown to effectively meet the requirements for large erectable spacecraft antennas. One configuration investigated consists of an antenna with three scattering surfaces requiring four reflections for an electromagnetic wave. This article presents a method for evaluating the performance of a four-reflection or "quadreflex" antenna. Geometrical optics was used initially to determine the ideal feed pattern required to produce uniform illumination on the aperture of the conical reflector and the reverse problem of quickly finding the aperture illumination given an arbitrary feed pattern. The knowledge of the aperture illumination makes it possible to compute the antenna efficiency, which is useful for comparing antenna performance during tradeoff studies. Scattering calculations, using physical optics techniques, were then used to more accurately determine the performance of a specific design.

CROTTY, J. D.

C053 Ion Thruster Thermal Characteristics and Performance

L. C. Wen, J. D. Crotty, and E. V. Pawlik

J. Spacecraft Rockets, Vol. 10, No. 1, pp. 35–41, January 1973

For abstract, see Wen, L. C.

CROW, R. B.

C054 DSN Progress Report for November–December 1972: Block IV Subcarrier Demodulator Assembly Acquisition Problem

R. B. Crow, J. K. Holmes, and R. C. Tausworthe

Technical Report 32-1526, Vol. XIII, pp. 42–47, February 15, 1973

The Block IV subcarrier demodulator assembly (SDA) has been designed with four loop bandwidths. Two of these bandwidths are designed with unity damping, while the other two are achieved by increasing the loop gain. Any one of the four bandwidths can be used for normal tracking, and the "high-gain" bandwidths of the set may be used for acquisition. The transition from acquisition to tracking mode should be accomplished by providing a slow reduction in gain in order to limit the peak phase error during the transition time. Excessive phase errors can lead to loss of lock or greatly diminished quality of

data. This article documents the experiments and analysis that led to the bandwidth-reduction procedure used in the Block IV SDA so that acquisition is complete 80 s after phase lock for the 3.9- to 0.5-Hz configuration and 1300 s after phase lock for the 0.23- to 0.03-Hz configuration.

C055 DSN Progress Report for May–June 1973: Block IV Subcarrier Demodulator Assembly Design

R. B. Crow

Technical Report 32-1526, Vol. XVI, pp. 140–158, August 15, 1973

A design effort was undertaken during the past two years to design and build a Block IV Subcarrier Demodulator Assembly. The salient features that were to be incorporated were: (1) capability of manual or computer control, (2) small size, (3) higher data rate capacity (500,000 symbols/s), and (4) improved subcarrier tracking in the presence of high doppler rates. This article reviews the design and indicates the current status of the development project.

C056 Improvements in Deep-Space Tracking by Use of Third-Order Loops

R. C. Tausworthe and R. B. Crow

Proceedings of the 1972 International Telemetering Conference, Los Angeles, California, October 10–12, 1972, pp. 577–583

For abstract, see Tausworthe, R. C.

CUDDIHY, E. F.

C057 Long-Time Dynamic Compatibility of Elastomeric Materials With Hydrazine

C. D. Coulbert, E. F. Cuddihy, and R. F. Fedors

Technical Memorandum 33-650, September 1, 1973

For abstract, see Coulbert, C. D.

CUFFEL, R. F.

C058 Experimental Evaluation of Fluctuating Density and Radiated Noise

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

Technical Memorandum 33-643, October 1, 1973

For abstract, see Massier, P. F.

CURTIS, H. A.

C059 Error Analysis for Mariner Venus/Mercury 1973 Conducted at the JPL Mesa West Antenna Range

N. L. Vincent, C. A. Smith, A. J. Brejcha, and H. A. Curtis

Technical Memorandum 33-625, June 1, 1973

For abstract, see Vincent, N. L.

CUTTS, J. A.

C060 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

C061 Eolian Deposits and Dunes on Mars

J. A. Cutts and R. S. U. Smith (California Institute of Technology)

J. Geophys. Res., Vol. 78, No. 20, pp. 4139–4153, July 10, 1973

A complex of coalescing ridges and diverse marginal features observed in Mariner 9 pictures of the Hellespontus region of Mars is identified as a dune mass. Many other possible dune features are recognized in mid-latitudes and polar latitudes, and regional differences in the appearance of cratered terrains are attributed to modification by dune deposits. The morphology and temporal behavior of some Martian albedo features can be explained by dune-forming saltation processes. Eolian activity seems to be widespread, if not ubiquitous, on Mars and appears to produce major regional variations in the surface environment.

C062 Wind Erosion in the Martian Polar Regions

J. A. Cutts

J. Geophys. Res., Vol. 78, No. 20, pp. 4211–4221, July 10, 1973

Wind erosion may have played a dominant role in sculpturing the terrains of the polar regions of Mars. Many topographic features of the pitted terrain and the laminated terrain are consistently aligned with wind directions inferred from albedo markings. Cold air outflow from the polar cap veering to the west as a result of the coriolis force may account for the observed alignments. The remarkable pseudocircular and spiral features that underlie the residual frost caps in both polar regions may

have been formed by the more complex circulation patterns of the inner polar zone.

C063 Nature and Origin of Layered Deposits of the Martian Polar Regions

J. A. Cutts

J. Geophys. Res., Vol. 78, No. 20, pp 4231–4249, July 10, 1973

Layered deposits in the polar regions of Mars may be formed from fine dust ultimately derived from the canyons and other eroded terrains of the equatorial regions. An analysis of dust deposition in the area of annual frost cover predicts the formation of vast featureless domed plateaus underlain by layered deposits of dust. Television observations suggest that these plateaus once existed, but they have now been dissected and stripped from most of the area of annual frost cover. A possible explanation is that a major secular change has occurred in the erosional environment of the Martian polar regions. Estimates of depositional rates of dust under current atmospheric conditions place the time span represented by the accumulation of layered deposits at about 500 million years.

Because of erosion the present surface appears very young and lacks any impact craters. The present rate of water ice accumulation in the area of perennial frost is comparable to that of dust, and thus it is suggested that large quantities of water ice may be trapped with dust beneath the perennial frost caps. The formation of terraced erosional surfaces corresponding to individual layers or groups of layers indicates variations in response to erosion. One possible explanation is that reworking of the surface has occurred during intervals of nondeposition. Perennial frost appears to inhibit erosion of the layered deposits. One speculative possibility is that the secular change in erosional conditions corresponds to a reduction in the area of the perennial polar cap. Materials eroded from the layered deposits appear to have been redeposited in the mid-latitudes of Mars.

DACHEL, P.

D001 DSN Progress Report for March–April 1973: Low Noise Receivers: Theory of "Noise Bursts" on Large Antennas

W. H. Higa, R. C. Clauss, and P. Dachel

Technical Report 32-1526, Vol. XV, pp. 80–83, June 15, 1973

For abstract, see Higa, W. H.

D002 DSN Progress Report for May–June 1973: Frequency Generation and Control: Improved Vacuum Pump for the Atomic Hydrogen Frequency Standard

H. Erpenbach and P. Dachel

Technical Report 32-1526, Vol. XVI, pp. 69–71, August 15, 1973

For abstract, see Erpenbach, H.

DAEGES, J. J.

D003 DSN Progress Report for January–February 1973: Motor Run-Up and Control Unit

J. J. Daeges

Technical Report 32-1526, Vol. XIV, pp. 167–169, April 15, 1973

A motor-generator set is used to convert 60-Hz line voltage to 400-Hz voltage for use in the high-power transmitter. The motors used in the motor-generator sets are either 1750- or 3500-hp synchronous motors. They must be brought up to speed before line voltage can be applied to avoid severe power-line transients. The present unit being used to bring the motor up to speed is an open-loop analog device and cannot compensate for drift, temperature changes, or line-frequency changes. The design of the new unit will compensate for all variations and is simple to set up and maintain.

DAHLGREN, J. B.

D004 Testing and Evaluation of the LES-6 Pulsed Plasma Thruster by Means of a Torsion Pendulum System

J. P. Hamidian and J. B. Dahlgren

Technical Memorandum 33-630, October 1, 1973

For abstract, see Hamidian, J. P.

DARNTON, L.

D005 The Temperature Dependence of the Half Widths of Some Self- and Foreign-Gas-Broadened Lines of Methane

L. Darnton and J. S. Margolis

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 10, pp. 969–976, October 1973

The temperature dependence of the half width of four lines of the $2\nu_3$ band of methane has been measured. The broadeners used were H_2, He, N_2, and CH_4. The temperature coefficients, defined by the relation $\gamma = \gamma_0(T/T_0)^n$, have been determined for all of the broadeners and, in some cases, depart significantly from a kinetic theory value of −0.5. Where possible, the half widths were determined by two independent methods. All measurements were made at pressures below 2 atm absolute to

reduce interfering effects from the wings of neighboring lines.

DAVIS, E. K.

D006 DSN Progress Report for November–December 1972: Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XIII, pp. 26–28, February 15, 1973

During November and December 1972, DSN activities in support of Mariner Venus/Mercury 1973 have concentrated on finalizing ground-system test planning, spacecraft/DSN compatibility test planning, and on continuing implementation. This article summarizes the major accomplishments in the areas of planning, implementation, and testing.

D007 DSN Progress Report for January–February 1973: Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XIV, pp. 5–13, April 15, 1973

During January and February 1973, DSN preparations for Mariner Venus/Mercury 1973 mission support included continuing implementation of new capabilities, initiation of training, test and operations planning, and revision of plans to match new budget guidelines. The DSN progress review was held on February 2, 1973 to evaluate the progress of these ongoing activities and much of the information in this article stems from progress-review material.

D008 DSN Progress Report for March–April 1973: Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XV, pp. 5–9, June 15, 1973

During March and April 1973, the DSN encountered problems in completing software development for deep-space-station telemetry and command data handling. This impacted follow-on test plans and schedules. A large part of this article is devoted to the software problem and the corrective action taken.

D009 DSN Progress Report for May–June 1973: Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XVI, pp. 8–12, August 15, 1973

During May and June 1973 the DSN concentrated on completion of open hardware and software implementation tasks. Particular attention was given to the Telemetry and Command Data Subsystem software problem reported in the previous article. DSN system testing was initiated and support was provided for Project Ground Data System tests.

D010 DSN Progress Report for July–August 1973: Mariner Venus/Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XVII, pp. 5–8, October 15, 1973

During July and August 1973, the DSN continued activities to complete open hardware and software implementation tasks for Mariner Venus/Mercury 1973 (MVM'73). However, the primary activity during this period was DSN testing and training for MVM'73, including DSN system testing, DSN/spacecraft compatibility testing, and DSN support for mission-operations system testing.

D011 DSN Progress Report for September–October 1973: Mariner Venus–Mercury 1973 Mission Support

E. K. Davis

Technical Report 32-1526, Vol. XVIII, pp. 5–15, December 15, 1973

This article describes DSN support of the Mariner Venus/Mercury 1973 Project Mission Operations System tests during September and October 1973. DSN performance during these tests was less than satisfactory in many cases. Therefore, a significant level of effort was devoted to DSN problem isolation and resolution. Progress on open implementation tasks also continued.

DeBROCK, S. C.

D012 Selection of a Surface-Tension Propellant Management System for the Viking 75 Orbiter

M. W. Dowdy and S. C. DeBrock (Lockheed Missiles and Space Co., Inc.)

J. Spacecraft Rockets, Vol. 10, No. 9, pp. 549–558, September 1973

For abstract, see Dowdy, M. W.

DeMORE, W. B.

D013 O(^{1}D) Production in Ozone Photolysis Near 310 nm

C.-L. Lin and W. B. DeMore

Technical Memorandum 33-635, July 15, 1973

For abstract, see Lin, C.-L.

D014 Activation Energies for Addition of $O(^3P)$ to Simple Olefins

W. B. DeMore

Chem. Phys. Lett., Vol. 16, No. 3, pp. 608-610, October 15, 1972

Relative rates have been measured for addition of $O(^3P)$ to C_2H_4, C_2F_4, C_3H_6, and C_4H_8-1 in liquid Ar at 87.5°K. The results indicate that the activation energies for the C_3H_6 and C_4H_8-1 reactions are equal, to within 0.1 kcal/mole. A similar conclusion holds for C_2H_4 and C_2F_4. Further, the experiments suggest that the activation energy for addition of $O(^3P)$ to the double bond of C_2H_4 may be as low as 0.6 kcal/mole, and is unlikely to be higher than about 1 kcal/mole.

D015 Temperature and Pressure Dependence of CO_2 Extinction Coefficients

W. B. DeMore and M. Patapoff

J. Geophys. Res., Space Physics, Vol. 77, No. 31, pp. 6291-6293, November 1, 1972

The extinction coefficients of CO_2 are of particular interest in connection with the Mars atmosphere. This article describes the measurement of CO_2 extinction coefficients under conditions of temperature and pressure somewhat different from those used for previous measurements. Room temperature data are reported for the wavelength range 1850-2200 Å at pressures of about 3-50 atm. Temperature dependence in the range of about -50 to +50°C was examined at wavelengths down to about 1750 Å. The results show that, whereas pressure effects are generally negligible, temperature dependence is strong enough to invalidate the use of room temperature data for the Mars atmosphere.

D016 Intermediates in the Ozonation of Simple Alkynes

W. B. DeMore and C.-L. Lin

J. Org. Chem., Vol. 38, No. 5, pp. 985-989, March 9, 1973

The reactions of O_3 with $HC{\equiv}CH$, $CH_3C{\equiv}CH$, $CH_3C{\equiv}CCH_3$, and $C_2H_5C{\equiv}CH$ have been studied in liquid CO_2 at -45°. The initial products were observed by *in situ* infrared spectroscopy, and subsequent changes occurring upon warm-up or flash vaporization of the mixture were followed by ir or gc analysis. The principal new spectral feature for all alkynes except acetylene was a strong carbonyl absorption near 1740 cm^{-1}, and all alkynes gave relatively weak absorption bands in the carbonyl region which are attributed to the corresponding acid anhydrides. The 1740-cm^{-1} band was shown to be an unstable precursor of the acid anhydrides and other products. The overall mechanism, the identity of the precursor, and factors influencing the final product distribution are discussed.

D017 $O(^1D)$ Production in Ozone Photolysis Near 3100 Å

C.-L. Lin and W. B. DeMore

J. Photochem., Vol. 2, pp. 161-164, 1973-1974

For abstract, see Lin, C.-L.

D018 Pressure Dependence and Mechanism of the Reaction of Atomic Oxygen and Carbon Monoxide

W. B. DeMore

J. Phys. Chem., Vol. 76, No. 24, pp. 3527-3532, November 23, 1972

The rate of the O + CO reaction has been measured at room temperature from 0.74 to 41.9 atm with CO_2 or N_2 as the major third body. The method was based on relative rate measurements, with the O + O_2 reaction as reference. The pressure dependence is more complex than that normally observed for simple atom association reactions. Below 1 atm the reaction appears to be intermediate between second and third order, in agreement with earlier results reported elsewhere. However, at higher pressures a further increase in rate constant is observed. This latter effect is attributed to a reaction path which is negligible at low pressures but which becomes dominant at higher pressures. Detailed mechanisms are suggested.

D019 Reactions of $O(^1D)$ With Methane and Ethane

C.-L. Lin and W. B. DeMore

J. Phys. Chem., Vol. 77, No. 7, pp. 863-869, March 29, 1973

For abstract, see Lin, C.-L.

D020 Rate Constants for the Reactions of Hydroxyl and Hydroperoxyl Radicals With Ozone

W. B. DeMore

Science, Vol. 180, No. 4087, pp. 735-737, May 18, 1973

Chain decomposition of ozone by hydroxyl and hydroperoxyl radicals has been observed. The rate constant at 300 K for $OH + O_3 \rightarrow HO_2 + O_2$ is 8×10^{-14} cm^3/s. The rate constant for $HO_2 + O_3 \rightarrow OH + 2O_2$ is 3×10^{-15} cm^3/s. These results have implications concerning stratospheric ozone.

DEVANEY, J. R.

D021 Allende Meteorite Carbonaceous Phase: Intractable Nature and Scanning Electron Morphology

A. J. Bauman, J. R. Devaney, and
E. M. Bollin (Bollin Scientific Laboratory)

Nature, Vol. 241, No. 5387, pp. 264–267, January 26, 1973

For abstract, see Bauman, A. J.

DeWITT, B.

D022 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist,
S. Christensen (University of Texas),
B. DeWitt (University of Texas),
L. Smarr (University of Texas), and
E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

For abstract, see Estabrook, F. B.

DIEMER, W. D.

D023 DSN Progress Report for January–February 1973: Viewperiod Generator for Spacecraft and the Planets

W. D. Diemer

Technical Report 32-1526, Vol. XIV, pp. 205–214, April 15, 1973

This article describes a method, and the supporting software, developed to provide an inexpensive means of generating spacecraft and planetary viewperiods for the deep space stations over a long period of time. In the past, the only method for obtaining this information was an expensive and complex computer program which provided these data as a secondary output to the actual station look angles.

DIPPREY, D. F.

D024 Liquid Propellant Rockets

D. F. Dipprey

Chemistry in Space Research, pp. 465–597, American Elsevier Publishing Company, New York, 1972

Future space missions will require propulsion systems of higher performance, higher reliability for operations extending over periods of years in space, and gross reductions in system costs. Accomplishment of these goals will depend heavily on the efforts of chemists and chemical engineers to better understand the physicochemical processes involved in the production, storage, and combustion of existing and improved liquid propellants.

This article presents a brief overview of the state of knowledge in liquid rocket technology; examples of instances where some fundamental principles of chemistry, fluid mechanics, and mathematics can be applied; examples of current investigations where chemistry is being applied to this field; and indications of where advances are likely.

DIVINE, T. N.

D025 Interplanetary Charged Particle Environments

T. N. Divine

Technical Memorandum 33-637, August 1, 1973

Current state-of-the-art knowledge of the solar wind, solar particle events, and galactic cosmic rays is reviewed for the development of space vehicle design criteria based on these interplanetary environments. These criteria are described quantitatively in terms of intensity, flux and fluence, and their dependences on time, position and energy, and the associated probabilities and related parameters, for electrons, protons and other ions.

D026 Probabilities for the Peak Flux and Fluence of Energetic Solar Protons Incident on Interplanetary Spacecraft

T. N. Divine

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 37–44, July 1973

Energetic protons injected into interplanetary space in solar-particle events can interfere with spacecraft operations and experiments and can cause permanent degradation of some components. For future long-term interplanetary and planetary missions, techniques have been developed which use solar-particle event data from 1956 through 1970 to predict the probability of exceeding any value of peak proton intensity or mission proton fluence. Dependences on proton energy (near 10 to 100 MeV), heliocentric distance, and phase of the solar cycle are included. The techniques are described and applied to the Mariner Jupiter/Saturn 1977 mission.

DONNELLY, H.

D027 DSN Progress Report for March–April 1973: S/X-Band Open-Loop Receivers

H. Donnelly

Technical Report 32-1526, Vol. XV, pp. 51-53, June 15, 1973

The existing open-loop receivers at the Mars Deep Space Station (DSS 14) are being modified on an R&D basis to support the Mariner Venus/Mercury 1973 mission. These modifications will provide both S- and X-band phase-stable receivers to obtain occultation data. This article presents a description of the modifications.

D028 DSN Progress Report for March–April 1973: Multiple-Mission Open-Loop Receiver

H. Donnelly and S. E. Friedenberg

Technical Report 32-1526, Vol. XV, pp. 181-184, June 15, 1973

Existing Block III open-loop receivers are being modified to provide multiple-mission capability at S-band. These modifications provide greater flexibility in the selection of the receiver data bandwidth and the synchronizing signal frequency for analog recording and digital-data processing. This article describes the basic receiver design and the modifications required for multiple-mission capability.

DOWDY, M. W.

D029 Selection of a Surface-Tension Propellant Management System for the Viking 75 Orbiter

M. W. Dowdy and S. C. DeBrock (Lockheed Missiles and Space Co., Inc.)

J. Spacecraft Rockets, Vol. 10, No. 9, pp. 549-558, September 1973

For the Viking Mars 1975 mission, the midcourse trajectory corrections, Mars orbit insertion, and Mars orbit adjustments of the spacecraft are performed by the Orbiter propulsion system. A surface-tension propellant management system was chosen because of (1) its passive reliability and light weight, (2) its lower projected cost, and (3) the propellant quantity and resultant slosh loads. Based on the propellant management system requirements of the Viking Mars 1975 mission, a series of surface-tension design concepts was evaluated. The chosen concept is identified and its mission operation is described. Ullage bubble and bulk liquid positioning characteristics, pressurization and venting considerations, and liquid communication provisions are discussed. The nucleus of a development plan is established, and the results of some preliminary design and testing are presented.

DOWLER, W. L.

D030 Development of Propulsion for High-Atmospheric-Pressure or Dense Environments

G. Varsi, L. H. Back, and W. L. Dowler

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 45-52, July 1973

For abstract, see Varsi, G.

DOWNS, G. S.

D031 DSN Progress Report for March–April 1973: Simultaneous Detection of Pulsar Radiation at S- and X-Bands

P. E. Reichley, G. S. Downs, and G. A. Morris

Technical Report 32-1526, Vol. XV, pp. 133-137, June 15, 1973

For abstract, see Reichley, P. E.

D032 Pulsar Detections at Frequencies of 8.4 and 15.1 GHz

G. S. Downs, P. E. Reichley, and G. A. Morris

Astrophys. J., Vol. 181, No. 3, Part 2, pp. L143-L146, May 1, 1973

Eleven pulsars were observed and five were detected at 15.1 GHz. Several exhibit strong scintillations at 8.4 GHz. Estimates are made of the spectral indices of five pulsars. Average pulse shapes are presented for the stronger signals.

D033 Martian Topography and Surface Properties as Seen by Radar: The 1971 Opposition

G. S. Downs, R. M. Goldstein, R. R. Green, G. A. Morris, and P. E. Reichley

Icarus, Vol. 18, No. 1, pp. 8-21, January 1973

Taking advantage of the favorable opposition of 1971, the Goldstone radar system, operating at 2388 MHz, was used to scan the Martian surface. Measurements of altitude and reflected power were taken approximately every 3 days. Each measurement represents an area 8 km E-W × 80 km N-S, the highest resolution attained to date. Altitude measurements obtained on different observing days were combined to produce altitude profiles for three complete rotations, each at different latitudes. Large-scale variations in altitudes cover a range of 14 km. Altitude changes of 5 in 30 km of longitude were observed. The altitude profiles show the heavy cratering of the surface, and several large craters (50–100 km) 1–2 km deep are easily seen. Reflected power for different angles of incidence was measured, yielding the scattering properties of the surface as a function of longitude. Correlation was found between the peak intensity of the reflected signal and the width of the scattering function. The average relationship between the intensity and the width suggests a power reflection coefficient of at least

0.064 ± 0.012. Departures from the average are interpreted as deviations in the reflection coefficient from the mean value. These variations are presented as a function of longitude for each of the three rotations.

DUNN, G. L.

D034 DSN Progress Report For January–February 1973: Effects of Doppler Rate on Subcarrier Demodulator Assembly Performance

G. L. Dunn

Technical Report 32-1526, Vol. XIV, pp. 200–204, April 15, 1973

A time-dependent, steady-state, static-phase-error equation that includes doppler-rate effects has been incorporated into the Subcarrier-Demodulator-Assembly efficiency program. With the program in its present form, the optimum possible bandwidths, bit rate, amount of nulling of static phase error, and expected degradation can be obtained for the tracking of a given two-way doppler-shift profile by various manipulations of the program.

DUSSEL, G. A.

D035 Photoconductor–Metal Contact at Higher Densities

G. A. Dussel (University of Delaware), K. W. Böer (University of Delaware), and R. J. Stirn

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1443–1454, February 15, 1973

The formation of space charge in the barrier region is discussed. This region extends to $x_0 \cong 200$ Å $+ 2\lambda$ (λ is the mean free path of majority carriers). The conventional transport equation can be used only for $x > x_0$, and the carrier density at x_0 represents a boundary condition for the bulk. Its change as a function of applied voltage, temperature, and light intensity in photoconducting CdS is discussed. The time dependence of the space-charge formation in the region $0 < x < x_0$ is analyzed. It is shown under which conditions the individuality of the metal contact is observable.

D036 CdS–Metal Contact at Higher Current Densities

R. J. Stirn, K. W. Böer (University of Delaware), and G. A. Dussel (University of Delaware)

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1433–1443, February 15, 1973

For abstract, see Stirn, R. J.

DUXBURY, T. C.

D037 On-Board Optical Navigation Data From Mariner 71

T. C. Duxbury and C. H. Acton, Jr.

Navigation: J. Institute Nav., Vol. 19, No. 4, pp. 295–307, Winter 1972–1973

Satellite–star optical navigation, a new spacecraft navigation technique, has been successfully demonstrated during Mariner 9's approach to Mars in mid-November of 1971. As Mariner 9 approached Mars, 21 TV pictures of its satellites, Phobos and Deimos, were taken and transmitted to earth. On earth, these pictures were carefully processed in order to locate the positions of the bright satellites against the relatively faint star background. These position fixes were used to obtain more accurate knowledge of Mariner 9's path with respect to Mars and its satellites. The accuracy of the new navigation technique has been confirmed by comparison with the standard radio navigation results on Mariner 9.

This article describes the objectives and performance of the preflight and real time activities leading to the successful demonstration of satellite–star navigation data.

DWIVEDI, N. P.

D038 Maneuver Strategies for Multiplanet Missions

N. P. Dwivedi

AIAA J., Vol. 11, No. 9, pp. 1229–1230, September 1973

This article compares a number of maneuver strategies for five multiplanet missions, including the single planet strategy of nulling the aim-plane and flight-time errors at the immediate target. Significant differences were found among the strategies in the amount of corrective propellant required and the residual miss at each target. In general, nulling or minimization of the residual miss at the next target was found to be superior to that at the immediate target, when error growth is not nulled early. The best strategy corrects aim-plane and flight-time errors at the next target.

EDWARDS, J. N.

E001 DSN Progress Report for November–December 1972: Network Control System

J. N. Edwards

Technical Report 32-1526, Vol. XIII, pp. 209–218, February 15, 1973

A key function of the JPL DSN Network Control System (NCS) is to reduce DSN operating costs while providing the required fiscal year 1974/1975 mission support capa-

bility. The NCS Implementation Project Team has been established to fulfill these requirements. This article provides information regarding team responsibilities and activities, and describes both the final and interim NCS configurations and their interfaces.

E002 DSN Progress Report for January–February 1973: Network Control System

J. N. Edwards

Technical Report 32-1526, Vol. XIV, pp. 141–145, April 15, 1973

The Network Control System (NCS) is being implemented for the DSN. This article includes progress activities for final NCS hardware implementation, NCS data formats and Mission Operations Control interfaces, a software development summary, and an interim NCS hardware and software development summary.

E003 DSN Progress Report for July–August 1973: Network Control System Development

J. N. Edwards

Technical Report 32-1526, Vol. XVII, pp. 113–119, October 15, 1973

This article discusses the development of the DSN Network Control System (NCS), which has been authorized to provide centralized computer control and monitoring of deep space station equipment status and data flow. The NCS is being implemented with an interim (Block I) capability for current spacecraft-support requirements. A transition (Block II) and a final (Block III) NCS, providing future spacecraft-support requirements, will be implemented by a complex of minicomputers with dedicated-subsystem functional capability.

EISENBERGER, I.

E004 DSN Progress Report for January–February 1973: A Comparison Between the Current and Proposed Inventory and Procurement Policies for the Deep Space Network

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

Technical Report 32-1526, Vol. XIV, pp. 81–86, April 15, 1973

This article presents a comparison between the performances of the current and a proposed inventory and procurement policy for the Network Supply Depot and the Complex Supply Facilities. Both policies were simulated on a computer using identical input demand data. The comparison is based on four criteria: average inventory level, frequency of procurement orders, frequency of shortages, and average inventory cost per year. The results of the study indicate that, with reference to maintenance and operating items, the inventory cost would be reduced by about 25% if the proposed policy were put into effect.

E005 DSN Progress Report for September–October 1973: A Preliminary Study of Spares Provisioning for the Deep Space Network

I. Eisenberger, G. Lorden, and F. R. Maiocco

Technical Report 32-1526, Vol. XVIII, pp. 102–110, December 15, 1973

This article presents the results of a preliminary investigation into the problem of developing an efficient Initial Spares Provisioning and Spares Allocation Strategy for DSN operational spares. A sparing procedure is described, based on failure and repair rates and specified operational requirements. The procedure was applied to several possible situations and the results are listed. The results of computer simulations of these cases are also given.

E006 Detection of Failure Rate Increases

G. Lorden (California Institute of Technology) and I. Eisenberger

Technometrics, Vol. 15, No. 1, pp. 167–175, February 1973

For abstract, see Lorden, G.

ELACHI, C.

E007 Periodic Structures in Integrated Optics

C. Elachi and C. Yeh

J. Appl. Phys., Vol. 44, No. 7, pp. 3146–3152, July 1973

Thin-film dielectric waveguides with a periodic refractive index, a periodic substrate, or periodic surface are studied. The field is determined from Maxwell's equations using Floquet's theorem. The Brillouin diagram and the interaction regions are investigated. The bandwidth and the attenuation coefficients of the interaction regions are given as a function of the optical wavelength. A number of applications in active and passive integrated optics systems are discussed.

ELLEMAN, D. D.

E008 Thermal Energy Charge Transfer Reactions of Rare-Gas Ions to Methane, Ethane, Propane, and Silane: The Importance of Franck–Condon Factors

M. T. Bowers (University of California, Santa Barbara) and D. D. Elleman

Chem. Phys. Lett., Vol. 16, No. 3, pp. 486–491, October 15, 1972

For abstract, see Bowers, M. T.

E009 Temperature Dependence of the Accommodation Coefficient of Liquid-Helium Film

T. G. Wang, D. D. Elleman, E. E. Olli, and M. M. Saffren

Phys. Rev. Lett., Vol. 30, No. 11, pp. 485–487, March 12, 1973

For abstract, see Wang, T. G.

EMERSON, R. F.

E010 DSN Progress Report for November–December 1972: Programmed Oscillator Software Development for High-Doppler-Rate Orbiting Spacecraft

R. F. Emerson

Technical Report 32-1526, Vol. XIII, pp. 48–53, February 15, 1973

The programmed oscillator can be used to track spacecraft signals. Orbiting spacecraft impose additional requirements upon the ephemeris used by the programmed oscillator; therefore, modifications to the existing programmed oscillator were made. Experience with the tracking of Mariner Mars 1971 during superior conjunction shows that a receiver, assisted by the signal from the programmed oscillator, permits the tracking of high-doppler-rate signals close to the threshold of the receiver. The advantages of programmed-oscillator-assisted receiver operation include the reduction of stress upon the loop voltage-controlled oscillator (VCO), obviating the need for more than one VCO per receiver, and the provision of an acquisition aid for the receiver operators. This was demonstrated during the recent Mariner 1971 solar occultation, where no other tracking method could maintain lock.

E011 DSN Progress Report for November–December 1972: Programmed Oscillator Tracking Accuracy Measurements

R. F. Emerson

Technical Report 32-1526, Vol. XIII, pp. 54–60, February 15, 1973

The programmed oscillator has previously been shown to accurately track the low doppler rates encountered in cruise-phase spacecraft and planetary radar situations. To determine whether the programmed oscillator would be able to track the high doppler rates encountered with orbiting spacecraft such as Mariner Mars 1971, further tests were conducted which demonstrated that the programmed oscillator does have that capability. These tests further showed that the computations within the program used to drive the oscillator are so precise that no significant degradation in tracking ability is contributed by them.

E012 DSN Progress Report for January–February 1973: A Minicomputer Vector Generator

R. F. Emerson

Technical Report 32-1526, Vol. XIV, pp. 101–108, April 15, 1973

A vector generator was designed and built as a peripheral for a minicomputer. The vector generator is a device which accepts two endpoints and draws a straight line between them on some display device. While this could be done point-by-point by a minicomputer, it would use valuable computing power in an inefficient way. This generator is part of the Precision Signal Power Measurement System and is used to graph the power spectra of the measured signal to determine the performance of spacecraft and ground-telemetry transmitters and receivers. This hardware increases the graphing efficiency by an average of 4000 times over the point-by-point plotting method, requiring less than 15 μs of computer time per endpoint. The vectors are composed of points spaced 0.004 mm apart, providing excellent resolution and linearity.

E013 DSN Progress Report for March–April 1973: Precision Signal Power Measurement System Using Central Computing

R. F. Emerson

Technical Report 32-1526, Vol. XV, pp. 116–127, June 15, 1973

A Precision Signal Power Measurement System was built for research, development, and demonstration of a digital technique for the measurement of spacecraft signal power. Demonstrations at the Mars Deep Space Station (DSS 14) have shown that the method is valid. Since the process relies heavily on digital computations and computers are in short supply at deep space stations, it was necessary to determine if centralized computation could be done. To test this feasibility, the system described in this article was developed from existing subsystems and additional or new programs. During design of this system, parameters and relationships were developed to predict the behavior of the completed system.

Tests of this system in January 1971 showed that it performed as predicted. The final demonstration was conducted using the Mark IIIA hardware/software system in the Mission Control and Computing Center. The results indicate that remote processing of precision signal-power measurement data is technically feasible. As

implemented, the technique is limited to narrow-band spectra of signals with power levels between -140 and -170 dBm.

EPSTEIN, E. E.

E014 3C 120, BL Lacertae, and OJ 287: Coordinated Optical, Infrared, and Radio Observations of Intraday Variability

E. E. Epstein, et al.

Astrophys. J., Vol. 178, No. 2, Pt. 2, pp. L51–L59, December 1, 1972

Simultaneous optical, infrared, and radio observations were made to search for intraday (time scale < 24 h) variability of the radiation from 3C 120, BL Lac, and OJ 287, sources known to be active at both radio and optical wavelengths on time scales of days or longer. Optical interday (time scale > 24 h) variability was found for all three sources. The finding of optical intraday variability for BL Lac verified earlier results. The 3.5-mm data strongly suggest intraday variations of OJ 287 with amplitudes as large as ~40%. The infrared data for OJ 287 show variability of ~25% on one night but show no correlation with the 3.5-mm data.

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ERICKSON, D. E.

E015 DSN Progress Report for March–April 1973: An Experiment in Remote Monitoring of Mu-Ranging Operation at Mariner Mars 1971 Superior Conjunction

D. E. Erickson and J. W. Layland

Technical Report 32-1526, Vol. XV, pp. 156–166, June 15, 1973

This article describes the computer configurations and software used at JPL in an experimental remote monitoring and verification of the operation of the Sequential Component Ranging System during the superior conjunction of the Mariner Mars 1971 spacecraft. At the time of the spacecraft's closest approach to the Sun, the ranging operation was subjected to both an extremely low signal-to-noise ratio and perturbations from solar plasma.

The Sigma 5 computer at JPL was programmed to perform a maximum-likelihood range measurement, using the range-code correlation values supplied (in real time) from the ranging system at the Mars Deep Space Station (DSS 14). The maximum-likelihood decision process provided about a 1.5-dB improvement in ranging-error probability considering additive noise alone. The process was, however, relatively impractical to implement in the 920 computer which controlled the ranging operation at DSS 14 and performed range measurement via a sequential decision process.

ERPENBACH, H.

E016 DSN Progress Report for May–June 1973: Frequency Generation and Control: Improved Vacuum Pump for the Atomic Hydrogen Frequency Standard

H. Erpenbach and P. Dachel

Technical Report 32-1526, Vol. XVI, pp. 69–71, August 15, 1973

This article describes the use of a turbo-molecular pump as an alternative to the getter-ion pumping systems normally used with the hydrogen maser. The preliminary results were excellent. The time required for pumpdown is about one-third that of the ion pump system. Argon, which is normally ion-pumped at a speed of about 5% of that of air, is removed at the same speed as air with the turbo-molecular pump.

The amount of maintenance required for a turbo-molecular is less than for an ion pump. Ion pump elements have to be replaced once a year which means turning off the maser, installing new elements, and disturbing the maser, a process which requires several days. Turbo-molecular pump manufacturers claim 5 years or more without servicing.

ESCOBAL, P. R.

E017 DSN Progress Report for March–April 1973: A Global Model of the Earth's Ionosphere: The Nighttime Ionosphere

O. H. von Roos and P. R. Escobal

Technical Report 32-1526, Vol. XV, pp. 32–47, June 15, 1973

For abstract, see von Roos, O. H.

E018 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

This report describes a new technique of satellite geodesy, called 3-D Multilateration, that can determine the relative three dimensional coordinates of ground stations within 1 cm over baselines of 20 to 10,000 km. With this high accuracy, several crucial geodetic applications become possible: earthquake-hazards assessment, precision surveying, plate tectonics, and orbital applications.

Achievement of such accuracy can be attained through use of pulsed lasers to obtain simultaneous slant-ranges between an ensemble of ground stations and a moving retroreflector whose trajectory is known *a priori* only to the accuracy necessary for aiming the lasers. Numerical analysis has shown that suitably chosen multistation configurations result in well-conditioned solutions, with very small error magnification of the inherent ranging errors occasioned by the hardware subsystem. Laboratory tests have demonstrated that a laser hardware subsystem with a ranging accuracy of 3 cm can be built from commercially available components. By 1975, at the latest, an accuracy level of 1 cm can be achieved.

ESPOSITO, P. B.

E019 Measurement of General Relativistic Time Delay With Mariners 6 and 7

J. D. Anderson, P. B. Esposito, W. Martin, and D. O. Muhleman (California Institute of Technology)

Space Research XII, pp. 1623–1630, Akademie-Verlag, Berlin, 1971

For abstract, see Anderson, J. D.

ESTABROOK, F. B.

E020 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist, S. Christensen (University of Texas), B. DeWitt (University of Texas), L. Smarr (University of Texas), and E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

This article presents analytic and computer-derived solutions of the problem of slicing the Schwarzschild geometry into asymptotically-flat, asymptotically-static, maximal spacelike hypersurfaces. The sequence of hypersurfaces advances forward in time in both halves ($u \geq 0$, $u < 0$) of the Kruskal diagram, tending asymptotically to the hypersurface $r = 3M/2$ and avoiding the singularity at $r = 0$. Maximality is therefore a potentially useful condition to impose in obtaining computer solutions of Einstein's equations.

FEDORS, R. F.

F001 Long-Time Dynamic Compatibility of Elastomeric Materials With Hydrazine

C. D. Coulbert, E. F. Cuddihy, and R. F. Fedors

Technical Memorandum 33-650, September 1, 1973

For abstract, see Coulbert, C. D.

F002 A Method for Estimating Both the Solubility Parameters and Molar Volumes of Liquids

R. F. Fedors

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 45–53, April 1973

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 types 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 contribution of a much larger number of functional groups has been evalu-

ated, and (2) the method requires only a knowledge of the structural formula of the compound.

FERRERA, J. D.

F003 A Method for Calculating Transient Thrust and Flow-Rate Levels for Mariner Type Attitude Control Nitrogen Gas Jets

J. D. Ferrera

Technical Memorandum 33-604, January 1, 1972

The purpose of this memorandum is to define and program the transient pneumatic-flow equations necessary to determine, for a given set of conditions (geometry, pressures, temperatures, valve on time, etc.), the total nitrogen impulse and mass flow per pulse for the single pulsing of a Mariner-type reaction-control assembly valve. The rates of opening and closing of the valves are modeled, and electrical pulse durations of 20 to 100 ms are investigated.

The impulse results are compared to an equivalent square-wave impulse for both the Mariner Mars 1971 (MM'71) and Mariner Mars 1964 (MM'64) systems. It is demonstrated that, whereas in the MM'64 system, the actual impulse was as much as 56% higher than an assumed impulse (which is the product of the steady-state thrust and valve on time—i.e., the square wave), in the MM'71 system, the assumed impulse was in error in the same direction by only approximately 4% because of the larger nozzle areas and shorter valve stroke used.

FINNEGAN, E. J.

F004 DSN Progress Report for January–February 1973: New Arc Detector

E. J. Finnegan and R. A. Leech

Technical Report 32-1526, Vol. XIV, pp. 170–172, April 15, 1973

During this reporting period a new arc detector was constructed and tested both on the bench and at the Venus Deep Space Station. Test data show that the new arc detector meets or exceeds the performance of the existing arc detector and has the advantages of being simpler in construction and half the physical size.

F005 DSN Progress Report for July–August 1973: A New Dual Ignitron High-Voltage Crowbar

E. J. Finnegan

Technical Report 32-1526, Vol. XVII, pp. 120–122, October 15, 1973

This article describes a crowbar which is capable of holding off 100,000 V dc using two mercury-pool ignitrons connected in series. This crowbar assembly will replace the single high-voltage ignitron in the 400-kW transmitter at the Mars Deep Space Station and will be part of the DSN 100-kW transmitters being constructed overseas. It was necessary to develop a higher-voltage device in order to improve the reliability of the crowbar used to protect the high-powered RF klystron from self-destruction. The single ignitron has trouble operating over 60,000 V. An engineering model was built and has been operating satisfactorily at the Venus Deep Space Station.

FINNIE, C.

F006 DSN Progress Report for January–February 1973: Tracking and Ground-Based Navigation: Hydrogen Maser Frequency Standard Automatic Cavity Tuning Servo

C. Finnie

Technical Report 32-1526, Vol. XIV, pp. 56–59, April 15, 1973

This article describes the automatic cavity-tuning servomechanism to be incorporated in the DSN prototype hydrogen-maser frequency standard. It is a first-order sample-data control system, featuring stability-monitoring circuits for the detection of malfunctions in the maser and its receiver-frequency synthesizing system. The control system ignores error measurements exceeding an adjustable limit. The system's counter calibrates the Zeeman oscillator used to correct the maser output frequency for ambient magnetic fields.

F007 DSN Progress Report for May–June 1973: Hydrogen Maser Frequency Standard Automatic Tuning Servo

C. Finnie and D. A. Norris

Technical Report 32-1526, Vol. XVI, pp. 72–77, August 15, 1973

The microwave cavity tuner control module for the DSN prototype hydrogen maser is described. General features and techniques employed in the tuning system were described in a previous report. This article details the operation of the tuner control module.

FITZGERALD, D. J.

F008 Ion Thruster Performance Calibration

E. V. Pawlik, R. Goldstein, D. J. Fitzgerald, and R. W. Adams

J. Spacecraft Rockets, Vol. 10, No. 6, pp. 327–332, May 1973

For abstract, see Pawlik, E. V.

FJELDBO, G.

F009 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484–516, October 1972

For abstract, see Kliore, A. J.

F010 S Band Radio Occultation Measurements of the Atmosphere and Topography of Mars with Mariner 9: Extended Mission Coverage of Polar and Intermediate Latitudes

A. J. Kliore, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4331–4351, July 10, 1973

For abstract, see Kliore, A. J.

F011 Radio Occultation Experiments Planned for Pioneer and Mariner Missions to the Outer Planets

G. Fjeldbo

Planet. Space Sci., Vol. 21, No. 9, pp. 1533–1547, September 1973

Spacecraft radio occultation measurements planned for outer planet missions may yield profiles in height of atmospheric refractivity and microwave loss above the super-refractive regions of the giant planets. In a planetary ionosphere, the refractivity determines the electron number density distribution. At lower levels, the loss and the refractivity may be used to study the density, pressure, temperature and composition of the atmosphere. In order to maximize the scientific yield of outer planet occultation experiments, it is necessary to consider the effects of atmospheric refraction, multipath propagation, navigation errors and spacecraft accelerations in the design of the radio system and the spacecraft attitude control system.

FLEISCHER, G. E.

F012 Results of Solar Electric Thrust Vector Control System Design, Development, and Tests

G. E. Fleischer

Technical Report 32-1578, February 15, 1973

This report describes efforts recently undertaken to develop and test a thrust-vector control system (TVCS) for a solar-energy-powered ion-engine array. In particular, it summarizes the results of solar–electric propulsion-system technology (SEPST) III real-time tests of present versions of TVCS hardware in combination with computer-simulated attitude dynamics of a solar–electric multi-mission Phase A-type spacecraft configuration. In addition, current work on an improved solar–electric TVCS, based on the use of a state estimator, is described.

The report concludes that the results of SEPST III tests of TVCS hardware have generally proved successful, and the dynamic response of the system is close to predictions. Also, it appears that if TVCS electronic hardware can be effectively replaced by control computer software a significant advantage in control capability and flexibility can be gained in future developmental testing, with practical implications for flight systems as well. Finally, it is concluded from computer simulations that TVCS stabilization using rate estimation promises a substantial performance improvement over the present design.

FLETCHER, B. C.

F013 Evaluation of Errors in Prior Mean and Variance in the Estimation of Integrated Circuit Failure Rates Using Bayesian Methods

B. C. Fletcher

Technical Memorandum 33-614, June 1, 1972

Under the constraint of limited testing time, many attempts have been made to incorporate prior knowledge and experience into a quantitative assessment of reliability. This type of technique is known as Bayesian statistics. Since the length of time available for testing integrated circuits is frequently very limited, an analysis of Bayesian methods when applied to the integrated-circuit testing problem was conducted.

The critical point of any Bayesian analysis concerns the choice and quantification of the prior information. This memorandum is a study of the effects of prior data on a Bayesian analysis. Comparisons of the maximum-likelihood estimator, the Bayesian estimator, and the known failure rate are presented. The results of the many simulated trials are then analyzed to show the region of criticality for prior information being supplied to the Bayesian estimator. In particular, effects of prior mean and variance are determined as a function of the amount of test data available.

FLIEGEL, H. F.

F014 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

FOSTER, C. F.

F015 DSN Progress Report for January–February 1973: S-Band Planetary Radar Receiver Development

C. F. Foster and G. F. Lutes

Technical Report 32-1526, Vol. XIV, pp. 23–26, April 15, 1973

This article describes the design of a wideband 2295/2388-MHz converter which is a part of the Mars Deep Space Station (DSS 14) bistatic radar receiver. The receiver is an open-loop superheterodyne receiver used for the development of communication techniques and this converter design eliminates the need for separate converters at each frequency. The 229572388-MHz converter has been installed at DSS 14 and is now being used in the Venus radar-mapping experiments.

FRAMAN, E. P.

F016 Numerical Correlation and Evaluation in the Comparison of Evidentiary Materials

D. D. Lawson and E. P. Framan

J. Forensic Sci., Vol. 18, No. 2, pp. 110–117, April 1973

For abstract, see Lawson, D. D.

FRANK, H. A.

F017 Evaluation of New Plastic Compression (Ziegler) Type of Seals for Long-Life Planetary Batteries

H. A. Frank

Technical Memorandum 33-588, February 1, 1973

A program was initiated to develop improved types of terminal seals for aerospace Ni–Cd batteries. The approach used has not involved attempts, such as employed elsewhere, to improve the ceramic-to-metal seal that is now extensively employed for this application. Rather, the approach has been directed toward the development and evaluation of new types of seals. Of prime interest in this initial investigation has been the "Ziegler" type of compression seal and in particular the injection molded version developed by the Bell Telephone Laboratories (BTL).

A number of these units were designed, fabricated, and evaluated on an accelerated life test under a simulated battery environment. Results have shown that there are no major problems involved in scaling up the BTL small-size (5-A) seal to a larger-size (up to 50-A) seal suitable for most JPL flight batteries. Five out of five such seals successfully completed over 10 months of continuous thermal cycling (2-h cycle from −40°C to +71.1°C) without developing any leaks greater than 1.8×10^{-9} atm-cm^3/s of He.

F018 Leak Rates in Sealed Cells

H. A. Frank and A. A. Uchiyama

J. Electrochem. Soc., Vol. 120, No. 3, pp. 313–317, March 1973

Water vapor loss rates were determined from simulated and imperfectly sealed alkaline cells in the vacuum environment. The observed rates were found to be in agreement with a semi-empirical equation employed in vacuum technology. Results thereby give support for using this equation for the prediction of loss rates of battery gases and vapors to the aerospace environment. On this basis it was shown how the equation can be applied to the solution of many heretofore unresolved questions regarding leaks in batteries. Among these are the maximum permissible leak size consistent with a given cell life and conversely the maximum life consistent with a given leak size. It was also shown that loss rates of these cells in the terrestrial environment are several orders of magnitude less than the corresponding loss rates in the aerospace environment.

FREILEY, A. J.

F019 DSN Progress Report for January–February 1973: Tracking and Ground-Based Navigation: Precision System Temperature Measurements at Goldstone

M. S. Reid, R. A. Gardner, and A. J. Freiley

Technical Report 32-1526, Vol. XIV, pp. 60–67, April 15, 1973

For abstract, see Reid, M. S.

FRENCH, R. L.

F020 From Earth to Mars Orbit—Mariner 9 Propulsion Flight Performance With Analytical Correlations

M. J. Cork, R. L. French, C. J. Leising, and D. D. Schmit

AIAA Preprint 72-1185, AIAA/SAE Eighth Joint Propulsion Specialist Conference, New Orleans, Louisiana, November 29–December 1, 1972

For abstract, see Cork, M. J.

FREY, W. C.

F021 DSN Progress Report for March–April 1973: Network Control System Development

W. C. Frey

Technical Report 32-1526, Vol. XV, pp. 167–176, June 15, 1973

The development of the DSN Network Control System (NCS) has been authorized to provide centralized computer control and monitoring of deep space station equipment status and data flow. The NCS is being implemented with an interim capability for current spacecraft-support requirements. A final NCS, providing future spacecraft-support requirements, will be implemented by a complex of minicomputers with dedicated-subsystem functional capability.

FRIEDENBERG, S. E.

F022 DSN Progress Report for March–April 1973: Multiple-Mission Open-Loop Receiver

H. Donnelly and S. E. Friedenberg

Technical Report 32-1526, Vol. XV, pp. 181–184, June 15, 1973

For abstract, see Donnelly, H.

FRIEDMAN, L. D.

F023 Estimating Trajectory Correction Requirements for Multiple Outer Planet Missions

L. D. Friedman, T. W. Hamilton, and R. H. Stanton

J. Spacecraft Rockets, Vol. 9, No. 12, pp. 909–914, December 1972

The estimation of trajectory correction (ΔV) requirements for multiple outer planet flyby missions is a unique and challenging problem for the systems analyst. This article presents a general approach to solving this problem when the navigation system uses onboard optical measurements made during approach to each target planet to complement the ground-based radio measurements. The accuracy and reliability of the onboard measurement system plays a critical role in sizing the ΔV capability required. An illustration of the combined use of radio and optical measurements is provided for the particular case of a Jupiter–Uranus–Neptune mission. Use of the statistical technique developed for computing the ΔV margin required to account for uncertainties in subsystem performance permits ΔV savings of 100–120 m/s over "worst case" designs. This represents weight savings of about 50% of the science payload. For the example case ΔV requirements are estimated for two candidate optical systems and the radio alone case. The use of onboard measurements allows a ΔV savings of approximately 140 m/s.

F024 Navigation Requirements for Advanced Deep Space Missions

L. D. Friedman, J. W. Moore, and R. L. Sohn

Navigation: J. Institute Nav., Vol. 19, No. 3, pp. 266–280, Fall 1972

Throughout the history of space exploration, the navigation performance of spacecraft has been a prime driving factor in controlling mission value and mission design. In examining advanced interplanetary missions, it has been found that the navigation performance will be of even greater significance in future mission design. This article presents a survey of advanced deep space mission navigation requirements by an examination of the potential missions and their navigation system goals.

FYMAT, A. L.

F025 Absorption Profile of a Planetary Atmosphere: A Proposal for a Scattering Independent Determination

A. L. Fymat and J. Lenoble (Université des Sciences et Techniques de Lille)

Appl. Opt., Vol. 11, No. 10, pp. 2249–2254, October 1972

The use of scattering theory to infer atmospheric optical parameters requires the separation of absorption and scattering. It is demonstrated that a gradient flux relation exists that would provide the absorption (altitude) profile independently of scattering and irrespective of the state of polarization of the light field. The relation is derived for an atmosphere of plane-parallel or spherical geometry and for broad (continuum) and narrow (spectral line) frequency bands. The results are shown to hold, in particular, for the polarizations induced by both Rayleigh and Mie scattering in the field. Experimental setups are proposed for each of the cases considered of atmospheric geometry and frequency bandwidth. A final discussion considers the relevance of the present determination of the atmospheric absorption profile to the related problems of aerosol relative concentration, interpretation of radiometric and spectrometric data formed in the presence of scattering, clouds morphology, and radiative heat budget of the atmosphere.

F026 Interferometric Spectropolarimetry: Alternate Experimental Methods

A. L. Fymat

Appl. Opt., Vol. 11, No. 10, pp. 2255–2264, October 1972

Three alternate methods of obtaining spectra of the intensity and state of polarization of light are proposed. The methods make use of a two-beam amplitude division interferometer using the technique of Fourier spectroscopy, and can be applied to either emerging beam, source beam, or detector beam, or to both. They do not require the presence of polarizers in the arms of the instrument. In one method (Method 2) a single analyzer is used in front of the detector with three successive orientations of its transmission axis azimuth (0, 45, and 90 deg). In another method (Method 3) a linear polarizer assuming the same set of orientations is placed in the incident beam. A third method (Method 4), a hybrid of the former two methods, makes use of both a polarizer and an analyzer in the locations indicated. The latter method presents itself three alternate possibilities. Method 2 permits the determination of all four Stokes parameters of polarization, whereas Methods 3 and 4 cannot yield the ellipticity parameter.

All methods require the recording of three interferograms. However, two interferograms can provide the intensity and degree of polarization in any of the methods described. The theory of Method 1, reported earlier, is also established more rigorously concerning the proposed interferometric arrangements, the applicability of the method to the source beam, and the possibility of deriving the orientation of the plane of polarization and the ellipticity from a single interferogram.

GALE, G. P.

G001 DSN Progress Report for July–August 1973: 64-Meter-Diameter Antenna Hydrostatic Bearing Runner Joint Leak Tests

G. P. Gale and H. P. Phillips

Technical Report 32-1526, Vol. XVII, pp. 89–92, October 15, 1973

Oil leaks from the hydrostatic-bearing runner-joint areas of the 64-m-diameter antenna installations at the Ballima Deep Space Station (DSS 43) and the Robledo Deep Space Station (DSS 63) have been a cause of concern since the erection of these antennas. This article describes the type of leak tests made on a model of the joint seal, the possible causes of leaks, and results after replacing the joint seals at DSS 63.

GARDNER, J. A.

G002 Solar Electric Propulsion System Integration Technology (SEPSIT) Final Report: Technical Summary

J. A. Gardner

Technical Memorandum 33-583, Vol. I, November 15, 1972

The use of solar-electric propulsion (SEP) as a means of exploring space beyond the reach of ballistic missions was investigated in 1972. The method used was to study the application of this new propulsion technology to a future flight project. A 1980 Encke rendezvous mission was chosen because a design successful for Encke could be used for less difficult, but scientifically rewarding, missions. Design points for the mission and for the thrust subsystem were specified, the baseline-vehicle design was defined, and a preliminary functional-description document for the thrust subsystem was originated. Analyses were performed in support of the design point selection for the SEP-module thrust subsystem to specify parameters, to clarify and optimize the interface requirements, and to assure feasibility of some of the more critical technological aspects of SEP application.

GARDNER, R. A.

G003 DSN Progress Report for January–February 1973: Tracking and Ground-Based Navigation: Precision System Temperature Measurements at Goldstone

M. S. Reid, R. A. Gardner, and A. J. Freiley

Technical Report 32-1526, Vol. XIV, pp. 60–67, April 15, 1973

For abstract, see Reid, M. S.

G004 DSN Progress Report for May–June 1973: The Development of a New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVI, pp. 78–86, August 15, 1973

For abstract, see Reid, M. S.

G005 DSN Progress Report for September–October 1973: Improvement in the Accuracy of the New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVIII, pp. 94–98, December 15, 1973

For abstract, see Reid, M. S.

GARY, B.

G006 Observations of Jupiter at 13-cm Wavelength During 1969 and 1971

S. Gulkis, B. Gary, M. Klein, and C. T. Stelzried

Icarus, Vol. 18, No. 2, pp. 181–191, February 1973

For abstract, see Gulkis, S.

G007 Radio Observations of Cygnus X-3 and the Surrounding Region

B. Gary, E. T. Olsen, and P. W. Rosenkranz

Nature Phys. Sci., Vol. 239, No. 95, pp. 128–130, October 23, 1972

On September 7, 1972, Cygnus X-3 was observed with the Goldstone 64-m antenna at wavelengths of 13.1, 3.55, and 2.07 cm. At 13.1 cm a map of received flux density has been constructed for a region 0.5 × 0.6 arc deg with a resolution of 8.15 arc min. This map reveals the presence of several partially resolved features having integrated flux densities in excess of one flux unit. This article presents and discusses the map as well as a summary of the intensity measurements taken at the three wavelengths.

GENSEL, D. R.

G008 Monitoring of Antarctic Dry Valley Drilling Sites

F. A. Morelli, R. E. Cameron, D. R. Gensel, and L. P. Randall (Northern Illinois University)

Antarctic J. U.S., Vol. VII, No. 4, pp. 92–94, July–August 1972

For abstract, see Morelli, F. A.

GEORGEVIC, R. M.

G009 Analytic Expressions for Perturbations and Partial Derivatives of Range and Range Rate of a Spacecraft With Respect to the Coefficient of the Second Harmonic

R. M. Georgevic

Technical Memorandum 33-594, March 15, 1973

Closed-form analytic expressions for the time variations of instantaneous orbital parameters and of the topocentric range and range rate of a spacecraft moving in the gravitational field of an oblate large body are derived using a first-order variation-of-parameters technique. In addition, the closed-form analytic expressions for the partial derivatives of the topocentric range and range rate are obtained with respect to the coefficient of the second harmonic (J_2) of the potential of the central body. The results are applied to the motion of a point-mass spacecraft moving in orbit around the equatorially elliptic, oblate Sun, with $J_2 \cong 2.7 \times 10^{-5}$.

G010 The Solar Radiation Pressure on the Mariner 9 Mars Orbiter

R. M. Georgevic

Astronaut. Acta, Vol. 18, No. 2, pp. 109–115, April 1973

The refined mathematical model of the force created by the light pressure of the Sun has been used to compute the solar radiation pressure force acting on the Mariner 9 spacecraft, taking into account the reflectivity characteristics of all its components. The results have been compared with values obtained from Mariner 9 observations during the cruise phase and found to be in agreement within 0.1% of the values.

G011 The Solar Radiation Pressure Force and Torques Model

R. M. Georgevic

J. Astronaut. Sci., Vol. XX, No. 5, pp. 257–274, March–April 1973

The general expressions for the solar radiation force and torques are derived in the vectorial form for any given reflecting surface, provided that the reflecting characteristics of the surface, as well as the value of the solar constant, are known. An appropriate choice of a spacecraft-fixed frame of reference leads to relatively simple expressions for the solar radiation force and torques in terms of the functions of the Sun-spacecraft-Earth angle. For illustration purposes the model is used for computing the solar radiation force and torques on the reflecting surface of the high-gain antenna reflector of a parabolic shape and on the curved surface of a circular cylinder.

GIFFIN, C. E.

G012 A Portable Self-Contained Gas Chromatograph

M. R. Stevens, C. E. Giffin, G. R. Shoemake, and P. G. Simmonds

Rev. Sci. Instr., Vol. 43, No. 10, pp. 1530–1534, October 1972

For abstract, see Stevens, M. R.

GILVARRY, J. J.

G013 Possible Variation of the Gravitational Constant Over the Elements

J. J. Gilvarry and P. M. Muller

Phys. Rev. Lett., Vol. 28, No. 25, pp. 1665-1669, June 19, 1972

This article re-examines the theory and data of a previous experiment, which measured the relative difference $\Delta\kappa/\kappa$ in the gravitational constant κ between the two elements, and cites significant errors in the statistical analysis. The upper bound for F and Br from his experimental data correctly becomes $(\Delta\kappa/\kappa)_{max} = 2 \times 10^{-2}$, about 10 times the limit already set on the general variation of κ over the elements by direct use of a Cavendish balance.

GIN, W.

G014 Unmanned Planetary Spacecraft Chemical Rocket Propulsion

H. Burlage, Jr., W. Gin, and R. W. Riebling

J. Spacecraft Rockets, Vol. 9, No. 10, pp. 729-737, October 1972

For abstract, see Burlage, H., Jr.

GOETZ, A. F. H.

G015 Isoluminous Additive Color Method for the Detection of Small Spectral Reflectivity Differences

E. Yost (Long Island University), R. Anderson (Long Island University), and A. F. H. Goetz

Photogr. Sci. Eng., Vol. 17, No. 2, pp. 177-182, March-April 1973

For abstract, see Yost, E.

GOLDSTEIN, B. E.

G016 Solar Wind Observations on the Lunar Surface With the Apollo-12 ALSEP

M. Neugebauer, C. W. Snyder, D. R. Clay, and B. E. Goldstein

Planet. Space Sci., Vol. 20, No. 20, pp. 1577-1591, October 1972

For abstract, see Neugebauer, M.

GOLDSTEIN, R.

G017 Nitrogen Ionization in an Hg-N_2 Discharge

R. Goldstein

J. Chem. Phys., Vol. 59, No. 2, pp. 983-984, July 15, 1973

Ionization products of a mercury vapor-nitrogen discharge have been studied as a function of nitrogen partial pressure. The discharge chamber used was a 20-cm-diam electron bombardment mercury ion thruster. As a result of the study it is felt that the mercury did not appreciably affect the nitrogen ionization processes. This assumption is supported by the fact that the relative peak height of Hg^+ remained constant to better than 1% throughout the N_2 pressure range investigated.

The most striking feature of the results is that below pressures of about 10^{-5} torr the nitrogen ion peaks increase quadratically with pressure, while above 10^{-5} torr the increase is linear. The quadratic dependence suggests a bi-molecular process, such as collision between two excited states.

G018 Ion Thruster Performance Calibration

E. V. Pawlik, R. Goldstein, D. J. Fitzgerald, and R. W. Adams

J. Spacecraft Rockets, Vol. 10, No. 6, pp. 327-332, May 1973

For abstract, see Pawlik, E. V.

GOLDSTEIN, R. M.

G019 Minor Planets and Related Objects: XII. Radar Observations of (1685) Toro

R. M. Goldstein, D. B. Holdridge, and J. H. Lieske

Astron. J., Vol. 78, No. 6, pp. 508-509, August 1973

Radar observations of Toro were made with a (one-dimensional) resolution of 0.005 arc sec. When radar and optical data are combined, they suggest an irregular rocky surface slightly smoothed by a mantle of loose material.

G020 Martian Topography and Surface Properties as Seen by Radar: The 1971 Opposition

G. S. Downs, R. M. Goldstein, R. R. Green, G. A. Morris, and P. E. Reichley

Icarus, Vol. 18, No. 1, pp. 8-21, January 1973

For abstract, see Downs, G. S.

GOODWIN, P. S.

G021 DSN Progress Report for November-December 1972: Helios Mission Support

P. S. Goodwin

Technical Report 32-1526, Vol. XIII, pp. 7–20, February 15, 1973

Project Helios is a joint space endeavor between the United States and West Germany. Its objective is to place into heliocentric orbits two unmanned spacecraft which will come closer to the sun than any previously or presently planned Free-World deep-space undertaking. The West German government is designing and fabricating the spacecraft and will conduct mission operations. NASA will provide the launch vehicle, the launch facilities, and the major portion of the tracking and data acquisition. The launch of the first spacecraft is planned for mid-1974 and the second for late 1975.

To ensure proper technical coordination between the activities in West Germany and in the United States, the International Agreement provides for semiannual Helios Joint Working Group Meetings for the exchange of information and for the proper coordination of the activities leading toward launch and subsequent mission operations. This article reports the highlights, with respect to the DSN, of the subjects discussed during the Seventh Helios Joint Working Group Meeting which was held at Porz-Wahn (near Bonn), West Germany, October 25 to 31, 1972.

GOSLINE, R. M.

G022 DSN Progress Report for January–February 1973: CONSCAN Implementation at DSS 13

R. M. Gosline

Technical Report 32-1526, Vol. XIV, pp. 87–90, April 15, 1973

The ability to do automatic boresighting of a large parabolic antenna without a monopulse feed or rotatable subreflector is desirable. A conical-scan technique based on the movement of the main reflector under computer control has been developed. This article describes the functional features of the hardware and software as implemented at the Venus Deep Space Station (DSS 13). Application to very precise antenna pointing is possible.

GOSS, W. C.

G023 Image Dissector Development

W. C. Goss

Technical Memorandum 33-608, April 15, 1973

A second-generation, electrostatically focused, image-dissector tube for use in spacecraft-attitude-control star trackers is being developed with the support of an industrial contractor. Significant improvements are being made in functional characteristics, as well as in package-dimension control, tolerance of a wide variety of environmental conditions, and expected reliability over long operational lifetimes.

GREEN, R. H.

G024 Planetary Quarantine Goes to Work in the Hospital

M. D. Wardle, A. S. Irons, and R. H. Green

Astronaut. Aeronaut., Vol. 11, No. 6, pp. 32–38, June 1973

For abstract, see Wardle, M. D.

GREEN, R. R.

G025 Martian Topography and Surface Properties as Seen by Radar: The 1971 Opposition

G. S. Downs, R. M. Goldstein, R. R. Green, G. A. Morris, and P. E. Reichley

Icarus, Vol. 18, No. 1, pp. 8–21, January 1973

For abstract, see Downs, G. S.

GREEN, W. B.

G026 A User's Guide to the Mariner 9 Television Reduced Data Record

J. B. Seidman, W. B. Green, P. L. Jepsen, R. M. Ruiz, and T. E. Thorpe

Technical Memorandum 33-628, September 1, 1973

For abstract, see Seidman, J. B.

G027 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

GREENHALL, C. A.

G028 DSN Progress Report for November–December 1972: Models for Flicker Noise in DSN Oscillators

C. A. Greenhall

Technical Report 32-1526, Vol. XIII, pp. 183–193, February 15, 1973

This article presents a mathematically tractable model for flicker noise. This model is not stationary but has stationary increments, and it is expressed as a limit of stationary processes. It behaves like flicker noise when subjected either to high-pass filtering or to direct spectral measurements, and the effects of a detrending operation on these measurements are investigated. The flicker-noise model of Barnes and Allan is reviewed, and the performances of the two models are compared.

G029 DSN Progress Report for July–August 1973: Dual-Carrier Intermodulation Caused by a Zero-Memory Nonlinearity

C. A. Greenhall

Technical Report 32-1526, Vol. XVII, pp. 108–112, October 15, 1973

Intermodulation products of a dual carrier distorted by a zero-memory nonlinearity F are calculated. Conversely, given certain of the intermodulation coefficients, the odd part F_o of the nonlinearity can be recovered. If the coefficients decrease fast enough, then F_o is analytic. The value of F_o is explicitly calculated for two cases of exponentially decreasing intermodulation products.

GRENOBLE, D. E.

G030 Unified Approach to the Biomechanics of Dental Implantology

D. E. Grenoble (University of Southern California) and A. C. Knoell

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 7–17, January 1973

The human need for safe and effective dental implants is well-recognized. Although many implant designs have been tested and are in use today, a large number have resulted in clinical failure. These failures appear to be due to biomechanical effects, as well as biocompatibility and surgical factors.

This article proposes a unified approach, using multidisciplinary systems technology for the study of the biomechanical interactions between dental implants and host tissues. The approach progresses from biomechanical modeling and analysis, supported by experimental investigations, through implant design development, clinical verification, and education of the dental practitioner.

GROTCH, S. L.

G031 Computer Identification of Mass Spectra Using Highly Compressed Spectral Codes

S. L. Grotch

Anal. Chem., Vol. 45, No. 1, pp. 2–6, January 1973

In file search methods, storage is often a significant problem, particularly with mini-computers. Spectral abbreviation alleviates the problem by coding only 2 peaks/14 amu. This concept may be further exploited by noting that the mass position of any peak in a 14-amu window may be coded using only four bits. For nearly 7000 spectra in the Aldermaston collection, this code requires an average of 48 bits/spectrum. Tests indicate that this code is highly specific, and with appropriate matching algorithms will produce very effective identifications. Further improvements in identification accuracy are obtained when two bits of intensity information are added to the peak position. Using an IBM 360/44, a 7000-spectra library can be searched in less than 10 s. Since most computers now manufactured have word sizes which are multiples of four bits, this technique should lend itself well to most machines.

GUISINGER, J. E.

G032 Magneto-Optic Investigation of MnBi Films

G. Lewicki and J. E. Guisinger

J. Appl. Phys., Vol. 44, No. 5, pp. 2361–2364, May 1973

For abstract, see Lewicki, G.

GULKIS, S.

G033 Search for Small-Scale Anisotropy in the 2.7° K Cosmic Background Radiation at a Wavelength of 3.56 Centimeters

R. L. Carpenter (California State University, Los Angeles), S. Gulkis, and T. Sato

Astrophys. J., Vol. 182, No. 2, Pt. 2, pp. L61–L64, June 1, 1973

For abstract, see Carpenter, R. L.

G034 Observations of Jupiter at 13-cm Wavelength During 1969 and 1971

S. Gulkis, B. Gary, M. Klein, and C. T. Stelzried

Icarus, Vol. 18, No. 2, pp. 181–191, February 1973

Radio observations of Jupiter have been carried out at Goldstone, California at a wavelength of 13 cm during the oppositions of 1969 and 1971. In 1969, circular-polarization and total-flux measurements were made with a 64-m radio telescope. From May through October

1971, Jupiter's flux density was measured at weekly intervals with a 26-m antenna. Analysis of the 2 years of data has yielded the following results: (a) The upper limit to the degree of circular polarization over the longitude ranges 10–100° and 160–250° System III (1957.0) is 1%; (b) the flux data have been used to derive a magnetospheric rotation period which is approximately 0.37 s longer than the IAU System III (1957.0); (c) the flux-density data define beaming curves which are apparently different from 11-cm beaming curves measured in 1964; (d) Jupiter's peak flux density decreased by ~20% between 1964 and 1971, and 8% between 1969 and 1971.

G035 Thermal Radio Emission From Jupiter and Saturn

S. Gulkis and R. Poynter

Phys. Earth Planet. Interiors, Vol. 6, Nos. 1–3, pp. 36–43, December 1972

Microwave brightness temperature calculations have been carried out for a number of model atmospheres for Jupiter and Saturn. The models considered are characterized by helium to hydrogen number mixing ratios which range from 0 to 0.2. Gaseous ammonia is assumed to be a trace constituent in all the models. The ammonia abundance below the (NH_3) cloud level is a free parameter which is determined by comparing the observed thermal spectrum of Jupiter and the total spectrum of Saturn with the model calculations. The theoretical microwave spectra corresponding to those models in which the ammonia abundance is that expected from an atmosphere containing a solar abundance of elements are found to be in generally good agreement with the observations. This result is shown to be nearly independent of the helium to hydrogen ratio for the models considered. There is no evidence at this time that a nonthermal component contributes to Saturn's microwave spectrum.

G036 A Survey of the Outer Planets Jupiter, Saturn, Uranus, Neptune, Pluto, and Their Satellites

R. L. Newburn, Jr., and S. Gulkis

Space Sci. Rev., Vol. 14, No. 2, pp. 179–271, February 1973

For abstract, see Newburn, R. L., Jr.

G037 Thermal Radio Emission From the Major Planets

S. Gulkis

Space Sci. Rev., Vol. 14, Nos. 3 and 4, pp. 497–510, March–May 1973

The use of long-wavelength radio measurements of brightness temperature to remotely measure the thermal structure of the atmospheres of the major planets at great depths (> 10 atm) is discussed. Data are presented which show that the gross features of Jupiter's and Saturn's microwave spectra, as determined from ground based observations, can be explained in terms of thermal emission from ammonia in deep convective atmospheres of He and H_2.

GUPTA, K. K.

G038 Free Vibration Analysis of Spinning Structural Systems

K. K. Gupta

Int. J. Numer. Methods Eng., Vol. 5, No. 3, pp. 395–418, January 1973

This article presents an efficient digital computer procedure, along with the complete listing of the associated computer program, which may be conveniently utilized for the accurate solution of a wide range of practical eigenvalue problems. Important applications of the present work are envisaged in the natural frequency analysis of spinning structures discretized by the finite element technique, and in the determination of transfer functions associated with the dynamic blocks of control systems of spacecraft utilizing gas jets or reaction wheels for attitude control, as well as of spin-stabilized and dual-spin-stabilized satellites.

The validity of the Sturm sequence property is first established for the related matrix formulation involving Hermitian and real symmetric, positive-definite matrices, both being usually of highly banded configuration. A numerically stable algorithm based on the Sturm sequence method is then developed which fully exploits the banded form of the associated matrices. The related computer program written in FORTRAN V for the JPL UNIVAC 1108 computer proves to be extremely fast and economical in comparison to other existing methods of such analysis. Numerical results are presented for a spinning bent cantilever beam and the solar arrays of SKYLAB, the Earth-orbiting space station proposed by NASA.

G039 Solution of Quadratic Matrix Equations for Free Vibration Analysis of Structures

K. K. Gupta

Int. J. Numer. Methods Eng., Vol. 6, No. 1, pp. 129–135, 1973

An efficient digital computer procedure and the related numerical algorithm are presented herein for the solution of quadratic matrix equations associated with free vibration analysis of structures. Such a procedure enables accurate and economical analysis of natural frequencies and associated modes of discretized structures. The numerically stable algorithm is based on the Sturm sequence method, which fully exploits the banded form of associated stiffness and mass matrices. The related com-

puter program written in FORTRAN V for the JPL UNIVAC 1108 computer proves to be substantially more accurate and economical than other existing procedures of such analysis. Numerical examples are presented for two structures: a cantilever beam and a semicircular arch.

G040 Eigenproblem Solution by a Combined Sturm Sequence and Inverse Iteration Technique

K. K. Gupta

Int. J. Numer. Methods Eng., Vol. 7, No. 1, pp. 17-42, 1973

This article presents an efficient and numerically stable algorithm, along with a complete listing of the associated computer program, developed for the accurate computation of specified roots and associated vectors of the eigenvalue problem $\mathbf{Aq} = \lambda\,\mathbf{Bq}$ with band symmetric A and B, B being also positive definite. The desired roots are first isolated by the Sturm sequence procedure; then a special variant of the inverse iteration technique is applied for the individual determination of each root along with its vector. The algorithm fully exploits the banded form of relevant matrices, and the associated program written in FORTRAN V for the JPL UNIVAC 1108 computer proves to be most significantly economical in comparison to similar existing procedures.

The program may be conveniently utilized for the efficient solution of practical engineering problems including free vibration and buckling analysis of structures. Results of such analyses are presented for representative structures.

HADEK, V.

H001 Alkali Metal Intercalates of Molybdenum Disulfide

R. B. Somoano, V. Hadek, and A. Rembaum

J. Chem. Phys., Vol. 58, No. 2, pp. 697-701, January 15, 1973

For abstract, see Somoano, R. B.

HALL, R. C.

H002 Annual Chronology of International Astronautical Events: 1970

R. C. Hall

Astronaut. Acta., Vol. 18, No. 3, pp. 155-170, June 1973

This article presents a chronology of scientific and technological events and achievements brought about during calendar year 1970 by international cooperative participation in space exploration. Also included is a bibliography of publications for the same year that pertain to the history of astronautics.

HALL, R. I.

H003 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

Technical Memorandum 33-646, July 15, 1973

Electron scattering spectra of CO_2 are reported in the 7 to 10 eV energy-loss range, at energies of 0.2, 0.35, 0.6, 0.7, and 7.0 eV above threshold, and at a scattering angle of 90°. Several new distinct overlapping continua with weak, diffuse bands superimposed are observed to lie in this energy-loss range. The experimental spectra are discussed in the light of recent *ab initio* configuration-interaction calculations of the vertical transition energies of CO_2. The experimental spectra are shown to be consistent with excitations to the $^3\Sigma_u^+$, $^{1,3}\Sigma_u^-$, $^{1,3}\Pi_g$, and $^{1,3}\Delta_u$ states of CO_2.

H004 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 9, pp. L264-L267, September 1973

Electron scattering spectra of CO_2 are reported in the 7-10 eV energy-loss range, at energies of 0.2, 0.35, 0.6, and 7.0 eV above threshold, and at a scattering angle of 90°. Several new distinct overlapping continua with weak, diffuse bands superimposed are observed to lie in this energy-loss range. The experimental spectra are discussed in the light of recent *ab initio* configuration-interaction calculations of the vertical transition energies of CO_2. The experimental spectra are shown to be consistent with excitations to the $^3\Sigma_u^+$, $^{1,3}\Sigma_u^-$, $^{1,3}\Pi_g$, and $^{1,3}\Delta_u$ states of CO_2.

HAM, N. C.

H005 DSN Progress Report for January-February 1973: Amplitude and Frequency Modulation Effects to Telemetry Link Reception

N. C. Ham

Technical Report 32-1526, Vol. XIV, pp. 149-160, April 15, 1973

A spin-stabilized spacecraft can produce an amplitude and phase variation to the normally phase-modulated downlink carrier signal due to its antenna characteristics. The manifestation of these variations is equivalent to an amplitude and frequency modulation of the carrier sig-

nal, and the effects to the telemetry link must be considered. The Helios spacecraft and mission is a typical case, and means for simulating a certain portion of the flight profile, which will create such conditions, was utilized to test and evaluate the effect upon the Deep Space Instrumentation Facility Telemetry System. Initial test results indicated that the Telemetry System was more sensitive to phase variation than to amplitude variation in increasing the detected symbol error rate for a given telecommunication-link situation.

H006 DSN Progress Report for September–October 1973: Helios Spacecraft Low-Gain Antenna Model

N. C. Ham

Technical Report 32-1526, Vol. XVIII, pp. 147–162, December 15, 1973

This article discusses an extension of the Helios spacecraft low-gain antenna analysis performed with emphasis on the region of RF signal interferometry produced by the combined signals radiated from the horn and dipole antennas of like polarization. A mathematical model of the low-gain antenna model is developed and resultant computer plots compared against the amplitude and phase characteristics measured from a spacecraft-antenna mockup. The model proved to correlate well with measured patterns and serves to consider major effects that may impact the telecommunications link.

HAMIDIAN, J. P.

H007 Testing and Evaluation of the LES-6 Pulsed Plasma Thruster by Means of a Torsion Pendulum System

J. P. Hamidian and J. B. Dahlgren

Technical Memorandum 33-630, October 1, 1973

This memorandum presents an investigation of the performance characteristics of the LES-6 pulsed plasma thruster over a range of input conditions by means of a torsion pendulum system. Parameters of particular interest included the impulse bit and time-average thrust (and their repeatability), specific impulse, mass ablated per discharge, specific thrust, energy per unit area, efficiency, and variation of performance with ignition command rate. Intermittency of the thruster as affected by input energy and igniter resistance were also investigated. Comparative experimental data from the Massachusetts Institute of Technology and from NASA's Goddard Space Flight Center have shown good correlation with the data presented.

The results of these tests indicate that the LES-6 thruster, with some identifiable design improvements, represents an attractive reaction-control thruster for attitude-control applications on long-life spacecraft requiring small metered impulse bits for precise pointing control of science instruments.

HAMILTON, T. W.

H008 Estimating Trajectory Correction Requirements for Multiple Outer Planet Missions

L. D. Friedman, T. W. Hamilton, and R. H. Stanton

J. Spacecraft Rockets, Vol. 9, No. 12, pp. 909–914, December 1972

For abstract, see Friedman, L. D.

HANSON, R. J.

H009 A Proposal for Standard Linear Algebra Subprograms

R. J. Hanson (Washington State University), F. T. Krogh, and C. L. Lawson

Technical Memorandum 33-660, November 15, 1973

This memorandum proposes a set of Fortran-callable subprograms which will be useful in the development of efficient portable American National Standards Institute Fortran subprograms and applications programs in the area of linear algebra. Examples and program listings are included.

H010 Integral Equations of Immunology

R. J. Hanson

Commun. ACM, Vol. 15, No. 10, pp. 883–890, October 1972

The inversion of a particular integral equation of the first (Fredholm) kind is the basic problem considered. The strategy which yielded success consisted of three essential points: (1) fit the known experimental data by a curve with properties which derive from properties of the (as yet unknown) function; (2) stabilize the computation for the unknown function by using singular value decomposition; (3) constrain the unknown function approximation (since it represents a probability distribution) to be nonnegative. A number of test cases are presented. One set of actual experimental data is analyzed with the procedures presented.

HARRISON, E. C.

H011 Prediction of Lipid Uptake by Prosthetic Heart Valve Poppets From Solubility Parameters

J. Moacanin, D. D. Lawson, H. P. Chin (University of Southern California), E. C. Harrison (University of Southern California), and D. H. Blankenhorn (University of Southern California)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 183–190, 1973

For abstract, see Moacanin, J.

HARSTAD, K. G.

H012 Rate Effects on Instabilities in Slightly Ionized Plasmas

K. G. Harstad

Technical Memorandum 33-642, July 15, 1973

This memorandum presents results of numerical computer calculations of dispersive wave growth rates in slightly ionized plasmas. The effects of employing a plasma model with detailed consideration of rate and radiative processes involving the electron quantum states are studied. Acoustic and electrothermal waves in unseeded argon are found to be frozen with the latter damped. Rate-thermal modes can exhibit large growth. Mode mixing and switching in both seeded and unseeded argon are demonstrated.

H013 One-Dimensional Line Radiative Transfer

K. G. Harstad

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 2, pp. 155–165, February 1973

Integrations over solid angle and frequency are performed in the expressions for the radiant heat flux and local energy loss of a line in a region of strong variations of the source function in one direction. Approximations are given for coefficients and kernels in the resulting forms which involve integrals over the physical coordinate.

HARTLEY, R. B.

H014 DSN Progress Report for January–February 1973: Apollo Mission Support

R. B. Hartley

Technical Report 32-1526, Vol. XIV, pp. 16–22, April 15, 1973

This article describes the support provided by the DSN to the Spaceflight Tracking and Data Network during the Apollo 17 mission. Support was provided by three 26-m-diameter-antenna deep space stations, the 64-m-diameter-antenna Mars Deep Space Station (DSS 14), the Ground Communications Facility, and the Mission Control and Computing Center. Premission and mission activities of the DSN are discussed, and the mission is described.

HARTOP, R. W.

H015 DSN Progress Report for March–April 1973: X-Band Waveguide Switches

R. W. Hartop

Technical Report 32-1526, Vol. XV, pp. 48–50, June 15, 1973

To accommodate the X-band requirements of the DSN, new microwave components, including high-performance waveguide switches, are being developed. Waveguide switches in the new WR-125 waveguide size are presently being evaluated. This article describes progress to date in prototype and preproduction model development.

H016 DSN Progress Report for May–June 1973: X-Band Hybrid Combiner

R. W. Hartop

Technical Report 32-1526, Vol. XVI, pp. 42–46, August 15, 1973

A four-port hybrid junction is being developed to combine the outputs of two 200-kW klystron amplifiers to achieve a 400-kW radiated signal at X-band. Progress to date in developing the hybrid under contract is reported.

H017 DSN Progress Report for July–August 1973: X-Band Antenna Feed Cone Assembly

R. W. Hartop

Technical Report 32-1526, Vol. XVII, pp. 131–133, October 15, 1973

A new X-band feed-cone assembly has been designed for the DSN 64-m-diameter antenna stations. This article describes unique features of the cone assembly and reports progress to date.

HASKINS, G. M.

H018 Design and Operation of a 1000°C Lithium–Cesium Test System

L. G. Hays, G. M. Haskins, D. E. O'Connor, and J. Torola, Jr.

Technical Memorandum 33-633, December 1, 1973

For abstract, see Hays, L. G.

HAYS, L. G.

H019 Design and Operation of a 1000°C Lithium–Cesium Test System

L. G. Hays, G. M. Haskins, D. E. O'Connor, and J. Torola, Jr.

Technical Memorandum 33-633, December 1, 1973

A 100-kW cesium–lithium magnetohydrodynamic test loop was fabricated of niobium–1% zirconium for experiments on erosion and two-phase system operation at temperatures of 980°C and velocities of 150 m/s. Although operated at design temperature for 100 hours, flow instabilities in the two-phase separator interfered with the achievement of the desired mass flow rates. A modified separator was fabricated and installed in the loop to alleviate this problem. Because of program cancellation, the test system has been placed in standby condition for storage. This memorandum documents the test system.

HEALD, T. C.

H020 Information Management System for the California State Water Resources Control Board (SWRCB)

T. C. Heald and G. H. Redmann

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 53–61, January 1973

A study was made to establish the requirements for an integrated state-wide information management system for water-quality control and water-quality rights for the State of California. The data sources and end requirements were analyzed for the data collected and used by the numerous agencies, both State and Federal, as well as the nine Regional Boards under the jurisdiction of the State Board. This article details the data interfaces and outlines the system design. A program plan and statement of work for implementation of the project is included.

HIGA, W. H.

H021 DSN Progress Report for March–April 1973: Low Noise Receivers: Theory of "Noise Bursts" on Large Antennas

W. H. Higa, R. C. Clauss, and P. Dachel

Technical Report 32-1526, Vol. XV, pp. 80–83, June 15, 1973

When a large, paraboloidal antenna is used simultaneously for high-power transmission and low-level reception of signals at different frequencies, frequent anomalous and random noise bursts appear at the receiver output. Also, if simultaneous transmission is made at two slightly separated frequencies, intermodulation products of high order number will often appear at the receiver output. Based on a plausible explanation for these phenomena, simple experiments have been performed in the laboratory to reproduce the observations.

HINNERS, N. W.

H022 The Apollo 17 Surface Experiments

N. W. Hinners (NASA Apollo Program Office) and P. V. Mason

Astronaut. Aeronaut., Vol. 10, No. 12, pp. 40–54, December 1972

During the Apollo 17 mission to be launched on December 6, 1972, Navy Captain Eugene Cernan, Dr. Harrison Schmitt, and Navy Commander Ronald Evans will carry out scientific activities of considerably greater sophistication than has been possible in previous missions. This article explains the scientific rationale behind the choice of the Apollo 17 Taurus-Littrow site, briefly notes the objectives of the mission in its entirety, and then describes in some detail the geophysical experiments as embodied in specific instruments.

HOLDRIDGE, D. B.

H023 Minor Planets and Related Objects: XII. Radar Observations of (1685) Toro

R. M. Goldstein, D. B. Holdridge, and J. H. Lieske

Astron. J., Vol. 78, No. 6, pp. 508–509, August 1973

For abstract, see Goldstein, R. M.

HOLMES, J. K.

H024 DSN Progress Report for November–December 1972: Block IV Subcarrier Demodulator Assembly Acquisition Problem

R. B. Crow, J. K. Holmes, and R. C. Tausworthe

Technical Report 32-1526, Vol. XIII, pp. 42–47, February 15, 1973

For abstract, see Crow, R. B.

H025 DSN Progress Report for March–April 1973: Bit Synchronizer for Sample Data Antenna Pointing System

T. O. Anderson, J. K. Holmes, and W. J. Hurd

Technical Report 32-1526, Vol. XV, pp. 128–132, June 15, 1973

For abstract, see Anderson, T. O.

HOLZER, R. E.

H026 Plasmaspheric Hiss

R. M. Thorne (University of California, Los Angeles), E. J. Smith, R. K. Burton (University of California, Los Angeles), and R. E. Holzer (University of California, Los Angeles)

J. Geophys. Res., Vol. 78, No. 10, pp. 1581–1596, April 1, 1973

For abstract, see Thorne, R. M.

HONER, W.

H027 DSN Progress Report for March–April 1973: Recent Modifications to the DSN Monitor and Control System

J. E. Allen and W. Honer

Technical Report 32-1526, Vol. XV, pp. 185–189, June 15, 1973

For abstract, see Allen, J. E.

HORD, C. W.

H028 Mariner 9 Ultraviolet Spectrometer Experiment: Afternoon Terminator Observations of Mars

J. Ajello, C. W. Hord (University of Colorado), C. A. Barth (University of Colorado), A. I. Stewart (University of Colorado), and A. L. Lane

J. Geophys. Res., Vol. 78, No. 20, pp. 4279–4290, July 10, 1973

For abstract, see Ajello, J.

HORIUCHI, H. H.

H029 Viking Orbiter 1975 Articulation Control Subsystem Design and Analysis

H. H. Horiuchi and L. J. Vallas

Technical Memorandum 33-599, July 15, 1973

The Articulation Control Subsystem, developed for the Viking Orbiter 1975 spacecraft, is a digital, multiplexed, closed-loop servo system used to control the pointing and positioning of the science scan platform and the high-gain communication antenna, and to position the solar-energy controller louver blades for the thermal control of the propellant tanks. The development, design, and analysis of the subsystem is preliminary.

The subsystem consists of a block-redundant control electronics multiplexed among eight control actuators. Each electronics block is capable of operating either individually or simultaneously with the second block. This provides the subsystem the capability of simultaneous two-actuator control or a single-actuator control with the second block in a standby redundant mode.

The results of the preliminary design and analysis indicate that the subsystem will perform satisfactorily in the Viking Orbiter 1975 mission. Some of the parameter values used, particularly those in the subsystem dynamics and the error estimates, are preliminary and the results will be updated as more accurate parameter values become available.

HOTZ, G. M.

H030 A Survey of Actuator Shaft Sealing Techniques for Extended Space Missions

G. M. Hotz

Technical Memorandum 33-587, December 15, 1972

Actuators for control and articulation aboard Mariner spacecraft have employed output-shaft seals to maintain an internal gaseous atmosphere. This, combined with the limitation of temperature extremes through the use of electric heaters or the location of actuators in temperature controlled areas, has resulted in a favorable environment for actuator mechanisms. On future missions, considerably greater expected lifetimes, temperature ranges, and radiation exposures have led to a need to determine the limitations of the present O-ring output-shaft seal and to examine other candidate seals. Seals suited both to dynamic and static sealing were examined for potential use in three specific JPL actuator applications.

HOUGHTON, J. T.

H031 Remote Sounding From Artificial Satellites and Space Probes of the Atmospheres of the Earth and the Planets

J. T. Houghton (University of Oxford) and F. W. Taylor

Rep. Prog. Phys., Vol. 36, No. 7, pp. 827–919, July 1973

Observation of radiation reflected, scattered or emitted in various regions of the electromagnetic spectrum can yield information about the structure of a planetary atmosphere. Instrumentation for the measurement of

temperature, density and composition and for cloud imaging is described, methods of information retrieval from radio metric observations are discussed, and some of the results for the atmospheres of Earth, Mars and Venus are presented. Further developments are considered particularly in the light of the information required for computer models of the atmosphere and for the consideration of the possible mechanisms for climatic change.

HOUSEMAN, J.

H032 Popping Phenomena With the Hydrazine Nitrogen-Tetroxide Propellant System

J. Houseman and A. Lee

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 678-682, September 1972

The propellant spray resulting from the impingement of liquid jets of hydrazine and nitrogen tetroxide has been studied at atmospheric pressure by means of streak photography. The streak photographs show periodic small explosions that originate near the impingement point and propagate through the propellant spray at velocities of 3000 to 5000 ft/s, consuming all propellant droplets over a distance of up to 6 in. Typical streak photographs are presented. The frequency of the explosions or pops ranged up to several hundred per second, and could be controlled by varying the contact time in the liquid phase. Below a minimum threshold contact time, popping did not take place. At high values of contact time, the popping rate was controlled by the transit time of the free jet before impingement. Flashing of the oxidizer prior to impingement prevented popping under certain conditions. It is postulated that popping is initiated by liquid phase reactions. A mechanism for the occurrence of popping and its relation to reactive stream separation is suggested.

HOWE, T. W.

H033 DSN Progress Report for November-December 1972: DSN Support of the Mariner Mars 1971 Extended Mission

T. W. Howe and D. W. Johnson

Technical Report 32-1526, Vol. XIII, pp. 21-25, February 15, 1973

Each mission supported by the DSN is unique. Operations planning normally covers the standard mission only and does not include extended-mission operations. This article describes the innovations that had to be made to support the extended portion of the Mariner Mars 1971 mission.

HSIEH, T. M.

H034 Preliminary Nuclear Electric Propulsion (NEP) Reliability Study

T. M. Hsieh, A. M. Nakashima, and J. F. Mondt

Technical Memorandum 33-629, July 1, 1973

A preliminary failure mode, failure effect, and criticality analysis of the major subsystems of nuclear electric propulsion is presented. Simplified reliability block diagrams are also given. A computer program, developed at JPL, was used to calculate the reliability of the heat rejection subsystem.

HUNT, G. E.

H035 On the Level of H_2 Quadrupole Absorption in the Jovian Atmosphere

J. S. Margolis and G. E. Hunt

Icarus, Vol. 18, No. 4, pp. 593-598, April 1973

For abstract, see Margolis, J. S.

HUNTRESS, W. T., JR.

H036 Reactions of Excited and Ground State H_3^+ Ions With Methyl Substituted Hydrides

W. T. Huntress, Jr., and M. T. Bowers (University of California, Santa Barbara)

Int. J. Mass Spectr. Ion Phys., Vol. 12, No. 1, pp. 1-18, August 1973

The reactions of H_3^+ with C_2H_6, CH_3NH_2, CH_3OH, CH_3F, CH_3SH, and CH_3Cl have been studied using ion cyclotron resonance pulse ejection techniques. The product distribution obtained is strongly dependent upon hydrogen pressure due to a large difference in reactivity between excited and ground state H_3^+ ions. The H_3^+ ions originally formed by the reaction of H_2^+ with H_2 are highly excited. At low hydrogen pressures, these excited H_3^+ ions react mainly by direct processes: by charge transfer and by a process equivalent to hydride ion abstraction. The product distribution changes as the hydrogen pressure is raised due to rapid deactivation of the H_3^+ ions by collisions with H_2 molecules.

At intermediate hydrogen pressures, the hydride ion abstraction process disappears and both ground state and partially deactivated H_3^+ ions react principally by proton transfer to give a longer-lived protonated intermediate. With the exception of ethane, decomposition of the protonated intermediate occurs via vicinal hydrogen elimination and except for C_2H_6, CH_3SH, and CH_3Cl, C-X bond scission to give the methyl cation is observed as well. From the dependence of the relative rate for

charge transfer on hydrogen pressure, evidence is obtained indicating that the excited H_3^+ ions may not be directly deactivated to the ground state but to some intermediate state(s) still containing a significant amount of internal energy, and that these intermediate H_3^+ ions are subsequently only very slowly deactivated to the ground state.

H037 Ion–Molecule Reactions in Mixtures of Methane With Water, Hydrogen Sulfide, and Ammonia

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

J. Am. Chem. Soc., Vol. 95, No. 13, pp. 4107–4115, June 27, 1973

Ion–molecule reactions of ions formed by electron impact in mixtures of methane with water, hydrogen sulfide, and ammonia have been studied using ion–cyclotron resonance techniques. The reactions of primary ions are identified and their relative reaction rates measured using the resonant cyclotron ejection method. Absolute rates are determined by reference to the absolute rates previously measured for the major reactions occurring in the pure gases.

H038 A New Ion and Electron Detector for Ion Cyclotron Resonance Spectroscopy

W. T. Huntress, Jr., and W. T. Simms

Rev. Sci. Instr., Vol. 44, No. 9, pp. 1274–1277, September 1973

A new detector using an externally driven tuned circuit has been developed for use in ion cyclotron resonance spectroscopy experiments. Based on the "Q-meter" circuit, this detector will operate at frequencies greater than 1 MHz at radio frequency levels less than 1 mV. Operation in the frequency range 1–15 MHz allows the use of higher magnetic fields for more efficient storage of low mass ions in the trapping mode of operation. In the frequency range 2–6 MHz electrons can be detected in the ion cyclotron resonance cell by their resonant motion in the trapping plane.

HURD, W. J.

H039 DSN Progress Report for March–April 1973: Bit Synchronizer for Sample Data Antenna Pointing System

T. O. Anderson, J. K. Holmes, and W. J. Hurd

Technical Report 32-1526, Vol. XV, pp. 128–132, June 15, 1973

For abstract, see Anderson, T. O.

H040 DSN Progress Report for July–August 1973: Demonstration of Intercontinental DSN Clock Synchronization by VLBI

W. J. Hurd

Technical Report 32-1526, Vol. XVII, pp. 39–44, October 15, 1973

This article describes the prototype system for DSN clock synchronization by very-long-baseline interferometry which has been demonstrated to operate successfully over intercontinental baselines in a series of experiments between deep space stations at Madrid, Spain, and Goldstone, California. As predicted by analysis and short-baseline demonstration, the system achieves reliable synchronization between 26-m and 64-m antenna stations with 17 and 37 K nominal system temperatures using under one million bits of data from each station. Semi-real-time operation is feasible since this small amount of data can be transmitted to JPL and processed within minutes. The system resolution is 50 to 400 ns, depending on the amount of data processed and the source intensity. The accuracy is believed to be comparable to the resolution, although it could be independently confirmed to only about 5 μs using LORAN C.

H041 DSN Progress Report for July–August 1973: Digital DC Offset Compensation of Analog-to-Digital Converters

S. S. Brokl and W. J. Hurd

Technical Report 32-1526, Vol. XVII, pp. 45–47, October 15, 1973

For abstract, see Brokl, S. S.

HUTCHINSON, R. B.

H042 Observation of the OH Radical in Betelgeuse

R. Beer, R. H. Norton, R. B. Hutchinson, D. L. Lambert (University of Texas), and J. V. Martonchik (University of Texas)

Mém. Soc. Roy. Sci. Liège, Vol. III, No. 6, p. 145, 1972

For abstract, see Beer, R.

HUTCHISON, J. J.

H043 Solid Propellants

H. E. Marsh, Jr., and J. J. Hutchison

Chemistry in Space Research, pp. 361–463, American Elsevier Publishing Company, New York, 1972

For abstract, see Marsh, H. E., Jr.

INGHAM, J. D.

I001 Thermoluminescence: Potential Applications in Forensic Science

J. D. Ingham and D. D. Lawson

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 18–28, January 1973

In crime laboratories one of the most difficult operations is to determine unequivocally whether or not two samples of evidence of the same type were originally part of the same thing or were from the same source. It has been found that high-temperature thermoluminescence (room temperature to 723 K) can be used for comparisons of this type, although work to date indicates that there is generally a finite probability for coincidental matching of glass or soil samples. Further work is required to determine and attempt to minimize these probabilities for different types of materials, and to define more clearly the scope of applicability of thermoluminescence to actual forensic situations.

I002 Thermoluminescence: Potential Applications in Forensic Science

J. D. Ingham and D. D. Lawson

J. Forensic Sci., Vol. 18, No. 3, pp. 217–225, July 1973

In crime laboratories, one of the most difficult operations is to determine unequivocally whether or not two samples of evidence of the same type were originally part of the same thing or were from the same source. It has been found that high temperature thermoluminescence (room temperature to 723 K) can be used for comparisons of this type, although work to date indicates that there is generally a finite probability for coincidental matching of glass or soil samples. Further work is required to determine and attempt to minimize these probabilities for different types of materials, and to more clearly define the scope of applicability of thermoluminescence to actual forensic situations.

IRONS, A. S.

I003 Planetary Quarantine Goes to Work in the Hospital

M. D. Wardle, A. S. Irons, and R. H. Green

Astronaut. Aeronaut., Vol. 11, No. 6, pp. 32–38, June 1973

For abstract, see Wardle, M. D.

ISHIMARU, A.

I004 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase I

R. Woo, W. Kendall, A. Ishimaru, and R. Berwin

Technical Memorandum 33-644, June 30, 1973

For abstract, see Woo, R.

I005 Remote Sensing of the Turbulence Characteristics of a Planetary Atmosphere by Radio Occultation of a Space Probe

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

Radio Sci., Vol. 8, No. 2, pp. 103–108, February 1973

For abstract, see Woo, R.

JACKSON, E. B.

J001 DSN Progress Report for November–December 1972: Development Support Group

E. B. Jackson and A. L. Price

Technical Report 32-1526, Vol. XIII, pp. 127–129, February 15, 1973

This article presents the activities of the Development Support Group in operating the Venus Deep Space Station (DSS 13) and the Microwave Test Facility for the period October 16 through December 15, 1972. Major activities include an extensive test program of dual-uplink carrier generation and measurement of the resulting intermodulation products in the downlink band. A description of the progress of this test program, along with work required to minimize production of intermodulation products, is given. Progress in precision antenna-gain measurements, continuing planetary-radar experiments, and weak-source observations are other activities noted.

J002 DSN Progress Report for January–February 1973: DSN Research and Technology Support

E. B. Jackson

Technical Report 32-1526, Vol. XIV, pp. 91–93, April 15, 1973

This article presents the activities of the Development Support Group in operating the Venus Deep Space Station (DSS 13) and the Microwave Test Facility for the period December 16, 1972 through February 15, 1973. Major activities include continuation of the intensive dual-carrier investigation, refurbishing of the S-band-megawatt-transmit cassegrain feedcone, implementation of the dedicated antenna-pointing computer for the 26-m-diameter antenna, and continuation of collection of Faraday-rotation data.

J003 DSN Progress Report for March–April 1973: DSN Research and Technology Support

E. B. Jackson, A. L. Price, and R. B. Kolbly

Technical Report 32-1526, Vol. XV, pp. 138–142, June 15, 1973

This article discusses the activities of the Development Support Group at the Venus Deep Space Station (DSS 13) and the Microwave Test Facility (MTF). Activities include interchange of the SDS-930 computers between DSS 13 and the Mars Deep Space Station (DSS 14) and subsequent installation and checkout; planetary radar support for the Mariner Venus/Mercury 1973 mission and modifications to DSS 14 and DSS 13 necessary to continue such support; installation of a new Faraday-rotation data-collection system; relocation of pulsar capability from DSS 13 to DSS 14; dual-carrier activity on the 26-m-diameter antenna; and dual-carrier activity for the Goddard Space Flight Center carried out at MTF on components of the Spaceflight Tracking and Data Network waveguide system. Also reported is a novel way to effect replacement of the 400-kW klystron without removing the assembly from the tricone support structure of the 64-m-diameter antenna.

J004 DSN Progress Report for May–June 1973: DSN Research and Technology Support

E. B. Jackson

Technical Report 32-1526, Vol. XVI, pp. 102–104, August 15, 1973

The activities of the Development Support Group, at the Goldstone Deep Space Communications Complex, are discussed and progress noted on continuing efforts. Activities include planetary radar support for the Mariner Venus/Mercury 1973 missions, preparation for a station automation demonstration, sky survey activity, dual-carrier activity on the 26-m-diameter antenna and progress thereof. Also discussed are changes in the Faraday rotation data collection system, repairs and support of the Mars Deep Space Station (DSS 14) 400-kW transmitter, and science support for later interpretation of the results from encounter observation of Jupiter by Pioneers 10 and 11.

J005 DSN Progress Report for July–August 1973: DSN Research and Technology Support

E. B. Jackson

Technical Report 32-1526, Vol. XVII, pp. 100–103, October 15, 1973

This article discusses the activities of the Development Support Group at Goldstone. These include planetary-radar support for the Mariner Venus/Mercury 1973 mission, sky survey radio-source activity, dual-uplink carrier testing, testing of 100-kW klystrons for use at the Ballima and Robledo Deep Space Stations (DSSs 43 and 63), 400-kW transmitter testing of ignitrons and power supplies, support of the Mars Deep Space Station (DSS 14) 400-kW transmitter, and very-long-baseline interferometry activity with the National Radio Astronomy Observatory, Effelsburg, Germany, and DSS 43.

J006 DSN Progress Report for September–October 1973: Development Support Group

E. B. Jackson

Technical Report 32-1526, Vol. XVIII, pp. 99–101, December 15, 1973

This article discusses the activities of the Development Support Group in operating and maintaining the Venus Deep Space Station. Activities covered include planetary radar, sky survey, Faraday-rotation data collection, dual-uplink carrier testing, X-band planetary radar developmental testing, Block IV receiver/exciter installation, equipping the 9-m-diameter antenna with a receive capability, and retrofitting the 26-m-diameter antenna with a functional planetary-radar feedcone. Activities in support of the Mars Deep Space Station high-power transmitter are also noted as are clock-synchronization transmissions and Pioneer 10 science support.

JACOBSON, R. A.

J007 Guidance Strategies and Analysis for Low-Thrust Navigation

R. A. Jacobson

Technical Memorandum 33-590, February 1, 1973

This memorandum presents a low-thrust guidance algorithm suitable for operational use. A constrained linear feedback-control law has been obtained using a minimum terminal-miss criterion and restricting control corrections to constant changes for specified time periods. Both fixed- and variable-time-of-arrival guidance were considered. The performance of the guidance law was evaluated by applying it to the approach phase of the 1980 rendezvous mission with the comet Encke.

JAFFE, L. D.

J008 On-Surface and Laboratory Size Measurements of Fine Lunar Particles

L. D. Jaffe and J. N. Strand

Nature Phys. Sci., Vol. 241, No. 107, pp. 57–59, January 15, 1973

Retrieval of the Surveyor 3 soil sampler scoop from the moon by the Apollo 12 astronauts provided an opportu-

nity for direct comparison and evaluation of the techniques being used for remote study of the lunar surface. The scoop contained 6.5 g of the same lunar soil for which particle sizes had been determined previously from Surveyor television pictures. Measurement of the actual returned soil samples showed that on-surface and laboratory findings are in good agreement. Therefore, confidence is increased that valid determinations of soil particle size can be made on the planets with Viking or other planetary landers.

J009 Spacecraft Techniques for Lunar Research

L. D. Jaffe, R. Chaote, and R. B. Coryell

The Moon, Vol. 5, Nos. 3–4, pp. 348–367, November–December 1972

The most significant findings concerning the moon obtained by spacecraft so far, have resulted from measurements of gravity, electromagnetic properties, seismicity, mechanical properties, geologic features, composition, ages, and the lunar environment. A number of major lunar questions remain to be answered. Other properties, measurable with spacecraft, which may provide data critical to answering these questions include geometrical shape, motions, and heat flow. In this article specific measurements that should provide critical data for each of these questions are identified, with some candidate techniques. Among the suggested techniques that have not yet been used are very long baseline interferometry (Earth-moon baseline), gravity gradiometry, elemental analysis by neutron interactions, and remotely-controlled on-moon microscopy.

Different types of missions are suitable for the different measurements: lunar orbiters, soft-landers, long-range surface traverses, and sample return to Earth are all needed. The choice of manned vs remotely-controlled missions does not depend on scientific requirements but on other considerations. Both manned and remotely-controlled techniques have been used for orbiters, landers, and sample return, neither for a long-range traverse.

J010 Shear Strength of Lunar Soil From Oceanus Procellarum

L. D. Jaffe

The Moon, Vol. 8, Nos. 1 and 2, pp. 58–72, July–August 1973

Soil from the scoop of Surveyor 3, returned to Earth by Apollo 12 astronauts, has been tested in a miniature shear box at five bulk densities, from 0.99 to 1.87 g cm^{-3}. Cohesion increased with bulk density from 3×10^{-2} to 3×10^{-1} N cm^{-2}; internal friction angle increased from 13° to 56°. Shear stress vs normal stress data fit a logarithmic relationship better than a linear one, at normal stresses of 3×10^{-3} to 3×10^{0} N cm^{-2}. Results of these tests, in air, show no systematic differences from those for tests made elsewhere in vacuum and nitrogen. Results agree with those obtained in remotely controlled lunar surface operations with Surveyor 3 and other spacecraft provided that the bulk density was slightly underestimated for the on-surface measurements.

JAFFE, R. M.

J011 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

JAHELKA, E. D.

J012 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

JAWORSKI, W.

J013 Effects of Overlaps, Stitches, and Patches on Multilayer Insulation

L. D. Stimpson and W. Jaworski

Progr. Astronaut. Aeronaut., Vol. 31, pp. 247–266, 1973

For abstract, see Stimpson, L. D.

JEPSEN, P. L.

J014 A User's Guide to the Mariner 9 Television Reduced Data Record

J. B. Seidman, W. B. Green, P. L. Jepsen, R. M. Ruiz, and T. E. Thorpe

Technical Memorandum 33-628, September 1, 1973

For abstract, see Seidman, J. B.

JET PROPULSION LABORATORY

J015 Mariner Mars 1971 Project Final Report: Project Development Through Launch and Trajectory Correction Maneuver

Jet Propulsion Laboratory

Technical Report 32-1550, Vol. I, April 1, 1973

The Mariner Mars 1971 mission was another step in the continuing program of planetary exploration in search of evidence of exo-biological activity, information on the origin and evolution of the solar system, and basic science data related to the study of planetary physics, geology, planetology, and cosmology. The mission plan was designed for two spacecraft, each performing a separate but complementary mission. However, a single mission plan was actually used for the Mariner 9 due to the failure of the first launch spacecraft.

This report, the first of five volumes of the Mariner Mars 1971 Project Final Report, describes the major pre-operational project activities, including planning, design, development, and system testing, and the operational activities from spacecraft launch through the Mariner 9 trajectory-correction maneuver.

J016 Mariner Mars 1971 Project Final Report: Mission Operations System Implementation and Standard Mission Flight Operations

Jet Propulsion Laboratory

Technical Report 32-1550, Vol. III, July 1, 1973

The Mariner Mars 1971 mission was another step in the continuing program of planetary exploration in search of evidence of exobiological activity, information on the origin and evolution of the solar system, and basic science data related to the study of planetary physics, geology, planetology, and cosmology. The mission plan was designed for two spacecraft, each performing a separate but complementary mission. However, a single mission plan was actually used for Mariner 9 because of launch-vehicle failure for the first spacecraft.

This report describes the implementation of the Mission Operations System, including organization, training, and data processing development and operations, and discusses Mariner 9 spacecraft cruise and orbital operations from launch through completion of the standard mission in April 1972.

J017 Mariner Mars 1971 Project Final Report: Science Experiment Reports

Jet Propulsion Laboratory

Technical Report 32-1550, Vol. V, August 20, 1973

On November 14, 1971, Mariner 9 became the first spacecraft to orbit another planet. Its objectives were to map photographically a significant part of the planet Mars and to observe from orbit, for a minimum of 90 days, the dynamic characteristics of the surface and atmosphere.

This report, prepared by the Mariner Mars 1971 science experimenter teams and science evaluation team working groups, is the final volume of the Mariner Mars 1971 Project final report. It presents the scientific objectives of each experiment, as originally planned; the results derived from 18 months of data analysis; and the degrees to which these objectives were met.

J018 Space Flight Operations

Jet Propulsion Laboratory

Technical Memorandum 33-444, Rev. 2, November 1973

Under contract to the National Aeronautics and Space Administration (NASA), the Jet Propulsion Laboratory (JPL) of the California Institute of Technology manages and operates the ground facilities required to support unmanned spacecraft in missions to the Moon, the planets, and beyond. A worldwide network of tracking stations, known as the Deep Space Network (DSN), was established to communicate with spacecraft. The Mission Control and Computing Center (MCCC) at JPL houses the mission control personnel and the computer facilities that command and control spacecraft in flight. Communications between the MCCC and the tracking stations, as well as communications among the stations, are the responsibility of the DSN Ground Communications Facility, which connects all parts of the ground system with telephone, teletype, and high-speed data lines. This memorandum outlines the operation of the ground system and describes the various missions which have been successfully supported.

JOHANSEN, R. A.

J019 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

JOHNS, C. E.

J020 DSN Progress Report for May–June 1973: Block IV Receiver–Exciter Control and Monitoring

C. E. Johns

Technical Report 32-1526, Vol. XVI, pp. 159–162, August 15, 1973

The Block IV Receiver–Exciter Subsystem has the capability of being configured and controlled either by a computer or manually. This article contains a brief discussion on the computer mode of control and a technical description of the manual controls and system monitor.

JOHNSON, D. W.

J021 DSN Progress Report for November–December 1972: DSN Support of the Mariner Mars 1971 Extended Mission

T. W. Howe and D. W. Johnson

Technical Report 32-1526, Vol. XIII, pp. 21–25, February 15, 1973

For abstract, see Howe, T. W.

JOHNSON, R. M.

J022 Bacterial Species in Soil and Air of the Antarctic Continent

R. E. Cameron, F. A. Morelli, and R. M. Johnson (Arizona State University)

Antarctic J. U.S., Vol. VII, No. 5, pp. 187–189, September–October 1972

For abstract, see Cameron, R. E.

JOHNSON, T. V.

J023 Minor Planets and Related Objects: XI. 0.4–0.8 μm Spectrophotometry of (1685) Toro

T. V. Johnson and D. L. Matson

Astron. J., Vol. 78, No. 6, pp. 505–507, August 1973

Spectrophotometric observations at 0.4 to 0.8 μm were made of (1685) Toro. The spectral reflectance obtained is in general agreement with data previously reported but suggests a slightly flatter curve during the period of our observations July 27–28, 1972 (Universal Time).

JOHNSTON, A. R.

J024 Evaluation of the Electro-optic Direction Sensor: Final Report

A. R. Johnston and P. M. Salomon

Technical Memorandum 33-598, February 1, 1973

This memorandum describes the evaluation of a no-moving-parts single-axis star tracker called an electro-optic direction sensor (EODS) and presents the results in detail. The work involved experimental evaluation of a breadboard sensor yielding results which would permit design of a prototype sensor for a specific application. The laboratory work included evaluation of the noise-equivalent input angle of the sensor, demonstration of a technique for producing an acquisition signal, constraints on the useful field-of-view, and a qualitative evaluation of the effects of stray light. In addition, the potential of the silicon avalanche-type photo diode for this application was investigated. No benefit in noise figure was found but the easily adjustable gain of the avalanche device was useful. The use of mechanical tuning of the modulating element to reduce voltage requirements was also explored. The predicted performance of EODS in both photomultiplier and solid-state detector configurations was compared to an existing state-of-the-art star tracker.

J025 Optical Proximity Sensors for Manipulators

A. R. Johnston

Technical Memorandum 33-612, May 1, 1973

A breadboard, optical proximity sensor intended for application to remotely operated manipulators has been constructed and evaluated. The sensing head was 20 × 15 × 10 mm in size, and could be made considerably smaller. Type I and Type II optical configurations are discussed, Type I having a sharply defined sensitive volume, Type II an extended one. The sensitive volume can be placed at any distance between 1 cm and approximately 1 m by choice of a replaceable prism. The Type I lateral resolution was 0.5 mm on one axis and 5 mm perpendicular to it for a unit focused at 7.5 cm. The corresponding resolution in the axial direction was 2.4 cm, but improvement to 0.5 cm is possible. The effect of surface reflectivity is discussed and possible modes of application are suggested.

J026 Kerr Response of Nematic Liquids

A. R. Johnston

J. Appl. Phys., Vol. 44, No. 7, pp. 2971–2974, July 1973

The Kerr response of seven nematic substances has been measured just above their nematic-isotropic transition temperature, in their isotropic state. If the reciprocal of the Kerr constant B is plotted against temperature, a linear relationship analogous to the Curie–Weiss dielectric relationship in ferroelectrics is found in all cases. The transient Kerr response—that is, the variation of induced birefringence with time in response to a field

step—was also measured in three of the compounds. In *p*-(*p*-ethoxybenzylidene) amino benzonitrile, a maximum Kerr constant of .175 × 10^{-10} cm^2. V^{-1} was observed, together with a response time of 13 ns. The extremely short response time indicates that molecular association does not take place. On the other hand, *n*-(*p*-methoxybenzylidene)-*p*-butylaniline under similar conditions showed a response time of 3 μs, indicating that a high degree of association does take place in the isotropic phase.

J027 An Electro-optic Direction Sensor

A. R. Johnston

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 690–696, September 1972

This article describes a single-axis star sensor in which a wave plate having direction-dependent retardation, together with an electro-optic modulator, provides the basis for indicating the direction of a distant point source of light. An alternating current photosignal is obtained, thus avoiding problems associated with detector drift. An analysis of the nominal sensor performance is compared with measurement and found to be in good agreement. The effect of varying the optical geometry on field of view is calculated; the effective noise input is evaluated; and satisfactory tracking of a +1 magnitude star with a 1-cm aperture and a photomultiplier detector is demonstrated, showing a signal-to-noise ratio of about 50 on an rms basis.

JOHNSTON, D. W.

J028 DSN Progress Report for May–June 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XVI, pp. 13–14, August 15, 1973

For abstract, see Mudgway, D. J.

J029 DSN Progress Report for July–August 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XVII, pp. 9–13, October 15, 1973

For abstract, see Mudgway, D. J.

JOHNSTON, E. J.

J030 Microwave Radiometric Measurements of Atmospheric Temperature and Water From an Aircraft

P. W. Rosenkranz, F. T. Barath, J. C. Blinn III, and E. J. Johnston

J. Geophys. Res., Vol. 77, No. 30, pp. 5833–5844, October 20, 1972

For abstract, see Rosenkranz, P. W.

JONES, V. D.

J031 DSN Progress Report for September–October 1973: Telemetry and Command Multiple-Mission Software (Model A)

V. D. Jones

Technical Report 32-1526, Vol. XVIII, pp. 163–166, December 15, 1973

This article gives the status of the deep space station telemetry and command operational software central to the support of Mariner Venus/Mercury 1973. The program was implemented by developing mission-oriented segments and integrating with a basic software nucleus. The selected method of implementation is an outgrowth of a feasibility study, conducted by the Data Systems Development Section.

JOSEPHS, R. H.

J032 The Mariner 9 Power Subsystem Design and Flight Performance

R. H. Josephs

Technical Memorandum 33-616, May 15, 1973

This memorandum documents the design and flight performance of the Mariner Mars 1971 power subsystem and discusses some of the power-management techniques employed to support an orbital mission far from Earth with marginal sunlight for its photovoltaic-battery power source. It also describes the performance of Mariner 9's nickel-cadmium battery during repetitive Sun-occultation phases of the mission and the results of unique in-flight tests to assess the performance capability of its solar array.

KATOW, M. S.

K001 DSN Progress Report for November–December 1972: Radial Extension Study of the 64-m-Diameter Antenna

M. S. Katow

Technical Report 32-1526, Vol. XIII, pp. 108–113, February 15, 1973

An increase in the paraboloidal RF capturing area of the 64-m-diameter antenna with minimal increase of the

surface distortion may be attractive from the operations standpoint. This article describes a study of the problems involved in increasing an antenna from a 64-m to a 68-m diameter and the resulting distortion increase due to gravity loadings.

K002 DSN Progress Report for January–February 1973: 64-m-Diameter Antenna: Computation of RF Boresight Direction

M. S. Katow

Technical Report 32-1526, Vol. XIV, pp. 68–72, April 15, 1973

With the addition of the new "kickers" on the 64-m-diameter antenna, foreknowledge of any change in the RF boresight-direction errors due to gravity loadings would be of operational value. Using ray-tracing techniques, the before and after boresight errors are computed, and the configurations are documented by line sketches of the RF surfaces and a table of linear and angular deflections. This method of analysis indicates that the RF boresight direction with respect to the intermediate reference surface will have lower deviations after the modifications.

K003 DSN Progress Report for March–April 1973: Wind Load Predictions for the 64-m-diameter Antenna

M. S. Katow and H. D. McGinness

Technical Report 32-1526, Vol. XV, pp. 96-101, June 15, 1973

Analytically computed predictions of the performance of the 64-m-diameter antenna in the wind environment have been uncertain because (1) the final design change in the porosity of the paraboloid markedly altered the similarity between the prototype and the wind-tunnel models used at the preliminary design period and (2) the force values computed from static-pressure taps in porous plates were doubtful.

This article describes an effort to establish a correlation factor between the analytical model and the prototype using as a primary basis the field-measured azimuth torques of the 64-m-diameter antenna. A tentative conclusion is made that the maximum azimuth torque at 130-deg yaw angle computed from the static-pressure taps of wind-tunnel models using a full 50% reduction in forces to account for the 50% porosity must be increased by 40%.

K004 DSN Progress Report for July–August 1973: Computation of RF Boresight Direction From Reflector Distortions

M. S. Katow and M. Mori

Technical Report 32-1526, Vol. XVII, pp. 78–82, October 15, 1973

This article compares the direction of the RF boresight computed by use of the RMS and Radiation programs with that calculated by using the same NASTRAN-computed distortion data and searching for the maximum gain location of the focus. For small gravity distortions of the 64-m-diameter antenna, the values compare within 0.000004 rad (0.0003 deg).

K005 DSN Progress Report for July–August 1973: 64-Meter-Diameter Antenna With New Braces: Installation Description and Computed Performance for Gravity Loads

V. B. Lobb and M. S. Katow

Technical Report 32-1526, Vol. XVII, pp. 93–99, October 15, 1973

For abstract, see Lobb, V. B.

KELLY, L. B.

K006 Tracking and Data System Support for the Mariner Mars 1971 Mission: Orbit Insertion Through End of Primary Mission

P. W. Barnum, N. A. Renzetti, G. P. Textor, and L. B. Kelly

Technical Memorandum 33-523, Vol. III, May 15, 1973

For abstract, see Barnum, P. W.

KENDALL, W.

K007 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase I

R. Woo, W. Kendall, A. Ishimaru, and R. Berwin

Technical Memorandum 33-644, June 30, 1973

For abstract, see Woo, R.

KENT, S. S.

K008 DSN Progress Report for May–June 1973: Dual Carrier Investigations at the Mars Deep Space Station

S. S. Kent

Technical Report 32-1526, Vol. XVI, pp. 163–173, August 15, 1973

Dual carrier transmission from a deep space station can result in receive-band interference signals. Investigations have been conducted at the Mars Deep Space Station to

determine the impact of this interference on telemetry and doppler data in terms of the carrier-to-interference power ratio. These investigations were limited to uncoded data at 2048 bit/s and to a fixed (near-zero) doppler frequency.

In general, it is seen that for carrier loop margins near 20 dB (typical of Viking orbital operations) the presence of detectable receive-band intermodulation interference will produce detectable data degradation.

KERRISK, D. J.

K009 SEP Thrust Subsystem Performance Sensitivity Analysis

K. L. Atkins, C. G. Sauer, Jr., and D. J. Kerrisk

Technical Memorandum 33-611, August 15, 1973

For abstract, see Atkins, K. L.

KIM, B. K.

K010 Induced Shock Pulse Testing by Transient Waveform Control

B. K. Kim

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 11–22, July 1973

This article describes a method of synthesizing an arbitrarily shaped transient time pulse on vibration exciters. The transient-waveform control technique is based on recent developments in digital time-series analysis, the real-time fast-Fourier-transform processor. A brief description of the theory, error estimates, and hardware/software implementation to the JPL Dynamic Environmental Testing Laboratory is presented.

KING, J., JR.

K011 Ground Level Ultraviolet Solar Flux in Pasadena, California

J. Ajello, J. King, Jr., A. L. Lane, and C. W. Odd

Bull. Am. Meteorol. Soc., Vol. 54, No. 2, pp. 114–115, February 1973

For abstract, see Ajello, J.

KIRSCHMAN, R. K.

K012 ac Response of Weakly Superconducting Structures

R. K. Kirschman

J. Low Temp. Phys., Vol. 11, Nos. 1 and 2, pp. 235–242, April 1973

Measurements have been made of the ac response of thin-film, weakly-superconducting structure discussed in previous reporting. Data on the maximum constant-voltage step size and the absolute amplitude of the applied signal necessary to achieve the maximum in step size are found to be consistent with an analytical model developed for this structure.

K013 Weakly Superconducting, Thin-Film Structures as Radiation Detectors

R. K. Kirschman

Proceedings of the Fifth Applied Superconductivity Conference, Annapolis, Maryland, May 1–3, 1972, pp. 707–708

Weakly superconducting quantum structures are being investigated for use as detectors of microwave and far-infrared radiation in the 0.1–3.0 mm region. A program of experiments has been conducted to determine the sensitivity and frequency response of these structures. This article presents some of the results of the experiments.

KLASS, M. J.

K014 DSN Progress Report for September–October 1973: Capacity of Noncoherent Channels

S. Butman and M. J. Klass (California Institute of Technology)

Technical Report 32-1526, Vol. XVIII, pp. 85–93, December 15, 1973

For abstract, see Butman, S.

KLEIN, M.

K015 Observations of Jupiter at 13-cm Wavelength During 1969 and 1971

S. Gulkis, B. Gary, M. Klein, and C. T. Stelzried

Icarus, Vol. 18, No. 2, pp. 181–191, February 1973

For abstract, see Gulkis, S.

KLIMASAUSKAS, C. C.

K016 DSN Progress Report for November–December 1972: A Myopic View of Computer-Based System Design

J. W. Layland and C. C. Klimasauskas

Technical Report 32-1526, Vol. XIII, pp. 154–167, February 15, 1973

For abstract, see Layland, J. W.

K017 DSN Progress Report for May–June 1973: A Universal Dump Program for Minicomputer Software Debugging

C. C. Klimasauskas

Technical Report 32-1526, Vol. XVI, pp. 110–124, August 15, 1973

Low-cost minicomputers in wide variety are finding application in control and monitoring tasks ranging from laboratory testing to network operation. One significant problem which arises from this circumstance is that a significantly larger minicomputer system than is needed to perform the primary tasks must be acquired to do convenient software development. Consequently, work has been underway for some time to facilitate software development for the minimal configuration minicomputer using the Medium-Scale Xerox Data Systems Sigma 5. This article describes a general-purpose memory display program which runs on the Sigma 5 to dump memory images of minicomputer software to a printer or other man-readable device. The dump is formatted, as specified by control-card options, into machine-language instructions, character strings, or virtually whatever word/byte/field format is meaningful to the current problem.

KLIORE, A. J.

K018 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484–516, October 1972

The Mariner 9 spacecraft was used to perform 160 radio occultation measurements in orbit about Mars during November and December of 1971. At that time, Mars was experiencing a severely obscuring global dust storm. The effect of dust in the atmosphere was reflected in the reduced temperature gradients measured, indicating heating of the atmosphere by solar radiation being absorbed by dust and a simultaneous cooling of the surface. A disparity in the pressures measured strongly suggests that the physical shape of Mars is more oblate than the shape of its gravitational equipotential surface, leading to higher atmospheric pressures near the poles than at the equator.

A daytime ionosphere was measured and showed some correlation between the variations in the peak density and the solar flux measured from the earth. The average topside plasma scale height showed little correlation with solar flux and solar zenith angle.

K019 The Shape of Mars From the Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, and M. J. Sykes

Icarus, Vol. 17, No. 2, pp. 517–524, October 1972

For abstract, see Cain, D. L.

K020 S Band Radio Occultation Measurements of the Atmosphere and Topography of Mars with Mariner 9: Extended Mission Coverage of Polar and Intermediate Latitudes

A. J. Kliore, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4331–4351, July 10, 1973

A set of significant S-band radio occultation measurements was obtained with Mariner 9 during May and June of 1972, for the first time yielding extensive occultation data on the north and south polar regions. The daytime temperature profiles, representative of a clear atmosphere, exhibit gradients (averaging −2.3 K/km) far smaller than those expected under conditions of radiative-convective balance. The measured gradients are in good agreement with those computed for earlier radiative dynamical models. The near-surface temperatures (180–190 K) measured in the Martian spring daytime on the north polar cap indicate that it may, at least in part, consist of water ice. Temperatures in the south polar area, measured in nighttime, were low enough for condensation of carbon dioxide to take place.

Measurements of the height of the daytime ionosphere at solar zenith angles greater than 72° are lower than the expected heights of the ionization peak, possibly indicating about 25% cooling of the lower atmosphere between November and December of 1971 and May and June of 1972. Planetary radii obtained at latitudes ranging from +86° to −80° indicate a pronounced north–south asymmetry. The south polar region is higher than the north polar area by an average of about 3.4 km; the entire southern hemisphere is 3–4 km higher than the northern hemisphere. A measurement was obtained near the summit of Middle Spot (Pavonis Lacus) showing it to rise about 13.5 km above the surrounding terrain.

K021 Approximations to the Mean Surface of Mars and Mars Atmosphere Using Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4352–4354, July 10, 1973

For abstract, see Cain, D. L.

KNOELL, A. C.

K022 Unified Approach to the Biomechanics of Dental Implantology

D. E. Grenoble (University of Southern California) and A. C. Knoell

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 7–17, January 1973

For abstract, see Grenoble, D. E.

KOLBLY, R. B.

K023 DSN Progress Report for March–April 1973: DSN Research and Technology Support

E. B. Jackson, A. L. Price, and R. B. Kolbly

Technical Report 32-1526, Vol. XV, pp. 138–142, June 15, 1973

For abstract, see Jackson, E. B.

K024 DSN Progress Report for March–April 1973: Intermodulation Product Generator

R. B. Kolbly

Technical Report 32-1526, Vol. XV, pp. 143–145, June 15, 1973

This article describes a microwave circuit used to generate intermodulation products in a predictable manner. This circuit is used in connection with dual-carrier testing to provide a known signal to verify the correct tuning of exciters, receivers, and transmitters. An adjustable voltage probe for a waveguide system is also described.

K025 DSN Progress Report for May–June 1973: High Power Switching and Combining Technique

R. B. Kolbly

Technical Report 32-1526, Vol. XVI, pp. 105–109, August 15, 1973

The X-band radar will radiate 400-kW of output power by paralleling two 250-kW klystron amplifiers. The klystron outputs will be summed into a single waveguide by properly phasing in a 3-dB short-slot hybrid. To obtain preliminary data on combining the outputs of two klystrons and switching the power between the antenna and water load, tests were conducted using two S-band 20-kW klystrons. These test results also apply at X-band since the hybrid is bilateral and linear.

K026 DSN Progress Report for July–August 1973: X-Band Traveling Wave Resonator (TWR)

R. B. Kolbly

Technical Report 32-1526, Vol. XVII, pp. 134–136, October 15, 1973

This article covers the design philosophy and operation for an X-band traveling-wave resonator. This equipment will be used to test high-power components for X-band planetary radar.

KOPF, E. H., JR.

K027 The Development and Demonstration of Hybrid Programable Attitude Control Electronics

L. S. Smith and E. H. Kopf, Jr.

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 1–10, July 1973

For abstract, see Smith, L. S.

KOSKELA, P. E.

K028 Mariner Mars 1971 Television Picture Catalog: Sequence Design and Picture Coverage

P. E. Koskela

Technical Memorandum 33-585, Vol. II, Addendum 1, July 1, 1973

This addendum to the Mariner Mars 1971 Television Picture Catalog, Volume II, contains data for the Mariner 9 TV pictures taken after Revolution 262. Some of the data presented in Volume II is brought up to date. The new provisional mapping pole is discussed, and tables provide the latitude and longitude with respect to the new pole, prime meridian, and rotation rate for the centerpoints of all the Mariner 9 TV pictures.

KROGH, F. T.

K029 A Proposal for Standard Linear Algebra Subprograms

R. J. Hanson (Washington State University), F. T. Krogh, and C. L. Lawson

Technical Memorandum 33-660, November 15, 1973

For abstract, see Hanson, R. J.

K030 On Testing a Subroutine for the Numerical Integration of Ordinary Differential Equations

F. T. Krogh

J. Assoc. Comp. Mach., Vol. 20, No. 4, pp. 545-562, October 1973

This article discusses a method used to test a subroutine numerically for the solution of ordinary differential equations. Results obtained with a variable order Adams method are given for eleven simple test cases.

K031 Algorithms for Changing the Step Size

F. T. Krogh

SIAM J. Numer. Anal., Vol. 10, No. 5, pp. 949-965, October 1973

Approximately ten different ways for changing the step size used by multistep methods are enumerated, and their good and bad features are compared. More efficient algorithms are given for the difference formulations of a frequently used halving and doubling process, and a cure for the instability inherent in this halving process is proposed.

KRON, M.

K032 DSN Progress Report for March-April 1973: Minimum Inertia Design for Gear Trains

M. Kron

Technical Report 32-1526, Vol. XV, pp. 102-108, June 15, 1973

In the design of gear trains, the load inertia is frequently small compared to the inertia of the gearing, and thus gear inertia becomes the major resistance to acceleration and also a large source of power consumption. The design program described in this article emphasizes minimum inertia for the gear train. Some high-acceleration and power-limited radar tracking systems can also benefit from minimum-inertia design even though the load inertia is significant. The optimization of gear-train ratios for minimum inertia provides smoother tracking and better system response.

The nonlinear differential equations used to determine minimum gear-train inertia are solved by the Newton-Raphson method. The final design, however, represents a solution to these equations constrained by allowable stresses, stiffness, and other standard American Gear Manufacturers Association specification requirements. Examples demonstrate the effectiveness of the procedure.

KROON, P. A.

K033 Nuclear Magnetic Resonance of Phosphorus Compounds: VII. Evidence for Steric Effects on the ^{31}P-^{77}Se Coupling and ^{31}P Chemical Shifts

R. P. Pinnell (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges),
C. A. Megerle (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges),
S. L. Manatt, and P. A. Kroon

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 977-978, February 7, 1973

For abstract, see Pinnell, R. P.

KUHNLE, P. F.

K034 DSN Progress Report for September-October 1973: Design of the 10-MHz IF Amplifier for the Block IV Subcarrier Demodulator Assembly

P. F. Kuhnle

Technical Report 32-1526, Vol. XVIII, pp. 141-146, December 15, 1973

This article describes the design effort started in September 1971 to design and build the Block IV subcarrier demodulator assembly (SDA). The design goals were (1) remote control of the adjustable parameters (gain and bandwidth) to allow automatic calibration and control; (2) increased package density to reduce cabinet space over the Block III SDA and improve performance at high symbol rates; and (3) improved linear dynamic range and extended symbol rate range. The basic design and current status of the SDA are reviewed.

KUMAR, R. N.

K035 A New Look at AP/Composite Propellant Combustion

R. N. Kumar (California Institute of Technology)

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 53-77, July 1973

This article presents some theoretical studies on the time-independent and oscillatory combustion of nonmetallized ammonium perchlorate/composite propellants. The study has for its aim a coherent and unified interpretation of the voluminous data available from experiments related to propellant combustion. Three fundamental hypotheses are introduced: the extent of propellant degradation at the varporization step has to be specified through a scientific criterion; the condensed-phase degradation reaction of ammonium perchlorate to a vaporizable state is the overall rate-limiting step; and gas-phase combustion rate is controlled by the mixing rate of fuel

and oxidizer vapors. In the treatment of oscillatory combustion, the assumption of quasi-steady fluctuations in the gas phase is used to supplement these hypotheses. This study successfully predicts several experimental observations including a few that were inconsistent with previous theoretical results.

KUPPERMANN, A.

K036 Electron Impact Excitation of H_2O

S. Trajmar, W. Williams, and
A. Kuppermann (California Institute of Technology)

J. Chem. Phys., Vol. 58, No. 6, pp. 2521–2531, March 15, 1973

For abstract, see Trajmar, S.

LAM, C.

L001 DSN Progress Report for January–February 1973: Data Storage and Data Compression II

C. Lam

Technical Report 32-1526, Vol. XIV, pp. 109–116, April 15, 1973

It has been shown that under certain idealized circumstances, a small increase in data-storage capability can lead to a dramatic increase in the rate at which data can be communicated reliably. This article presents a detailed investigation of the circumstances under which the maximum possible rate increase will occur.

LAMBERT, D. L.

L002 Observation of the OH Radical in Betelgeuse

R. Beer, R. H. Norton, R. B. Hutchinson,
D. L. Lambert (University of Texas), and
J. V. Martonchik (University of Texas)

Mém. Soc. Roy. Sci. Liège, Vol. III, No. 6, p. 145, 1972

For abstract, see Beer, R.

LANDEL, R. F.

L003 Thermomechanical Behavior of Rubberlike Materials

T. J. Peng and R. F. Landel

J. Polym. Sci., Pt. A-2: Polym. Phys., Vol. 10, No. 9, pp. 1681–1689, September 1972

For abstract, see Peng, T. J.

LANE, A. L.

L004 Ground Level Ultraviolet Solar Flux in Pasadena, California

J. Ajello, J. King, Jr., A. L. Lane, and C. W. Odd

Bull. Am. Meteorol. Soc., Vol. 54, No. 2, pp. 114–115, February 1973

For abstract, see Ajello, J.

L005 Mariner 9 Ultraviolet Spectrometer Experiment: Afternoon Terminator Observations of Mars

J. Ajello, C. W. Hord (University of Colorado),
C. A. Barth (University of Colorado),
A. I. Stewart (University of Colorado), and
A. L. Lane

J. Geophys. Res., Vol. 78, No. 20, pp. 4279–4290, July 10, 1973

For abstract, see Ajello, J.

LANE, F. L.

L006 Dielectric Constant and Loss Tangent of Eccofoam PT, at 2.3 GHz, for Various Packing Densities

F. L. Lane

Technical Report 32-1433, Rev. 1, July 15, 1973

The dielectric constant and loss tangent of Eccofoam PT, at various densities, are determined and the resulting density gradients provided. The range of densities over which the dielectric constant and loss tangent are determined are from ~320 to 1280 kg/m^3 (20 to 80 lb/ft^3).

LARMAN, B. T.

L007 Mariner 9 Data Storage Subsystem Flight Performance Summary

N. E. Thomas and B. T. Larman

Technical Memorandum 33-638, August 1, 1973

For abstract, see Thomas, N. E.

LARSON, V.

L008 Dynamical Models for a Spacecraft Idealized as a Set of Multi-Hinged Rigid Bodies

V. Larson

Technical Memorandum 33-613, May 1, 1973

This memorandum provides a brief description of a canonical set of equations which governs the behavior of an n-body spacecraft. General results are given for the

case in which the spacecraft is modeled in terms of n rigid bodies connected by dissipative elastic joints. The final equations are free from constraint torques and involve only r variables (r is the number of degrees of freedom of the system). An advantage which accompanies the elimination of the constraint torques is a decrease in the computer run time, especially when n is large.

L009 Suboptimal Stochastic Controller for an n-Body Spacecraft

V. Larson

Technical Memorandum 33-640, August 15, 1973

Considerable attention is being focused in the open literature on the problem of developing a suitable set of deterministic dynamical equations for a complex spacecraft. This memorandum addresses the problem of determining a stochastic optimal controller for an n-body spacecraft. The approach used in obtaining the stochastic controller involves the application, interpretation, and combination of advanced dynamical principles and the theoretical aspects of modern control theory. The stochastic controller obtained herein for a complicated model of a spacecraft (1) uses sensor angular measurements associated with the base body to obtain smoothed estimates of the entire state vector, (2) can be easily implemented, and (3) enables system performance to be significantly improved.

LAUDENSLAGER, J. B.

L010 Ion–Molecule Reactions in Mixtures of Methane With Water, Hydrogen Sulfide, and Ammonia

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

J. Am. Chem. Soc., Vol. 95, No. 13, pp. 4107–4115, June 27, 1973

For abstract, see Huntress, W. T., Jr.

LAWSON, C. L.

L011 Sparse Matrix Methods Based on Orthogonality and Conjugacy

C. L. Lawson

Technical Memorandum 33-627, June 15, 1973

A matrix having a high percentage of zero elements is called sparse. In the solution of systems of linear equations or linear least-squares problems involving large sparse matrices, significant savings in computer cost can be achieved by taking advantage of the sparsity. This memorandum derives and describes the well known conjugate-gradient algorithm and a set of related algorithms which are applicable to such problems. However, control of accuracy is a serious problem with this class of methods.

L012 A Proposal for Standard Linear Algebra Subprograms

R. J. Hanson (Washington State University), F. T. Krogh, and C. L. Lawson

Technical Memorandum 33-660, November 15, 1973

For abstract, see Hanson, R. J.

LAWSON, D. D.

L013 Thermoluminescence: Potential Applications in Forensic Science

J. D. Ingham and D. D. Lawson

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 18–28, January 1973

For abstract, see Ingham, J. D.

L014 Prediction of Lipid Uptake by Prosthetic Heart Valve Poppets From Solubility Parameters

J. Moacanin, D. D. Lawson, H. P. Chin (University of Southern California), E. C. Harrison (University of Southern California), and D. H. Blankenhorn (University of Southern California)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 183–190, 1973

For abstract, see Moacanin, J.

L015 Numerical Correlation and Evaluation in the Comparison of Evidentiary Materials

D. D. Lawson and E. P. Framan

J. Forensic Sci., Vol. 18, No. 2, pp. 110–117, April 1973

One of the neglected areas in criminalistic laboratory techniques is the ability of the criminalist to compare and evaluate, quantitatively, sets of numerical data. At the present time, there does not exist in practice any uniformly accepted approach to determining a "figure-of-merit" (or rather a quantitative, reliable expression of the degree of match) for sets of data. The need for such a technique arose in a task designed to apply the phenomena of thermoluminescence to criminalistics. This task, funded and supported by NASA, was conducted through the Civil Systems Program Office at JPL. In this specific application, each piece of physical evidence provided,

after processing, a continuous curve. In comparing the curve of an unknown with that of an exemplar, a need was established for a quantitative expression of the extent to which the two curves matched. A well-established statistical procedure was applied and was found to be fully satisfactory in resolving the problem.

The same technique, without modifications was also found to be applicable to the analysis of emission spectrography data, neutron activation analysis, gradient density measurements, and any other criminalistic technique where sets of numerical data are determined. The main attribute of this developed technique is that it allows the criminalist to make judgements on the quality of the evidentiary determinations.

L016 Thermoluminescence: Potential Applications in Forensic Science

J. D. Ingham and D. D. Lawson

J. Forensic Sci., Vol. 18, No. 3, pp. 217–225, July 1973

For abstract, see Ingham, J. D.

LAYLAND, J. W.

L017 DSN Progress Report for November–December 1972: A Myopic View of Computer-Based System Design

J. W. Layland and C. C. Klimasauskas

Technical Report 32-1526, Vol. XIII, pp. 154–167, February 15, 1973

This article presents one approach to the economical allocation of resources in a complex logical system. The main goal is the understanding of systems that may involve specialized digital hardware, a computer with software, and possibly a specialized microcode within the computer processor. These components are treated as uniformly characterizable options in the design of the system that will ultimately be used.

L018 DSN Progress Report for January–February 1973: Comment on Software Efficiency: Loops, Subroutines, and Interpretive Execution

J. W. Layland

Technical Report 32-1526, Vol. XIV, pp. 124–130, April 15, 1973

This article discusses the relationship between the efficiency of software operation and the use within that software of conventional control structures such as loops and subroutines. These control structures "fold" a program to reduce its storage requirements at the expense of increased execution time. The typical intuitive response to this consideration is one of "the faster, the better." In some contexts, this is far from correct. The extent to which folding should be done depends upon many factors, especially the program's total size. The extent to which this folding can actually be done depends upon details of its operation. The analysis presented in this article is unrealistic in that it assumes the program in question can be folded arbitrarily.

L019 DSN Progress Report for March–April 1973: An Experiment in Remote Monitoring of Mu-Ranging Operation at Mariner Mars 1971 Superior Conjunction

D. E. Erickson and J. W. Layland

Technical Report 32-1526, Vol. XV, pp. 156–166, June 15, 1973

For abstract, see Erickson, D. E.

L020 DSN Progress Report for July–August 1973: A Note on Noisy Reference Detection

J. W. Layland

Technical Report 32-1526, Vol. XVII, pp. 83–88, October 15, 1973

Telemetry systems supported by the DSN employ coherent detection of a bi-phase phase-shift-keyed waveform. The coherent reference for the detector is supplied by a bandpass limiter/phase-locked loop. Phase noise in this coherent reference is often a critical factor in establishing link performance. The performance of the DSN receivers has been analyzed at the extremes of high data rate, when the phase error of the coherent reference is constant over the symbol interval, and low data rate, when the phase error of the coherent reference varies rapidly over the symbol interval.

Techniques were subsequently developed to approximate the DSN receiver performance between these extremes. Under close examination, however, it becomes apparent that with typical DSN parameters, the approximations become suspect at many interesting data rates. This article develops a refined approximation to the performance of the DSN receivers with a wider validity range than previous techniques.

L021 DSN Progress Report for September–October 1973: A Sequential Decoding Medium Rate Performance Model

J. W. Layland

Technical Report 32-1526, Vol. XVIII, pp. 29–40, December 15, 1973

This article presents an approximate analysis of the effect of a noisy carrier reference on the performance of sequential decoding. The analysis uses previously-devel-

oped techniques for analyzing noisy-reference performance for medium-rate uncoded communications adapted to sequential decoding for data rates of 8 to 2048 bits/s. In estimating the 10^{-4} deletion probability thresholds for Helios, the model agrees with experimental data to within a few tenths of a dB at 8 and 2048 bits/s; the greatest error is 1.5 dB at 128 bits/s.

L022 Scheduling Algorithms for Multiprogramming in a Hard-Real-Time Environment

C. L. Liu (Massachusetts Institute of Technology) and J. W. Layland

J. Assoc. Comp. Mach., Vol. 20, No. 1, pp. 46–61, January 1973

For abstract, see Liu, C. L.

LEE, A.

L023 Popping Phenomena With the Hydrazine Nitrogen–Tetroxide Propellant System

J. Houseman and A. Lee

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 678–682, September 1972

For abstract, see Houseman, J.

LEECH, R. A.

L024 DSN Progress Report for January–February 1973: New Arc Detector

E. J. Finnegan and R. A. Leech

Technical Report 32-1526, Vol. XIV, pp. 170–172, April 15, 1973

For abstract, see Finnegan, E. J.

LEFLANG, J. G.

L025 DSN Progress Report for March–April 1973: Maser Development

J. G. Leflang

Technical Report 32-1526, Vol. XV, pp. 92–95, June 15, 1973

Operational X-band masers are being developed for use in the Deep Space Instrumentation Facility. Mathematical models have been formulated that provide useful information about the amplitude and phase performance of the proposed X-band maser as well as the existing S-band masers. These models provide X–Y plots of frequency vs amplitude response, carrier phase shift, or time delay.

LEIBOWITZ, L. P.

L026 Measurements of the Structure of an Ionizing Shock Wave in a Hydrogen–Helium Mixture

L. P. Leibowitz

Phys. Fluids, Vol. 16, No. 1, pp. 59–68, January 1973

Shock structure during ionization of a hydrogen–helium mixture has been followed using hydrogen line and continuum emission measurements. A reaction scheme is proposed which includes hydrogen dissociation and a two-step excitation–ionization mechanism for hydrogen ionization by atom–atom and atom–electron collisions. Agreement has been achieved between numerical calculations and measurements of emission intensity as a function of time for shock velocities from 13 to 20 km/s in a 0.208 H_2–0.792 He mixture. The electron temperature was found to be significantly different from the heavy particle temperature during much of the ionization process. Similar time histories for H_β and continuum emission indicate upper level populations of hydrogen in equilibrium with the electron concentration during the relaxation process.

LEISING, C. J.

L027 From Earth to Mars Orbit—Mariner 9 Propulsion Flight Performance With Analytical Correlations

M. J. Cork, R. L. French, C. J. Leising, and D. D. Schmit

AIAA Preprint 72-1185, AIAA/SAE Eighth Joint Propulsion Specialist Conference, New Orleans, Louisiana, November 29–December 1, 1972

For abstract, see Cork, M. J.

LENOBLE, J.

L028 Absorption Profile of a Planetary Atmosphere: A Proposal for a Scattering Independent Determination

A. L. Fymat and J. Lenoble (Université des Sciences et Techniques de Lille)

Appl. Opt., Vol. 11, No. 10, pp. 2249–2254, October 1972

For abstract, see Fymat, A. L.

LESH, J. R.

L029 Signal-to-Noise Ratios in Coherent Soft Limiters

J. R. Lesh

Technical Report 32-1589, September 15, 1973

This article presents and discusses expressions for the output signal-to-noise power ratio of a bandpass soft limiter followed by a coherent detection device. It is found that a significant improvement in the output signal-to-noise ratio (SNR) at low input SNRs 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.

L030 DSN Progress Report for November–December 1972: Bandlimited Power of an Asynchronously Biphase-Modulated Squarewave

J. R. Lesh

Technical Report 32-1526, Vol. XIII, pp. 236–238, February 15, 1973

Expressions for the bandlimited power of a square wave which is biphase-modulated by an asynchronous binary data stream are determined by means of spectral integration. This article demonstrates the utility of these expressions through examples using typical Mariner Venus–Mercury 1973 mission parameters.

L031 DSN Progress Report for March–April 1973: Theoretical Analysis of the Doppler System Test

J. R. Lesh

Technical Report 32-1526, Vol. XV, pp. 190–202, June 15, 1973

This article formulates and analyzes models for the doppler-extraction and measurement processes used in the doppler-system test. The purpose of the article is to acquaint operations personnel with the doppler system as well as the corresponding system-test criteria.

L032 DSN Progress Report for May–June 1973: Error Probability of Binary Signals With Subcarrier Interference

J. R. Lesh

Technical Report 32-1526, Vol. XVI, pp. 178–182, August 15, 1973

Expressions are presented for the symbol detection error probability of a binary data stream in the presence of an asynchronously related interfering squarewave. These expressions are useful in computing effective symbol energy-to-noise ratio degradation resulting from subcarrier interference.

L033 DSN Progress Report for July–August 1973: A Re-Examination of Subcarrier Demodulator Performance

J. R. Lesh

Technical Report 32-1526, Vol. XVII, pp. 137–145, October 15, 1973

This article presents a re-examination of the Subcarrier Demodulator Assembly and develops a mathematical model wherein an attempt is made to remove some of the restrictions placed on previous models. The resulting model is found to differ from previous models at low symbol rates, when subcarrier doppler offsets exist, or when carrier-tracking phase errors become significant.

LEU, R. L.

L034 DSN Progress Report for January–February 1973: Computer Control of High-Power Transmitters

R. L. Leu

Technical Report 32-1526, Vol. XIV, pp. 27–32, April 15, 1973

The objectives of computer control of high-power transmitters are development of techniques and equipment for complete control, monitoring, and fault isolation to ensure minimum recovery time from a fault and reduction of the skill level required for operation and maintenance. This article covers the computer program for the Venus Deep Space Station high-power transmitters.

L035 DSN Progress Report for May–June 1973: X-Band Filter

R. L. Leu

Technical Report 32-1526, Vol. XVI, pp. 33–37, August 15, 1973

The need for additional filtering in the 400-kW S-band transmitter was established during compatibility testing between the 400-kW transmitter and the X-band traveling-wave maser receiver. The tests showed that ranging modulation on the S-band carrier resulted in side bands on the fourth harmonic (fourth harmonic is in X-band frequency range) that were approximately −145 dBm and in the passband of the X-band receiver.

L036 DSN Progress Report for July–August 1973: High-Power Microwave Transmitter Switch

C. P. Wiggins, H. R. Buchanan, and R. L. Leu

Technical Report 32-1526, Vol. XVII, pp. 21–27, October 15, 1973

For abstract, see Wiggins, C. P.

LEVINE, M. D.

L037 Scene Analysis for a Breadboard Mars Robot Functioning in an Indoor Environment

M. D. Levine

Technical Memorandum 33-645, September 1, 1973

This memorandum deals with the problem of computer perception in an indoor laboratory environment containing rocks of various sizes. The sensory data processing is required for the NASA/JPL breadboard mobile robot that is a test system for an adaptive variably-autonomous vehicle that will conduct scientific explorations on the surface of Mars. Scene analysis is discussed in terms of object segmentation followed by feature extraction, which results in a representation of the scene in the robot's world model.

LEVINTHAL, E. C.

L038 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

The purpose of this article is to describe the system for the display, processing, and production of image-data products created to support the Mariner 9 Television Experiment. Of necessity, the system was large in order to respond to the needs of a large team of scientists with a broad scope of experimental objectives. The desire to generate processed data products as rapidly as possible to take advantage of adaptive planning during the mission, coupled with the complexities introduced by the nature of the vidicon camera, greatly increased the scale of the ground-image processing effort.

This article describes the systems that carried out the processes and delivered the products necessary for real-time and near-real-time analyses. References are made to the computer algorithms used for the different levels of decalibration and analysis.

LEVITT, B. K.

L039 DSN Progress Report for March–April 1973: Intermodulation Products in Dual Carrier Transmission: Power Series Analysis

B. K. Levitt

Technical Report 32-1526, Vol. XV, pp. 70–79, June 15, 1973

The proposed Viking Mars 1975 dual-carrier telemetry modes have generated an interest in determining the relative power levels of dual-carrier intermodulation products (IMPs) for a klystron amplifier. To this end, a finite-order power-series model for the time-domain input–output response of the klystron was investigated. The parameters needed to define the model for a particular klystron were derived from experimental measurements of the nonlinear power-transfer characteristic of the amplifier for single-carrier transmission. The power-series approach does not appear to be a useful analytic tool for predicting dual-carrier IMP levels. With the exception of the first-order IMP, the model is evidently too sensitive to small changes in the experimental single-carrier data to provide accurate IMP information.

L040 DSN Progress Report for March–April 1973: Capacity for Noncoherent, Soft-Decision MFSK Signaling

S. Butman and B. K. Levitt

Technical Report 32-1526, Vol. XV, pp. 146–155, June 15, 1973

For abstract, see Butman, S.

L041 DSN Progress Report for September–October 1973: Word Formatter for MVM'73 Real-Time High-Rate TV Data

B. K. Levitt

Technical Report 32-1526, Vol. XVIII, pp. 111–116, December 15, 1973

During both Mariner Venus/Mercury 1973 encounters, real-time TV data at 117.6 kilobits/s will be transmitted from the Mars Deep Space Station to the Space Flight Operations Facility (SFOF) along a 230.4-kilobits/s supergroup line. The reliability of this link is largely an unknown parameter, but previous experience with similar data channels suggests that random bit errors may occur at rates between 1 in 10^4 and 1 in 10^7 bits. The original design of the word formatter necessitated by the discrepancy between the source and ground transmission rates is shown to be inadequate to guarantee acceptable reception of the TV data at the SFOF. This article describes an alternative formatter design which alleviates this problem with minimum cost changes from the original system.

LEVY, R.

L042 DSN Progress Report for January–February 1973: Structural Stiffness Matrix Wavefront Resequencing Program (WAVEFRONT)

R. Levy

Technical Report 32-1526, Vol. XIV, pp. 42–45, April 15, 1973

The computer program WAVEFRONT is a preprocessor that resequences the stiffness matrix for wavefront reduction prior to processing by structural-analysis computer programs. This article describes the program operation, deck, input-data requirements, and suggested usage. Summary data extracted from example applications show that this program is an effective preprocessor for the NASTRAN structural-analysis program and is generally preferable to alternative bandwidth-reduction preprocessors.

LEWICKI, G.

L043 Magneto-Optic Investigation of MnBi Films

G. Lewicki and J. E. Guisinger

J. Appl. Phys., Vol. 44, No. 5, pp. 2361–2364, May 1973

Another variation in the preparation of MnBi films from double layers of the constituents is reported. The dependence of Faraday and Kerr rotations on both composition and film thickness in these films suggests a model wherein a reacted double layer is made up of four separate layers. The variance in magneto-optic constants of MnBi reported here and previously is resolved in terms of this model.

LICCIARELLO, M. R.

L044 The Technology Transfer Process—Where's the Bridge

M. R. Licciarello (Science Applications, Inc.) and B. J. Reiss (City of Fresno)

AIAA Preprint 73-977, Third Urban Technology Conference and Technical Display, Boston, Massachusetts, September 25–28, 1973

Technology developed by the space industry might help cities improve delivery system effectiveness, but diffusion of ideas between local governments and industry is not occurring naturally. The City of Fresno, under the National Science Foundation and NASA sponsorship, is evaluating the nature of the bridge required to condition city decision processes to greater use of technology. It was concluded that the basic bridge required is the demonstration of the problem definition process. Promoting dialogue between active decision makers—particularly department heads—on the nature of current city problems will result in internalization and operational use of the transfer process as needs arise. The remaining tools needed for effective technology transfer projects—risk management techniques, payback analyses, project management systems, and productivity indexes—will be more easily accepted by the decision process when supported by a clear and internalized problem definition process.

LIESKE, J. H.

L045 On the 3–7 Commensurability Between Jupiter's Outer Two Galilean Satellites

J. H. Lieske

Astron. Astrophys., Vol. 27, No. 1, pp. 59–65, August 1973

The 3–7 commensurability between Jupiter's outer two galilean satellites is investigated. The solution is developed in a manner which enables its adoption to any subsequent revision of Sampson's theory of their motion. A comparison with the results of de Heardtl is used to demonstrate the validity of the final expressions. The effect of the commensurability is to introduce periodic perturbations in longitude on the order of 20–40 km.

L046 Minor Planets and Related Objects: XII. Radar Observations of (1685) Toro

R. M. Goldstein, D. B. Holdridge, and J. H. Lieske

Astron. J., Vol. 78, No. 6, pp. 508–509, August 1973

For abstract, see Goldstein, R. M.

LIN, C.-L.

L047 $O(^1D)$ Production in Ozone Photolysis Near 310 nm

C.-L. Lin and W. B. DeMore

Technical Memorandum 33-635, July 15, 1973

Relative quantum yields of $O(^1D)$ production, ϕ, in ozone photolysis from 275 nm to 334 nm have been determined in the gas phase at 233 K. The $O(^1D)$ was monitored by means of its reaction with isobutane to form isobutyl alcohol. The light source was a high pressure mercury lamp combined with a monochromator, with a bandwidth of 1.6 nm. The results show a constant ϕ below 300 nm, which is taken as unity on the basis of previous work. There is a very sharp fall-off in ϕ which is centered at 308 nm. At 313 nm ϕ is not greater than 0.1.

L048 Intermediates in the Ozonation of Simple Alkynes

W. B. DeMore and C.-L. Lin

J. Org. Chem., Vol. 38, No. 5, pp. 985–989, March 9, 1973

For abstract, see DeMore, W. B.

L049 O(^{1}D) Production in Ozone Photolysis Near 3100 Å

C.-L. Lin and W. B. DeMore

J. Photochem., Vol. 2, pp. 161–164, 1973–1974

Relative quantum yields of O(^{1}D) production, Φ, in ozone photolysis from 2750 to 3340 Å have been determined in the gas phase at −40°C. The O(^{1}D) was monitored by means of its reaction with isobutane to form isobutyl alcohol. The light source was a high pressure mercury lamp combined with a monochromator, with a bandwidth of 16 Å. The results show a constant Φ below 3000 Å, which is taken as unity on the basis of previous work. There is a very sharp fall-off in Φ which is centered at 3080 Å. At 3130 Å Φ is not greater than 0.1.

L050 Reactions of O(^{1}D) With Methane and Ethane

C.-L. Lin and W. B. DeMore

J. Phys. Chem., Vol. 77, No. 7, pp. 863–869, March 29, 1973

Gas-phase reactions of O(^{1}D) with CH_4 and with C_2H_6 were studied by the photolyses of N_2O–CH_4 and N_2O–C_2H_6 mixtures using 1849-Å light. Pressure effects and radical scavenging techniques were used to identify the sources of the products. At low pressures, where stabilization of excited alcohol intermediates did not occur, the main path of the O(^{1}D) + CH_4 reaction was to form CH_3 + OH radicals, which ultimately produce C_2H_6. Molecular elimination giving H_2 + CH_2O occurred to the extent of 9%, which is the same as when the reaction takes place in liquid Ar at 87°K. The main path of the O(^{1}D) + C_2H_6 reaction was to form C_2H_5 + OH and CH_3 + CH_2OH radicals, which ultimately produce n-C_4H_{10}, C_3H_8, and C_2H_6 as principal products. The total reaction does not proceed via ROH* intermediates. The OH radicals are produced both by fission of such intermediates and by direct abstraction of H atoms. Comparison with previous results in liquid argon indicates that the condensed medium suppresses the abstraction reaction in favor of the insertion reaction. The molecular process giving CH_2O + H_2 also does not involve the CH_3OH^* intermediate, as shown by the fact that this path contributes equally both in the gas and liquid phases.

LINDSEY, W. C.

L051 A Bibliography of the Theory and Application of the Phase-Lock Principle

W. C. Lindsey (University of Southern California) and R. C. Tausworthe

Technical Report 32-1581, April 1, 1973

Since much has been reported on the phase-locked loop, a literature search was conducted in an effort to collect and compile as many references on the subject as possible. Although not all inclusive, this report presents a comprehensive listing of phase-locked-loop references covering the past two decades throughout the world. The compilation is given in two parts: first by categories, and then alphabetically by authors.

L052 L-Orthogonal Signal Transmission and Detection

W. C. Lindsey (University of Southern California) and M. K. Simon

IEEE Trans. Commun., Vol. COM-20, No. 5, pp. 953–960, October 1972

This paper investigates the detail capabilities and performance characterization of systems that employ *L*-orthogonal signaling techniques. *L*-orthogonal signals represent a unified set of signals wherein the polyphase and orthogonal (biorthogonal) signal sets are included as special cases. This fact is important since orthogonal (biorthogonal) and polyphase signaling sets represent opposing forces as far as tradeoffs between error probability, energy-to-noise ratio, and bandwidth requirements are concerned. Bounds on the performance of the optimum receiver and the performance of various suboptimum (practical) receiver structures are given. Coherent and differentially encoded signals are also pursued. Various comparisons and tradeoffs are made by means of numerical evaluation of the error-probability expressions.

L053 On the Detection of Differentially Encoded Polyphase Signals

W. C. Lindsey (University of Southern California) and M. K. Simon

IEEE Trans. Commun., Vol. COM-20, No. 6, pp. 1121–1128, December 1972

Any digital communication system that employs coherent detection requires coherent reference signals for proper operation. This article discusses the transmission and detection of differentially encoded multiple phase-shift-keyed (MPSK) signals and the ambiguity resolution problem that results from suppression of the transmitted carrier. In particular, the analysis and performance of differentially encoded coherent MPSK systems that reconstruct coherent reference signals by means of generalized Costas or *N*th power loops are presented. The performance of such systems is then compared with that of ideal reception of MPSK signals and differentially coherent detection of differentially encoded MPSK sig-

nals. Emphasis is placed upon the special cases of quadriphase and octaphase signaling.

LINNES, K. W.

L054 DSN Progress Report for November–December 1972: Radio Science Support

K. W. Linnes

Technical Report 32-1526, Vol. XIII, pp. 37–41, February 15, 1973

Since 1967, radio scientists have used the DSN 26- and 64-m-diameter antenna stations to investigate pulsars, quasars, and radio galaxies, to study the effect of solar corona on radio signals, and to observe radio emissions from X-ray sources. Very-long-baseline-interferometry (VLBI) techniques have been used for high-resolution studies of quasars. During the reporting period, September–December 1972, VLBI observations of quasars and pulsars were made as part of the Quasar Patrol. Support was also provided by the 64-m-diameter antenna to search for interstellar molecules and to observe radiation from Jupiter.

L055 DSN Progress Report for September–October 1973: Radio Science Support

K. W. Linnes

Technical Report 32-1526, Vol. XVIII, pp. 20–28, December 15, 1973

This article summarizes the support provided by the DSN to radio science experiments for the period of January–October 1973. The 26-m and 64-m-diameter antennas were used to conduct very-long-baseline interferometry (VLBI) observations of pulsars, quasars, and radio galaxies. Radio astronomy scientists used the 64-m-diameter antenna at Goldstone, California, at 2.3 and 8.4 GHz to measure the confusion distribution of weak radio sources, to determine the population of radio sources near certain spiral galaxies, and to study emissions from various pulsars. This radio telescope was also used at 14 GHz to search for interstellar molecules and to study radio emissions from Jupiter and Uranus; pulsar observations were also conducted at this frequency.

The high-power transmitter capability of the Goldstone 64-m-diameter antenna was also used for radar ranging to the planets Venus, Mercury, and Mars for the purpose of improving the ephemerides of Venus and Mercury in support of the Mariner Venus/Mercury 1973 Project and to obtain surface height and roughness data of Mars in support of the Viking Mars 1975 Project. Some radio science-related DSN development activities were also carried on; these included attempts to obtain radar return from Saturn and/or its rings and to search for radar reflection from Jupiter or its moon Ganymede. In addition, VLBI techniques were used to make measurements between California and Spain to determine deep space station locations, Earth polar motion, and Universal Time to higher precision. A bibliography of papers published by radio scientists using data obtained with DSN facilities is included.

LIU, C. L.

L056 Scheduling Algorithms for Multiprogramming in a Hard-Real-Time Environment

C. L. Liu (Massachusetts Institute of Technology) and J. W. Layland

J. Assoc. Comp. Mach., Vol. 20, No. 1, pp. 46–61, January 1973

The problem of multiprogram scheduling on a single processor is studied from the viewpoint of the characteristics peculiar to the program functions that need guaranteed service. It is shown that an optimum fixed priority scheduler possesses an upper bound to processor utilization which may be as low as 70% for large task sets. It is also shown that full processor utilization can be achieved by dynamically assigning priorities on the basis of their current deadlines. A combination of these two scheduling techniques is also discussed.

LOBB, V. B.

L057 DSN Progress Report for July–August 1973: 64-Meter-Diameter Antenna With New Braces: Installation Description and Computed Performance for Gravity Loads

V. B. Lobb and M. S. Katow

Technical Report 32-1526, Vol. XVII, pp. 93–99, October 15, 1973

The performance of the 64-m-diameter antenna was improved for gravity loading by addition of two reaction bars or braces in the elevation-wheel assembly. This article describes the installation of the braces and presents antenna performance in RF gain–loss curves vs elevation-angle changes from the 45-deg setting position of the Cassegrainian RF system. The gain–loss curves were analytically calculated using distortion data computed by the NASTRAN program, which was then best-fitted by the RMS program.

LORDEN, G.

L058 DSN Progress Report for January–February 1973: A Comparison Between the Current and Proposed Inventory and Procurement Policies for the Deep Space Network

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

Technical Report 32-1526, Vol. XIV, pp. 81–86, April 15, 1973.

For abstract, see Eisenberger, I.

L059 DSN Progress Report for September–October 1973: A Preliminary Study of Spares Provisioning for the Deep Space Network

I. Eisenberger, G. Lorden, and F. R. Maiocco

Technical Report 32-1526, Vol. XVIII, pp. 102–110, December 15, 1973

For abstract, see Eisenberger, I.

L060 Detection of Failure Rate Increases

G. Lorden (California Institute of Technology) and I. Eisenberger

Technometrics, Vol. 15, No. 1, pp. 167–175, February 1973

The problem of devising systematic policies for replacement of equipment subject to wear-out involves the detection of increases in failure rates. In this article detection procedures are defined as stopping times N with respect to the observed sequence of random failures. The concepts of "quickness of detection" and "frequency of false reactions" are made precise and a class of procedures is studied which optimizes the former asymptotically as the latter is reduced to zero. Results of Monte Carlo experiments are given which show that efficient quickness of detection is attainable simultaneously for various levels of increase in failure rates.

LORELL, J.

L061 Gravity Field of Mars From Mariner 9 Tracking Data

J. Lorell, et al.

Icarus, Vol. 18, No. 2, pp. 304–316, February 1973

Further reduction of Doppler tracking data from Mariner 9 confirms an earlier conclusion that the gravity field of Mars is considerably rougher than the fields of either the Earth or the moon. The largest positive gravity anomaly uncovered is in the Tharsis region which is also topographically high and geologically unusual. The best determined coefficients of the harmonic expansion of the gravitational potential are presented in this article.

The value obtained for the inverse mass of Mars is in good agreement with prior determinations from Mariner flyby trajectories. The direction found for the rotational pole of Mars is in excellent agreement with recent values determined from Earth-based observations of Mars satellites. Other important physical constants that have either been refined or confirmed by the Mariner 9 data include the dynamical flattening, maximum principal moment of inertia, and the period of precession of Mars' pole.

Contributors to this article include:

Jet Propulsion Laboratory: J. Lorell, G. H. Born, E. J. Christensen, P. B. Esposito, J. F. Jordan, P. A. Laing, W. L. Sjogren, and S. K. Wong

Massachusetts Institute of Technology: R. D. Reasenberg, I. I. Shapiro, and G. L. Slater

L062 Estimation of Gravity Field Harmonics in the Presence of Spin-Axis Direction Error Using Radio Tracking Data

J. Lorell

J. Astronaut. Sci., Vol. XX, No. 1, pp. 44–54, August 1972

The problem of estimating a planet's gravity harmonic coefficients using tracking data from an orbiting spacecraft is complicated by many factors, one of which is the uncertainty of spin-axis direction. In this article, formulas relating the spin-axis direction error to the second-degree gravity coefficients are derived. The error induced in the harmonic coefficients is then evaluated, and methods are suggested for correction. Finally, the effect of rotation is accounted for.

L063 Mariner 9 Celestial Mechanics Experiment: A Status Report

J. Lorell and I. I. Shapiro (Massachusetts Institute of Technology)

J. Geophys. Res., Vol. 78, No. 20, pp. 4327–4329, July 10, 1973

There are two basic efforts in the Mariner 9 celestial mechanics experiment: the determination of the gravity field of Mars and the performance of a very precise test of the theory of general relativity. In addition, there are a number of astrodynamic constants that are being determined. All analyses are based on the Mariner 9 radio metric data.

LOREMAN, J. R.

L064 DSN Progress Report for May–June 1973: Waveguide Installation Measurements at DSS 14

J. R. Loreman

Technical Report 32-1526, Vol. XVI, pp. 97-101, August 15, 1973

The match of the Mars Deep Space Station (DSS 14) waveguide installation has been affected by several waveguide changes necessitated by the installation of an additional X-band filter. A series of tests has been conducted as part of an effort to reduce transmitter back power.

LUBELEY, A.

L065 DSN Progress Report for September–October 1973: Short Baseline QVLBI Demonstrations—Part I

C. C. Chao, S. K. Wong, and A. Lubeley (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XVIII, pp. 47-56, December 15, 1973

For abstract, see Chao, C. C.

LUDWIG, A. C.

L066 Determination of the Maximum Scan-Gain Contours of a Beam-Scanning Paraboloid and Their Relation to the Petzval Surface

W. V. T. Rusch and A. C. Ludwig

IEEE Trans. Anten. Prop., Vol. AP-21, No. 2, pp. 141-147, March 1973

For abstract, see Rusch, W. V. T.

L067 A New Method for Calculating Correction Factors for Near-Field Gain Measurements

A. C. Ludwig and R. A. Norman

IEEE Trans. Anten. Prop., Vol. AP-21, No. 5, pp. 623-628, September 1973

A new method is presented for calculating near-field antenna gain correction factors directly from measured far-field pattern data by using a spherical wave expansion of the pattern. This eliminates the need for any assumptions regarding antenna aperture field distributions. The only significant assumption in the new method is to neglect multiple scattering between the antennas. The method is applied to the case of a horn antenna. Calculated results are compared to direct measured results, demonstrating agreement to within 0.03 dB. The method is also compared to a method reported earlier, with similar agreement. The sensitivity of the results to truncation error and noise in the data is also investigated and contrasted to sensitivity of prior methods to errors in the assumed field distribution.

LUSHBAUGH, W. A.

L068 DSN Progress Report for March–April 1973: A Driver/Receiver Unit for an Intercomputer Communications Link

W. A. Lushbaugh

Technical Report 32-1526, Vol. XV, pp. 109-115, June 15, 1973

One of the most likely configurations for the computational complement of future tracking stations is a number of small computers, each performing a dedicated function and interfacing with some specific subset of the tracking-station equipment and with the other computers. This article describes in some detail the line-interface or driver/receiver (D/R) unit for intercomputer communications.

This unit is capable of receiving and transmitting digital information a distance of up to 600 m via coaxial cable. The trilevel signaling format used to code the information is discussed, as well as the various interactions that are involved between computer and D/R unit and between transmitting and receiving D/R units. Status information is supplied to the associated computer via the status register, and a bit-by-bit description of this status register is given.

LUTES, G. F.

L069 DSN Progress Report for January–February 1973: S-Band Planetary Radar Receiver Development

C. F. Foster and G. F. Lutes

Technical Report 32-1526, Vol. XIV, pp. 23-26, April 15, 1973

For abstract, see Foster, C. F.

LUTWACK, R.

L070 Diffusion Across the Modified Polyethylene Separator GX in the Heat-Sterilizable AgO–Zn Battery

R. Lutwack

Technical Memorandum 33-636, August 1, 1973

Models of diffusion across an inert membrane have been studied using the computer program CINDA. The models were constructed to simulate various conditions obtained in the consideration of the diffusion of Ag $(OH)_2^-$ ions in the AgO–Zn battery. The effects on concentrations across the membrane at the steady state and on the fluxout as a function of time were used to examine the consequences of stepwise reducing the number of sources of ions, of stepwise blocking the source and sink surfaces,

of varying the magnitude of the diffusion coefficient for a uniform membrane, of varying the diffusion coefficient across the membrane, and of excluding volumes to diffusion.

LYTTLETON, R. A.

L071 On the Formation of Planets From a Solar Nebula

R. A. Lyttleton

Mon. Not. R. Astr. Soc., Vol. 158, No. 4, pp. 463–483, 1972

The development of planets within a solar nebula of both gas and dust is shown to occur in two main stages. First, in a time comparable with the orbital period at any distance the dust comes to move with Keplerian motion in a thin plane disc. This is an essential prerequisite since the volume-density in such a disc is amply sufficient for the self-gravitation of condensations to overcome the differential action of the Sun. By such means small solid planets can form independently of the gaseous component of the nebula. Second, the range-of-influence of a planet (of mass m moving at distance R) out to which its gravitation dominates over that of the Sun is $(m/3M)^{1/3}$ R. At any stage material within this distance can be captured, and the growth of bodies to mass of lunar order requires about 10^4 yr. It seems probable that many small bodies would begin to form separately, and then themselves combine by collisions to yield larger bodies fewer in number.

L072 A New Solution to the Accretion Problem

R. A. Lyttleton

Mon. Not. R. Astr. Soc., Vol. 160, No. 3, pp. 255–270, 1972

In this article a previously-reported theory of line-accretion is briefly reviewed, and it is shown that there are an infinity of steady-state solutions satisfying the requirements originally imposed as boundary conditions. Questions are raised as to the applicability of these solutions to physical reality. The existence is demonstrated of an entirely different type of steady-state solution that implies slow velocity in the accretion stream beyond the neutral point. Accurate numerical values are obtained of this solution for a number of cases. The braking action given by this solution, for any selected cutoff distance, is far stronger than that of the earlier theory. Consideration of the physical state in the accretion stream shows that for this slow solution the appropriate cutoff range would be only of the order 10^2 AU rather than of interstellar-distance order. With stronger braking action, the velocity of stars relative to interstellar material will be reduced in correspondingly shorter times, and more rapid accretion will thereby come about. This result, combined with recent measures of gas densities at various regions of the galaxy, suggests that the problem posed by the brightest stars may well be resolvable on the basis of the accretion process.

L073 The End of the Iron-Core Age

R. A. Lyttleton

The Moon, Vol. 7, Nos. 3 and 4, pp. 422–439, May–June 1973

The terrestrial planets aggregated essentially from small particles, to begin as solid cool bodies with the same general compositions, and there is no possibility of an iron core developing within any of them at any stage. Their differing internal and surface properties receive ready explanation from their different masses which determine whether the pressures within are sufficient to bring about phase changes. The claim that the terrestrial core can be identified by means of shock-wave data as nickel-iron is based on theoretical misconception, whereas the actual seismic data establish an uncompressed-density value much lower than any such mixture could have.

According to a hypothesis presented herein, the onset of the phase change in the Earth takes the form of a rapid initial collapse to produce a large core in metallic state which thereafter continues to grow secularly as a result of radioactive heating and leads to reduction of surface area at long last adequate to account for folded and thrusted mountain building. The hypothesis implies a similar but retarded evolution for Venus. The moon and Mars are too small in mass to have undergone the phase change to a metallic core, and can have no resulting dipole field, nor can they develop terrestrial-type mountains. Effects resulting from a transition corresponding to the 20° discontinuity will occur for Mars, including large-scale rifting at the surface, but will not occur on the moon. Finally brief reference is made to subjective nonscientific factors associated with continued efforts to rely on the iron-core hypothesis despite its lack of any success in rendering the properties of the Earth explicable.

MacCONNELL, J. W.

M001 DSN Progress Report for May–June 1973: Tracking Assistor for DSN Receivers

R. L. Sydnor and J. W. MacConnell

Technical Report 32-1526, Vol. XVI, pp. 30–32, August 15, 1973

For abstract, see Sydnor, R. L.

MacDORAN, P. F.

M002 Near Sun Observations of the Solar Wind

P. S. Callahan, P. F. MacDoran, and A. I. Zygielbaum

Space Research XII, pp. 1529–1533, Akademie-Verlag, Berlin, 1972

For abstract, see Callahan, P. S.

MACIE, T. W.

M003 Processing of Thermionic Power on an Electrically Propelled Spacecraft

T. W. Macie

Technical Memorandum 33-618, November 1, 1973

A study was conducted at JPL to define the power-processing equipment required between a thermionic reactor and an array of mercury-ion thrusters for a nuclear-electric propulsion system. Observations and recommendations that resulted from this study were: (1) the preferred thermionic-fuel-element-source voltages are 23 V or higher; (2) transistor forward-voltage drop has a strong effect on power-processor mass; (3) magnetic materials that exhibit low losses at high frequencies, that have a high Curie point, and that can operate at 15 to 20 kG could contribute significantly to additional reduction of the power-processor mass; (4) electrical component packaging on the radiator requires further study to reduce the area that is vulnerable to meteoroids, thereby reducing the meteoroid-shielding-mass requirement; and (5) an experimental model of this power processor design should be built and tested to verify the efficiencies, masses, and all the automatic operational aspects of the design.

M004 Electromagnetic Interference of Power Conditioners for Solar Electric Propulsion

A. C. Whittlesey and T. W. Macie

Technical Memorandum 33-623, July 1, 1973

For abstract, see Whittlesey, A. C.

MAIOCCO, F. R.

M005 DSN Progress Report for January–February 1973: A Comparison Between the Current and Proposed Inventory and Procurement Policies for the Deep Space Network

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

Technical Report 32-1526, Vol. XIV, pp. 81–86, April 15, 1973

For abstract, see Eisenberger, I.

M006 DSN Progress Report for September–October 1973: A Preliminary Study of Spares Provisioning for the Deep Space Network

I. Eisenberger, G. Lorden, and F. R. Maiocco

Technical Report 32-1526, Vol. XVIII, pp. 102–110, December 15, 1973

For abstract, see Eisenberger, I.

MALLORY, C. W.

M007 Evidence for a Steric Effect on Directly Bonded Carbon–Fluorine and Carbon–Proton Nuclear Magnetic Resonance Couplings

S. L. Manatt, M. A. Cooper, C. W. Mallory (Bryn Mawr College), and F. B. Mallory (Bryn Mawr College)

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 975–977, February 7, 1973

For abstract, see Manatt, S. L.

MALLORY, F. B.

M008 Evidence for a Steric Effect on Directly Bonded Carbon–Fluorine and Carbon–Proton Nuclear Magnetic Resonance Couplings

S. L. Manatt, M. A. Cooper, C. W. Mallory (Bryn Mawr College), and F. B. Mallory (Bryn Mawr College)

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 975–977, February 7, 1973

For abstract, see Manatt, S. L.

MANATT, S. L.

M009 Nuclear Magnetic Resonance Determination of Water and an Oxygen Titration for Nitric Oxide in Liquid Nitrogen Tetroxide

S. P. Vango and S. L. Manatt

Anal. Chem., Vol. 45, No. 7, pp. 1060–1064, June 1973

For abstract, see Vango, S. P.

M010 Magnetic Phases in Lunar Fines: Metallic Fe or Ferric Oxides

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

Geochim. Cosmochim. Acta, Vol. 37, No. 2, pp. 1201–1211, May 1973

For abstract, see Tsay, F.-D.

M011 Evidence for a Steric Effect on Directly Bonded Carbon–Fluorine and Carbon–Proton Nuclear Magnetic Resonance Couplings

S. L. Manatt, M. A. Cooper, C. W. Mallory (Bryn Mawr College), and F. B. Mallory (Bryn Mawr College)

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 975–977, February 7, 1973

This article presents data indicating $^1J_{13C-F}$ sensitivity to steric effects. Previously reported steric effects on $^1J_{13C-H}$ and values of $^1J_{13C-F}$ for a number of fluorobenzenes and other fluoroaromatic molecules are summarized for comparison purposes.

M012 Nuclear Magnetic Resonance of Phosphorus Compounds: VII. Evidence for Steric Effects on the ^{31}P–^{77}Se Coupling and ^{31}P Chemical Shifts

R. P. Pinnell (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), C. A. Megerle (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), S. L. Manatt, and P. A. Kroon

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 977–978, February 7, 1973

For abstract, see Pinnell, R. P.

MARGOLIS, J. S.

M013 On the Level of H_2 Quadrupole Absorption in the Jovian Atmosphere

J. S. Margolis and G. E. Hunt

Icarus, Vol. 18, No. 4, pp. 593–598, April 1973

The hydrogen quadrupole absorption lines are uniquely characterized by the property of being collision-narrowed. For the 3-0 and 4-0 bands the lines continue to narrow to below the pressure levels in the Jovian atmosphere where they appear to be formed. Since the collision narrowing is the reverse of the case for ordinary molecular absorptions the use of previously reported approximations have been reconsidered and found to represent the absorption very well through the inhomogeneous Jovian atmosphere. The hydrogen quadrupole absorptions, 3-0 S(1) and 4-0 S(1), have been analysed by a procedure which has been shown to give self-consistent results for the methane $3\nu_3$ manifolds. The 3-0 S(1) line is strongly saturated and even the weak 4-0 S(1) line (equivalent width ~8 mÅ) exhibits a 10% saturation. A mixing ratio (by volume) of approximately 7×10^{-4} is derived for methane to hydrogen in agreement with earlier results.

M014 Measurement of Some 1–0 H_2 Quadrupole Transition Strengths

J. S. Margolis

J. Molec. Spectrosc., Vol. 48, No. 2, pp. 409–410, November 1973

High order transitions, up to the third and fourth overtones, of the molecular hydrogen quadrupole spectrum may be observed in the spectra of the atmospheres of the outer planets. These are too weak to observe in laboratory spectra, but the absorption strengths may be estimated from theoretical calculations. The absorption strengths of three lines of the 1–0 band of molecular hydrogen have been measured for the purpose of comparing them to the theoretical calculations which have been made and verifying the theory as far as possible.

M015 The Temperature Dependence of the Half Widths of Some Self- and Foreign-Gas-Broadened Lines of Methane

L. Darnton and J. S. Margolis

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 10, pp. 969–976, October 1973

For abstract, see Darnton, L.

M016 Line Strength Measurements of the $2\nu_3$ Band of Methane

J. S. Margolis

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 11, pp. 1097–1103, November 1973

The line strengths of the manifolds of the $2\nu_3$ band of methane have been measured for the P, Q and R branches up to $J = 10$ ($J = 9$ for the R branch). The results are based on curves of growth using the assignments given by three different groups of investigators. They indicate that intensities deviate from the conventional factor reported earlier. The deviation is described in terms of an empirical Herman–Wallis factor.

MARINER MARS 1971 SCIENCE EXPERIMENTER TEAMS

M017 Mariner Mars 1971 Project Final Report: Science Results

Mariner Mars 1971 Science Experimenter Teams

Technical Report 32-1550, Vol. IV, July 15, 1973

This report contains science results from the mission of Mariner 9, the first planetary orbiting spacecraft. Mariner

9 was inserted into Mars orbit on November 14, 1971, and expired on October 27, 1972. A summary of significant mission events is also included.

Mariner 9 observed the impact-cratered surface of Mars, discovered volcanic mountains, rift valleys, tectonic faults, and various types of terrain showing evidence of fluvial and wind erosion. It recorded an atmosphere with a complex meteorology of clouds, storms, and weather fronts and photographed Phobos and Deimos, the two satellites of Mars. The results of analyses derived from these observations are presented in this report, as written by individual experimenters or by members of the experiment teams, and represent analysis efforts through November 1972.

MARKIEWICZ, B. R.

M018 Analysis of the Computed Torque Drive Method and Comparison With Conventional Position Servo for a Computer-Controlled Manipulator

B. R. Markiewicz

Technical Memorandum 33-601, March 15, 1973

A manipulator and its control system (modeled after a Stanford design) is being developed at JPL as part of an artificial intelligence project. The development includes an analytical study of the control system software. This report presents a comparison of the computed-torque method and the conventional position servo. No conclusion is made as to the preference of one system over the other, as this depends upon the application and the results of a sample data analysis.

MARSH, H. E., JR.

M019 Lipid-Absorbing Polymers

H. E. Marsh, Jr., and C. J. Wallace

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 1–6, January 1973

Present medicinal approaches to cholesterol reduction are indirect. They employ ion exchange to bind bile acids (which are derived from cholesterol by the liver) so that they will be eliminated instead of assimilated.

New polymers have been made that have the unusual property of being capable of absorbing both water and oils. As a result of this property, they are able to absorb lipids from micellar solutions. Lipid absorptions as high as 10% (based on dry polymer weight) in 5 min and 50% at equilibrium have been measured in model bile solutions. The presence of significant amounts of cholesterol, as well as of bile acid, in the absorbed lipids has been confirmed by thin-layer chromatography.

M020 Solid Propellants

H. E. Marsh, Jr., and J. J. Hutchison

Chemistry in Space Research, pp. 361–463, American Elsevier Publishing Company, New York, 1972

Before a new propellant is accepted for extensive use, it naturally must demonstrate advantages over existing propellants and that it can be applied practically at a cost commensurate with its advantages. A number of factors must be considered, such as the propellant energetics, propellant/motor mass fraction, and overall propellant performance. In addition, trade-offs must be evaluated and disadvantageous characteristics reduced, eliminated or compensated for by design. This article discusses the wide range of technological problems involved in the development of new and improved solid propellants and describes some of the most promising approaches to these problems.

M021 Formulating Propellants for Fully Case-Bonded End-Burning Motors

H. E. Marsh, Jr., and D. E. Udlock

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 625–626, September 1972

A new family of solid propellants is developed which makes possible high performance, fully case-bonded end-burning motors, resulting in an order-of-magnitude improvement in the thrust-to-mass capability of solid propellant rocket motors. This new capability is demanded of solid rocket motors by missions, such as planetary orbit insertion, requiring both low acceleration and large total impulse. Propellants having very high elongation and very low modules are made by means of a new formulating concept without sacrifice in performance and with improved quality control. Structural integrity tests in flight-weight motors have demonstrated this new technology.

MARTIN, W.

M022 Measurement of General Relativistic Time Delay With Mariners 6 and 7

J. D. Anderson, P. B. Esposito, W. Martin, and D. O. Muhleman (California Institute of Technology)

Space Research XII, pp. 1623–1630, Akademie-Verlag, Berlin, 1971

For abstract, see Anderson, J. D.

MARTONCHIK, J. V.

M023 Observation of the OH Radical in Betelgeuse

R. Beer, R. H. Norton, R. B. Hutchinson, D. L. Lambert (University of Texas), and J. V. Martonchik (University of Texas)

Mém. Soc. Roy. Sci. Liège, Vol. III, No. 6, p. 145, 1972

For abstract, see Beer, R.

MASEK, T. D.

M024 Solar Electric Propulsion Thrust Subsystem Development

T. D. Masek

Technical Report 32-1579, March 15, 1973

This report presents the results of the third phase of the JPL Solar-Electric Propulsion System Technology (SEPST III) Program. This phase of the program included about three years of preparation and testing. Of this time, approximately six months were spent in testing a complete, automated thrust subsystem.

The system developed under this program was designed to demonstrate all the thrust subsystem functions thought to be necessary on an unmanned planetary spacecraft. The demonstration included operation of the basic elements, power matching, input and output voltage regulation, three-axis thrust-vector control, subsystem automatic control including failure detection and correction capability (using a PDP-11 computer), operation of critical elements in thermal-vacuum, zero-gravity-type propellant storage, and data outputs from all subsystem elements. The subsystem elements, functions, unique features, and test setup are described. General features and capabilities of the test-support data system are also presented.

The test program culminated in a 1500-h, computer-controlled, system-functional demonstration that included simultaneous operation of two thruster/power conditioner sets. The results of this testing phase satisfied all the program goals. In particular, the subsystem performed all the expected functions, subsystem efficiency appears to be compatible with spacecraft requirements, projected specific mass is about 17 kg/kW of input power, and the major teletype-switching-system integration problems are understood. This work provides a base for the next phase of subsystem development (i.e., an engineering model).

MASON, P. V.

M025 The Apollo 17 Surface Experiments

N. W. Hinners (NASA Apollo Program Office) and P. V. Mason

Astronaut. Aeronaut., Vol. 10, No. 12, pp. 40–54, December 1972

For abstract, see Hinners, N. W.

MASSIER, P. F.

M026 Experimental Evaluation of Fluctuating Density and Radiated Noise

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

Technical Memorandum 33-643, October 1, 1973

An experimental investigation has been conducted to characterize the fluctuating density within a high-temperature (1100 K) subsonic jet and to characterize the noise radiated to the surroundings. Cross correlations obtained by introducing time delay to the signals detected from spatially separated crossed laser beams set up as a Schlieren system were used to determine radial axial distributions of the convection velocity of the moving noise sources (eddies). In addition, the autocorrelation of the fluctuating density was evaluated in the moving frame of reference of the eddies. Also, the autocorrelation of the radiated noise in the moving reference frame was evaluated from cross correlations by introducing time delay to the signals detected by spatially separated pairs of microphones.

The radiated noise results are compared with Lighthill's theory and with the data of Lush. Radial distributions of the mean velocity were obtained from measurements of the stagnation temperature, and stagnation and static pressures with the use of probes.

M027 Viscous Non-adiabatic Laminar Flow Through a Supersonic Nozzle: Experimental Results and Numerical Calculations

L. H. Back and P. F. Massier

Trans. ASME, Ser. C: J. Heat Transf., Vol. 94, No. 4, pp. 437–445, November 1972

For abstract, see Back, L. H.

MATSON, D. L.

M028 Minor Planets and Related Objects: XI. 0.4–0.8 μm Spectrophotometry of (1685) Toro

T. V. Johnson and D. L. Matson

Astron. J., Vol. 78, No. 6, pp. 505–507, August 1973

For abstract, see Johnson, T. V.

MAXWORTHY, T.

M029 A Review of Jovian Atmospheric Dynamics

T. Maxworthy

Planet. Space Sci., Vol. 21, No. 4, pp. 623-641, April 1973

A brief review is presented of available knowledge of the fluid motions within Jupiter's atmosphere. Evidence is presented to support the contention that the observed cloud masses are probably not simply convected by the main zonal flows. It is likely that an understanding of wave motions within the atmosphere will be of great importance in interpreting data gathered both from the ground and from spacecraft.

McCLURE, D. H.

M030 DSN Progress Report for May-June 1973: DSN Supply System Model

D. H. McClure

Technical Report 32-1526, Vol. XVI, pp. 183-192, August 15, 1973

A model of the DSN Supply System was developed, using the Forrester approach, which describes the existing supply system material and paper flow. The model accurately depicts the system for typical situations involving items of supply normally stocked at a Complex Supply Depot. The model allows the user to study the effects of parameter variations such as procurement lead time, shipping time, reorder points, and user demand rates.

McDANELL, J. P.

M031 Orbit Determination for Low-Thrust Spacecraft: Concepts and Analysis

J. P. McDanell

Technical Memorandum 33-609, April 15, 1973

This memorandum re-evaluates the Earth-based orbit-determination capability for solar-electric-propulsion spacecraft in the light of recent developments both in multi-station tracking concepts and in thrust-subsystem error modeling. Five different tracking strategies are applied to a 15-day segment of an Encke rendezvous mission. Both optimal and suboptimal orbit-determination performance are determined for a wide range of process-noise parameter values. The multi-station tracking techniques are found to be extremely effective, reducing orbit-determination errors by orders of magnitude over that obtained with conventional single-station tracking. Explicitly differenced multi-station data is found to be least sensitive to gross modeling errors, but if a reasonably good process-noise model is available, explicit differencing is not required.

McELIECE, R. J.

M032 DSN Progress Report for September-October 1973: A Golay-Viterbi Concatenated Coding Scheme for MJS'77

L. D. Baumert and R. J. McEliece

Technical Report 32-1526, Vol. XVIII, pp. 76-84, December 15, 1973

For abstract, see Baumert, L. D.

M033 Hiding and Covering in a Compact Metric Space

R. J. McEliece and E. C. Posner

Ann. Stat., Vol. 1, No. 4, pp. 729-739, July 1973

This article studies the relationship between games of search on a compact metric space X and the absolute epsilon entropy $I(X)$ of X. The main result is that $I(X) = -\log v_L^*$, v_L^* being the lower value of a game on X called "restricted hide and seek."

M034 Weight Congruences for p-ary Cyclic Codes

R. J. McEliece

Discrete Math., Vol. 3, Nos. 1-3, pp. 177-192, September 1972

The largest integer λ is identified such that all weights in a p-ary cyclic code C are divisible by p^λ, and give a congruence for the weights mod $p^{\lambda+1}$. λ turns out to be $\omega/(p-1) - 1$, where ω is the smallest multiple of $p-1$ such that there is an equation of the form $1 = \theta_1\theta_2\cdots\theta_\omega$, each θ_i being a root of the check polynomial of C. Several related results are presented.

M035 A Note on the Griesmer Bound

L. D. Baumert and R. J. McEliece

IEEE Trans. Inform. Theor., Vol. IT-19, No. 1, pp. 134-135, January 1973

For abstract, see Baumert, L. D.

M036 Comment on "A Class of Codes for Asymmetric Channels and a Problem From the Additive Theory of Numbers"

R. J. McEliece

IEEE Trans. Inform. Theor., Vol. IT-19, No. 1, p. 137, January 1973

This article comments on error-correcting codes for asymmetric channels previously reported. Evidence is

constructed to attest to the superiority of these codes over other error-correcting codes currently in use.

McGINNESS, H. D.

M037 DSN Progress Report for January–February 1973: Design of Shipping Containers for Master Equatorials

H. D. McGinness

Technical Report 32-1526, Vol. XIV, pp. 226–234, April 15, 1973

The delicate nature of the master equatorials makes them highly susceptible to damage, especially during transit. A special container has been designed and built for the purpose of shipping assembled master equatorials to overseas antenna sites in Australia and Spain. This article outlines the design features of the shipping containers and describes the advantageous use of motor-vehicle shock absorbers.

M038 DSN Progress Report for March–April 1973: Wind Load Predictions for the 64-m-diameter Antenna

M. S. Katow and H. D. McGinness

Technical Report 32-1526, Vol. XV, pp. 96-101, June 15, 1973

For abstract, see Katow, M. S.

McLYMAN, W. T.

M039 Magnetic Materials Selection for Static Inverter and Converter

W. T. McLyman

Technical Memorandum 33-498, Rev. 1, September 15, 1973

This memorandum presents a study of magnetic materials for use in spacecraft transformers used in static inverters, converters, and transformer-rectifier supplies. Different magnetic alloys best suited for high-frequency and high-efficiency applications were comparatively investigated, along with each alloy's inherent characteristics.

One of the characteristics in magnetic materials detrimental in transformer design is the residual flux density, which can be additive on turn-on and cause the transformer to saturate. Investigation of this problem led to the design of a transformer with a very low residual flux. Tests were performed to determine the dc and ac magnetic properties at 2400 Hz using square-wave excitation. These tests were performed on uncut cores, which were then cut for comparison of the gapped and ungapped magnetic properties. When the data of many transformers in many configurations were compiled, the optimum transformer was found to be that with the lowest residual flux and a small amount of air gap in the magnetic material. The data obtained from these tests are described, and the potential uses for the materials are discussed.

M040 Design Parameters for Toroidal and Bobbin Magnetics

W. T. McLyman

Technical Memorandum 33-651, September 15, 1973

The adoption by NASA of the metric system for dimensioning to replace the long-used English units imposes a requirement on the U.S. transformer designer to convert from the familiar units to the less familiar metric equivalents. Material is presented to assist in that transition in 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.

McPEAK, W. L.

M041 DSN Progress Report for March–April 1973: Arithmetic Processing Unit

W. L. McPeak

Technical Report 32-1526, Vol. XV, pp. 66–69, June 15, 1973

This article describes an arithmetic processing unit being developed to provide more meaningful numerical data from meters mounted in the antenna portion of high-power transmitters. This unit will compute directly changes in temperature, power dissipation, and water-flow levels. The design constraints, requirements, and concepts are discussed.

MEDLEY, E. E.

M042 Thermal Decomposition of Aliphatic Monoamino-Monocarboxylic Acids

P. G. Simmonds, E. E. Medley, M. A. Ratcliff, Jr., and G. P. Shulman

Anal. Chem., Vol. 44, No. 12, pp. 2060–2066, October 1972

For abstract, see Simmonds, P. G.

MEGERLE, C. A.

M043 Nuclear Magnetic Resonance of Phosphorus Compounds: VII. Evidence for Steric Effects on the ^{31}P–^{77}Se Coupling and ^{31}P Chemical Shifts

R. P. Pinnell (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), C. A. Megerle (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), S. L. Manatt, and P. A. Kroon

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 977–978, February 7, 1973

For abstract, see Pinnell, R. P.

MENICHELLI, V. J.

M044 A High-Efficiency, Small, Solid-State Laser for Pyrotechnic Ignition

L. C. Yang and V. J. Menichelli

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 29–37, January 1973

For abstract, see Yang, L. C.

M045 Generation of Narrow High Current Pulses

V. J. Menichelli and L. A. Rosenthal

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 38–43, January 1973

Many of the fundamental factors affecting the initiation of electroexplosive devices have not been satisfactorily explained. This article describes a narrow, high-current pulse generator capable of 94-A pulses 4 μs wide and which will be useful in the study of the initiation mechanism.

M046 Impulsive Firing Method for Electroexplosive Devices

L. A. Rosenthal and V. J. Menichelli

IEEE Trans. Instr. Meas., Vol. IM-22, No. 2, pp. 119–123, June, 1973

For abstract, see Rosenthal, L. A.

M047 Nondestructive and Impulsive Testing of Electroexplosive Devices

V. J. Menichelli

J. Spacecraft Rockets, Vol. 9, No. 12, pp. 936–937, December 1972

Since failure of an electroexplosive device (EED) during a space mission can result in partial or complete failure of the mission, a detailed knowledge of the quality of each EED used is required. JPL has developed nondestructive test techniques and instrumentation that demonstrate the quality and normal behavior of 1-W/1-A no-fire EEDs without firing or degrading the units. This article describes nondestructive tests and impulsive firings performed on three groups of aerospace-type EEDs.

MENZIES, R. T.

M048 Remote Detection of SO_2 and CO_2 With a Heterodyne Radiometer

R. T. Menzies

Appl. Phys. Lett., Vol. 22, No. 11, pp. 592–593, June 1, 1973

A heterodyne radiometer, operating in the 9- to 11-μm wavelength region, has been used to detect SO_2 and CO_2 in the laboratory with sensitivity adequate for remote stack monitoring and other sensing applications. CO_2 lasers were used as local oscillators. The mixer was copper-doped germanium, compensated with antimony donors, and the intermediate frequency bandwidth was 500 MHz. Wavelengths of operation were chosen to minimize interference from water vapor.

M049 Beat-Frequency Measurements Between $C^{12}O_2{}^{16}$ and $C^{12}O_2{}^{18}$ Lasers

R. T. Menzies and M. S. Shumate

IEEE J. Quantum Electron., Vol. QE-9, No. 8, p. 862, August 1973

Several beat frequencies in the range below 6 GHz have been measured using a $C^{12}O_2{}^{16}$ laser and a $C^{12}O_2{}^{18}$ laser operating on several pairs of closely spaced lines in the 9.3-μm region. The determination of the $C^{12}O_2{}^{16}$-laser frequencies has permitted accurate estimation of the molecular rotational constants of $C^{12}O_2{}^{16}$. The results have been used to produce a revised estimate of the molecular rotational constants for $C^{12}O_2{}^{18}$.

M050 Remote Sensing With Infra-red Heterodyne Radiometers

R. T. Menzies

Opto-electronics, Vol. 4, No. 2, pp. 179–186, May 1972

The narrow spectral bandwidth capability of heterodyne radiometers can be utilized to construct highly selective pollutant sensing instruments. The infrared spectral region is favorable due to the availability of pollutant absorption lines and the wavelength dependence of heterodyne sensitivity. This article reviews the types of sensing systems that can make use of heterodyne techniques, including comments about the type of lasers that can serve as local oscillators. Sensitivity calculations of passive heterodyne radiometers to NO, CO_2, and SO_2 are

then presented. The concluding discussion involves the use of a heterodyne receiver in an active NO sensing system which is based on infrared fluorescence.

METZGER, A. E.

M051 Lunar Surface Radioactivity: Preliminary Results of the Apollo 15 and Apollo 16 Gamma-Ray Spectrometer Experiments

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

Science, Vol. 179, No. 4075, pp. 800–803, February 23, 1973

Gamma-ray spectrometers on the Apollo 15 and Apollo 16 missions have been used to map the moon's radioactivity over 20% of its surface. The highest levels of natural radioactivity are found in Mare Imbrium and Oceanus Procellarum with contrastingly lower enhancements in the eastern maria. The ratio of potassium to uranium is higher on the far side than on the near side, although it is everywhere lower than commonly found on the earth.

MEYER, R. F.

M052 DSN Progress Report for September–October 1973: Hydrogen Maser Frequency Standard: Receiver Configuration and Stability Requirements

R. F. Meyer

Technical Report 32-1526, Vol. XVIII, pp. 66–72, December 15, 1973

This article discusses the final receiver configuration and the current status of the JPL hydrogen maser to be used as a station frequency standard in the DSN. The phase noise and stability requirements for the various receiver modules are also presented.

MICCIO, J. A.

M053 DSN Progress Report for November–December 1972: The Traceability and Reporting Program: Mariner Mars 1971—Integration, Review, Evolution

J. A. Miccio

Technical Report 32-1526, Vol. XIII, pp. 239–243, February 15, 1973

The traceability and reporting program (TARP) is the basic support software utilized by the DSN Operational Data Center (ODC). It is used during mission operations to provide administrative control and selective dissemination of information concerning transferable DSN mission-data products. Significant qualitative information relative to data-record production, quality, logistics, and recycleability status are entered into the data base with respective operational data. Data records covered in TARP consist of original, system, and master magnetic tapes with supplemental microfilmed hard-copy records.

This article reviews the execution of this program in support of Mariner Mars 1971 operations. It also describes the evolution of the program through Mariner Mars 1971 and into its current status, and presents the planned configuration for Pioneer G and Mariner Venus–Mercury 1973 mission support. The program's current organization structure is adaptive to both mission-operation support and management-information support environments. Thus, concurrent efforts are being expended on the adaptability of the present system to data-management systems involved in hierarchical reporting relationships concerned with user–operations–management interfaces.

MICHAUX, C. M.

M054 A Model of the Physical Properties of Comet Encke

F. W. Taylor, C. M. Michaux, and R. L. Newburn, Jr.

Technical Report 32-1590, October 1, 1973

For abstract, see Taylor, F. W.

MILES, R. F., JR.

M055 Mariner Jupiter/Saturn 1977—The Mission Frame

R. D. Bourke, R. F. Miles, Jr., P. A. Penzo, S. L. Van Dillen, and R. A. Wallace

Astronaut. Aeronaut., Vol. 10, No. 11, pp. 42–49, November 1972

For abstract, see Bourke, R. D.

MILLER, C. G.

M056 Improved Spatial Uniformity of Beam-Plane Interaction by Means of Inverse Rastering

C. G. Miller

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 78–90, July 1973

This article presents an analysis that shows the desirability and feasibility of conducting irradiations of large test objects with beams of penetrating radiation by the method of moving the test object back and forth through the beam, rather than by sweeping the beam across the

object. An extension of this method of inverse rastering allows the generation of composite beams with any desired intensity-vs-energy spectrum, obviating the need to determine equivalent damage factors for every energy in the spectrum.

MILLER, R. B.

M057 DSN Progress Report for March–April 1973: Pioneer 10 and 11 Mission Support

R. B. Miller

Technical Report 32-1526, Vol. XV, pp. 22–28, June 15, 1973

The DSN has completed more than a full year of continuous telemetry-data acquisition, command, and radio metric tracking support for Pioneer 10. Pioneer 11 was successfully launched on April 5, 1973. Detailed encounter-support planning activity was initiated. This article describes recent organizational changes in JPL support of the Pioneer Project.

M058 DSN Progress Report for May–June 1973: Pioneer 10 and 11 Mission Support

R. B. Miller

Technical Report 32-1526, Vol. XVI, pp. 15–21, August 15, 1973

The Pioneer 10 and 11 encounters will place the greatest demands of any mission to date on total Ground Data System reliability. The encounter sequence and aspects of the spacecraft design which place demands on DSN performance are described.

M059 DSN Progress Report for July–August 1973: Pioneer 10 and 11 Mission Support

R. B. Miller

Technical Report 32-1526, Vol. XVII, pp. 14–16, October 15, 1973

This article presents a general description of the Pioneer 10 Jupiter-encounter objectives and the resulting operations plan. A list of Pioneer 10 scientific experiments, as well as a chronology of Jupiter-encounter events, is included.

M060 DSN Progress Report for September–October 1973: Pioneer 10 and 11 Mission Support

R. B. Miller

Technical Report 32-1526, Vol. XVIII, pp. 16–19, December 15, 1973

The Pioneer 10 Jupiter encounter will be the first major unmanned mission event that JPL has supported involving a remote control center. This article describes the major elements involved in the total Ground Data System which supports the Pioneer 10 and 11 missions as it exists during the Pioneer 10 Jupiter encounter time frame.

MINER, E.

M061 Another Possible Post-Eclipse Brightening of Io

B. O'Leary (Hampshire College) and E. Miner

Icarus, Vol. 20, No. 1, pp. 18–20, September 1973

For abstract, see O'Leary, B.

MINOVITCH, M. A.

M062 Gravity Thrust Jupiter Orbiter Trajectories Generated by Encountering the Galilean Satellites

M. A. Minovitch

J. Spacecraft Rockets, Vol. 9, No. 10, pp. 751–756, October 1972

A trajectory design philosophy is introduced for Jupiter orbiter missions that is based on the gravity thrust concept developed for interplanetary trajectories. This is accomplished by utilizing the moving gravitational fields of the four Galilean satellites. A general theorem, applicable to any existing planetary satellite system, is developed to show how the effects of small satellite perturbations can be magnified by incorporating multiple revolutions between encounters.

MOACANIN, J.

M063 Prediction of Lipid Uptake by Prosthetic Heart Valve Poppets From Solubility Parameters

J. Moacanin, D. D. Lawson, H. P. Chin (University of Southern California), E. C. Harrison (University of Southern California), and D. H. Blankenhorn (University of Southern California)

Biomat., Med. Dev., Art. Org., Vol. 1, No. 1, pp. 183–190, 1973

Most prosthetic heart valves currently implanted consist of a silicone rubber poppet situated within a metallic cage. Recent reports indicate that gradual deterioration of the poppet can occur and lead to serious valve malfunction. Physical changes (variance) observed in recovered prosthesis include discoloration, swelling, and cracking.

MOHAN, S. N.

M064 Cartography and Orbit Determination Using TV Data From a Mars Orbiting Spacecraft

S. N. Mohan and G. A. Ransford

J. Astronaut. Sci., Vol. XX, No. 5, pp. 275–301, March–April 1973

Television pictures of the surface features of the planet Mars taken from a Mars orbiting spacecraft, when used in conjunction with earth-based tracking data, constitute an onboard observable which can, in principle, improve knowledge uncertainties of both the spacecraft state and of the landmark positions. The benefits of such TV data, for orbit determination, both in the orbiter and approach phases is presented as the results of covariance analysis. Simultaneous with solutions for the spacecraft state, solutions for the landmark positions in topocentric coordinates, the pole location of Mars in inertial space, and the TV pointing direction are also investigated. It is shown that while some improvement in the spacecraft state is possible both in the approach and orbiter phases of orbit determination, it is possible to get good solutions for landmark locations and the local radius of Mars at hitherto unknown landmarks. This information is of value in establishing a cartographic control point network.

MONDT, J. F.

M065 Preliminary Nuclear Electric Propulsion (NEP) Reliability Study

T. M. Hsieh, A. M. Nakashima, and J. F. Mondt

Technical Memorandum 33-629, July 1, 1973

For abstract, see Hsieh, T. M.

MOORE, J. W.

M066 Navigation Requirements for Advanced Deep Space Missions

L. D. Friedman, J. W. Moore, and R. L. Sohn

Navigation: J. Institute Nav., Vol. 19, No. 3, pp. 266–280, Fall 1972

For abstract, see Friedman, L. D.

MORELLI, F. A.

M067 Monitoring of Antarctic Dry Valley Drilling Sites

F. A. Morelli, R. E. Cameron, D. R. Gensel, and L. P. Randall (Northern Illinois University)

Antarctic J. U.S., Vol. VII, No. 4, pp. 92–94, July–August 1972

Man's relatively recent permanent occupancy of the Antarctic, his past, present, and anticipated activities and practices, and a deeper appreciation for the environment have given rise to a microbiological monitoring program during the past field season in the dry valleys. The monitoring effort was centered around the activities of the Dry Valley Drilling Project, which investigated various sites for drilling operations. This article describes the microbiological monitoring activities and results.

M068 Hydrocarbons in Air Samples From Antarctic Dry Valley Drilling Sites

J. V. Behar (University of California, Riverside), L. Zafonte (University of California, Riverside), R. E. Cameron, and F. A. Morelli

Antarctic J. U.S., Vol. VII, No. 4, pp. 94–96, July–August 1972

For abstract, see Behar, J. V.

M069 Bacterial Species in Soil and Air of the Antarctic Continent

R. E. Cameron, F. A. Morelli, and R. M. Johnson (Arizona State University)

Antarctic J. U.S., Vol. VII, No. 5, pp. 187–189, September–October 1972

For abstract, see Cameron, R. E.

MORGAN, N. R.

M070 The JPL 7.62-m Space Simulator Modification

N. R. Morgan

Technical Memorandum 33-639, September 1, 1973

The JPL 7.62-m space simulator was modified to simulate the solar intensities at the planet Mercury. The capability of the simulator was increased to support testing of both the Mariner spacecraft mission to Venus and Mercury (to be launched in 1973) and the Helios spacecraft. The design of the off-axis reflecting system of the JPL simulators allowed attainment of increased solar intensity, at the expense of test area, by placing a smaller collimating mirror at a lower elevation in the space simulator. In addition to requiring a new collimating mirror 4.57 m in diameter, the optical integrating system required a new design and there were several other efforts necessary to support these primary alterations.

MORI, M.

M071 DSN Progress Report for July–August 1973: Computation of RF Boresight Direction From Reflector Distortions

M. S. Katow and M. Mori

Technical Report 32-1526, Vol. XVII, pp. 78–82, October 15, 1973

For abstract, see Katow, M. S.

MORRIS, G. A.

M072 DSN Progress Report for March–April 1973: Simultaneous Detection of Pulsar Radiation at S- and X-Bands

P. E. Reichley, G. S. Downs, and G. A. Morris

Technical Report 32-1526, Vol. XV, pp. 133–137, June 15, 1973

For abstract, see Reichley, P. E.

M073 Pulsar Detections at Frequencies of 8.4 and 15.1 GHz

G. S. Downs, P. E. Reichley, and G. A. Morris

Astrophys. J., Vol. 181, No. 3, Part 2, pp. L143–L146, May 1, 1973

For abstract, see Downs, G. S.

M074 Martian Topography and Surface Properties as Seen by Radar: The 1971 Opposition

G. S. Downs, R. M. Goldstein, R. R. Green, G. A. Morris, and P. E. Reichley

Icarus, Vol. 18, No. 1, pp. 8–21, January 1973

For abstract, see Downs, G. S.

MORTON, J. B.

M075 Mascons: Progress Toward a Unique Solution for Mass Distribution

R. J. Phillips, J. E. Conel, E. A. Abbott, W. L. Sjogren, and J. B. Morton

J. Geophys. Res., Vol. 77, No. 35, pp. 7106–7114, December 10, 1972

For abstract, see Phillips, R. J.

MOTTINGER, N. A.

M076 DSN Progress Report for May–June 1973: Candidate Extragalactic Radio Sources for Differenced VLBI Tracking With Deep Space Probes

N. A. Mottinger

Technical Report 32-1526, Vol. XVI, pp. 65–68, August 15, 1973

The application of the differenced very-long-baseline interferometry (ΔVLBI) or VLBI switching technique for tracking extragalactic radio sources (ERS) and spacecraft which are at 10° or less angular separation offers a method for augmenting the current doppler navigation system. From general radio source catalogs, ERS have been selected which have promising spectral features and correlated flux values suitable for ΔVLBI tracking using the antennas in the DSN. A computer program has been written which reduces this list to those occurring in a specific region of the celestial sphere near the track of a deep spacecraft. Surveying two current missions, Pioneers 10 and 11, and two future missions, Mariner Venus/Mercury and Viking, reveals numerous opportunities for ΔVLBI.

MOYNIHAN, P. I.

M077 Performance Characterization Tests of Three 0.44-N (0.1-lbf) Hydrazine Catalytic Thrusters

P. I. Moynihan and R. A. Bjorklund

Technical Report 32-1584, September 1, 1973

The 0.44-N (0.1-lbf) class of hydrazine catalytic thruster has been evaluated at JPL to assess its capability for spacecraft limit-cycle attitude control with thruster pulse durations on the order of 10 ms. Dynamic-environment and limit-cycle simulation tests were performed on three commercially available thruster/valve assemblies, purchased from three different manufacturers. The results indicate that this class of thruster can sustain a launch environment and, when properly temperature-conditioned, can perform limit-cycle operations over the anticipated life span of a multi-year mission. The minimum operating temperature for very short pulse durations was determined for each thruster. Pulsing life tests were then conducted on each thruster under a thermally controlled condition which maintained the catalyst bed at both a nominal 93°C (200°F) and 205°C (400°F). These were the temperatures believed to be slightly below and very near the minimum recommended operating temperature, respectively. The ensuing life tests ranged from 1×10^5 to 2.5×10^5 pulses at these temperatures, as would be required for spacecraft limit-cycle attitude control applications.

MUDGWAY, D. J.

M078 DSN Progress Report for November–December 1972: Viking Mission Support

D. J. Mudgway

Technical Report 32-1526, Vol. XIII, pp. 29–36, February 15, 1973

DSN support for Viking remains in the transitional phase between planning and commitment and the early stages of implementation. Existing implementation schedules have been thoroughly reworked to reconcile desired operational-readiness dates with anticipated DSN manpower and funding resources. Investigation of downlink interference effects in a dual-carrier environment continued to make progress at the Venus Deep Space Station (DSS 13). The network configuration for the DSN Test and Training System is described.

M079 DSN Progress Report for January–February 1973: Viking Mission Support

D. J. Mudgway

Technical Report 32-1526, Vol. XIV, pp. 14–15, April 15, 1973

DSN support for Viking Mars 1975 has been reexamined in the light of new budget constraints. Some impact on existing plans and schedules is expected to result. An earlier decision to use the single-station configuration for providing dual-carrier capability was abandoned in favor of the more predictable dual-station approach. The first Viking/DSN progress review has been postponed to permit the impact of the changes necessitated by the budget constraints to be evaluated.

M080 DSN Progress Report for March–April 1973: Viking Mission Support

D. J. Mudgway

Technical Report 32-1526, Vol. XV, pp. 10–21, June 15, 1973

Because of budget constraints, previous plans and schedules for Viking Mars 1975 have been reworked to minimize the impact on readiness dates committed to the Viking Project. An improved implementation schedule has been developed to manage hardware and software progress toward Viking configurations in the DSN. Several significant reviews have been held and some new problem areas identified. In the particular case of deep-space-station longitude accuracy, a task team has been formed to try to resolve the problem. Operations activity in support of Viking is introduced.

M081 DSN Progress Report for May–June 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XVI, pp. 13–14, August 15, 1973

The release of a preliminary version of the DSN Operations Plan for Viking has initiated the operations support for the Viking Mission. This article emphasizes the operations support in the planning phases of documentation, scheduling, training, and testing.

M082 DSN Progress Report for July–August 1973: Viking Mission Support

D. J. Mudgway and D. W. Johnston

Technical Report 32-1526, Vol. XVII, pp. 9–13, October 15, 1973

This article presents the initial application of the finalized Viking Mars 1975 hardware configurations to detailed Viking strategies and the associated operations procedures. Problems arising from the Viking Lander acquisition and command requirements are described and several strategies for solution are outlined.

MUHLEMAN, D. O.

M083 Measurement of General Relativistic Time Delay With Mariners 6 and 7

J. D. Anderson, P. B. Esposito, W. Martin, and D. O. Muhleman (California Institute of Technology)

Space Research XII, pp. 1623–1630, Akademie-Verlag, Berlin, 1971

For abstract, see Anderson, J. D.

MULHALL, B. D.

M084 DSN Progress Report for July–August 1973: A System Analysis of Error Sources in the Technique Used for Ionospheric Calibration of Deep Space Probe Radio Metric Data

K. W. Yip and B. D. Mulhall

Technical Report 32-1526, Vol. XVII, pp. 48–67, October 15, 1973

For abstract, see Yip, K. W.

MULLER, P. M.

M085 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

M086 Possible Variation of the Gravitational Constant Over the Elements

J. J. Gilvarry and P. M. Muller

Phys. Rev. Lett., Vol. 28, No. 25, pp. 1665–1669, June 19, 1972

For abstract, see Gilvarry, J. J.

MYKKELTVEIT, J.

M087 DSN Progress Report for May–June 1973: Weight Distributions of Some Irreducible Cyclic Codes

L. D. Baumert and J. Mykkeltveit (University of Bergen)

Technical Report 32-1526, Vol. XVI, pp. 128–131, August 15, 1973

For abstract, see Baumert, L. D.

NAKAMURA, Y.

N001 Solid Motor Diagnostic Instrumentation

Y. Nakamura, W. E. Arens, and W. S. Wuest

Technical Memorandum 33-656, December 1, 1973

This memorandum presents a review of typical surveillance and monitoring practices followed during the flight phases of representative solid-propellant upper stages and apogee motors, which was conducted to evaluate the need for improved flight-diagnostic instrumentation on future spacecraft. The findings of previous failure review boards were also reviewed and factored into the study to identify critical parameters and instrumentation requirements associated with these diagnostic traces. To bound the problem, the capabilities of the flight instrumentation package were limited to the detection of whether or not the solid motor was the cause of failure and to the identification of probable primary failure modes.

Conceptual designs of self-contained flight instrumentation packages capable of meeting these requirements were generated and their performance, typical cost, and unit characteristics determined. Comparisons of a continuous real-time and a threshold hybrid design were made on the basis of performance, mass, power, cost, and expected life. The results of this analysis substantiated the feasibility of a self-contained, independent flight-instrumentation module as well as the existence of performance margins by which to exploit growth option applications.

NAKASHIMA, A. M.

N002 Preliminary Nuclear Electric Propulsion (NEP) Reliability Study

T. M. Hsieh, A. M. Nakashima, and J. F. Mondt

Technical Memorandum 33-629, July 1, 1973

For abstract, see Hsieh, T. M.

NANCE, H. E.

N003 DSN Progress Report for November–December 1972: DSN Tracking System: Conversion to High-Speed Radio Metric Data

W. D. Chaney and H. E. Nance

Technical Report 32-1526, Vol. XIII, pp. 5–6, February 15, 1973

For abstract, see Chaney, W. D.

NASH, D. B.

N004 Experimental Results on Combined Ultraviolet–Proton Excitation of Moon Rock Luminescence

D. B. Nash

J. Geophys. Res., Vol. 78, No. 17, pp. 3512–3514, June 10, 1973

Laboratory studies of moon rocks have established beyond any reasonable doubt that solar-excited luminescence from the moon's surface is undetectable from earth observation with present methods. Yet it is still claimed by some lunar astronomers that a luminescence component exists in lunar light, especially during lunar eclipses.

Preliminary studies of combined ultraviolet (UV)–proton excitation indicated no detectable luminescence contribution from the UV irradiation component and thus no synergism. This article describes further studies of combined UV–proton irradiations of additional moon samples in which weak luminescence has been observed for UV excitation and a small apparent synergistic effect has been measured for combined UV–proton excitation.

NERHEIM, N. M.

N005 Supersonic Electrical-Discharge Copper Vapor Laser

G. R. Russell, N. M. Nerheim, and T. J. Pivirotto

Appl. Phys. Lett., Vol. 21, No. 12, pp. 565–567, December 15, 1972

For abstract, see Russell, G. R.

N006 Double-Discharge Copper Vapor Laser With Copper Chloride as a Lasant

C. J. Chen, N. M. Nerheim, and G. R. Russell

Appl. Phys. Lett., Vol. 23, No. 9, pp. 514–515, November 1, 1973

For abstract, see Chen, C. J.

NEUGEBAUER, M.

N007 Solar Wind Observations on the Lunar Surface With the Apollo-12 ALSEP

M. Neugebauer, C. W. Snyder, D. R. Clay, and B. E. Goldstein

Planet. Space Sci., Vol. 20, No. 20, pp. 1577–1591, October 1972

The Apollo-12 ALSEP solar wind spectrometer obtained data from the lunar surface starting November 20, 1969. To a first approximation, the general features of the positive ion flux depend only on the instrument's orientation and location in space relative to the Sun-Earth system. However, there are some detectable effects of the interaction of the solar wind with the local magnetic field and surface, including the deceleration of incident positive ions and the enhancement of fluctuations in the plasma. The expected asymmetry of sunset and sunrise times due to the motion of the Moon about the Sun is not observed. On one occasion, the solar wind was incident on the ALSEP site as early as 36 h (18°) before sunrise.

NEWBURN, R. L., JR.

N008 A Model of the Physical Properties of Comet Encke

F. W. Taylor, C. M. Michaux, and R. L. Newburn, Jr.

Technical Report 32-1590, October 1, 1973

For abstract, see Taylor, F. W.

N009 A Survey of the Outer Planets Jupiter, Saturn, Uranus, Neptune, Pluto, and Their Satellites

R. L. Newburn, Jr., and S. Gulkis

Space Sci. Rev., Vol. 14, No. 2, pp. 179–271, February 1973

A survey of current knowledge of Jupiter, Saturn, Uranus, Neptune, Pluto, and their satellites is presented. The best available numerical values are given for physical parameters, including orbital and body properties, atmospheric composition and structure, and photometric parameters. The more acceptable current theories of these bodies are outlined with thorough referencing offering access to the details.

NEWTON, J. W.

N010 DSN Progress Report for July–August 1973: Precise Measurement of Spacecraft Signal Power

J. W. Newton

Technical Report 32-1526, Vol. XVII, pp. 104–107, October 15, 1973

This article describes the precision signal-power measurement technique which is a computer-based method for the automatic measurement of signal power at the standard DSN receiver. Using sampled-data techniques, a table of spectral estimates is created from which accurate signal/noise ratios are derived and the signal strength computed. The process is continuous, fast, and automatic. Recent improvements give an extended dynamic range running from below −185 dBm to above −125 dBm and accuracies within 0.2 dB over this range.

NORMAN, R. A.

N011 A New Method for Calculating Correction Factors for Near-Field Gain Measurements

A. C. Ludwig and R. A. Norman

IEEE Trans. Anten. Prop., Vol. AP-21, No. 5, pp. 623–628, September 1973

For abstract, see Ludwig, A. C.

NORRIS, D. A.

N012 DSN Progress Report for May–June 1973: Hydrogen Maser Frequency Standard Automatic Tuning Servo

C. Finnie and D. A. Norris

Technical Report 32-1526, Vol. XVI, pp. 72–77, August 15, 1973

For abstract, see Finnie, C.

NORTON, H. N.

N013 Electro-Optical Measuring Instruments for Orbital Observations of the Planet Mars

H. N. Norton

Microtecnic, Vol. XXVII, No. 4, pp. 201–202, May 1973

Several interesting remote-sensing instruments were used for observations of the planet Mars by Mariner 9, which completed its mission in October 1972, 516 days after it was launched, and after 349 days in orbit around Mars. These instruments were a television system with separate narrow- and wide-angle cameras, an infrared radiometer, an ultraviolet spectrometer, and an infrared interferometer spectrometer. During the mission of Mariner 9, a total of 7329 television pictures of Mars and its satellites, Deimos and Phobos, were received on Earth. The entire planet was thus able to be mapped. 54×10^9 bits of scientific data were received via the telecommunications link from the spacecraft. The radiometer and the two spectrometers are specialized high-performance versions of related instruments used for industrial research and are therefore of general interest to the engineering community.

NORTON, R. H.

N014 Observation of the OH Radical in Betelgeuse

R. Beer, R. H. Norton, R. B. Hutchinson, D. L. Lambert (University of Texas), and J. V. Martonchik (University of Texas)

Mém. Soc. Roy. Sci. Liège, Vol. III, No. 6, p. 145, 1972

For abstract, see Beer, R.

O'CONNOR, D. E.

0001 Design and Operation of a 1000°C Lithium–Cesium Test System

L. G. Hays, G. M. Haskins, D. E. O'Connor, and J. Torola, Jr.

Technical Memorandum 33-633, December 1, 1973

For abstract, see Hays, L. G.

O'LEARY, B.

0002 Another Possible Post-Eclipse Brightening of Io

B. O'Leary (Hampshire College) and E. Miner

Icarus, Vol. 20, No. 1, pp. 18–20, September 1973

An apparent brightening of Io after eclipse reappearance on June 25, 1971 was observed from Kitt Peak (area scanning at 3500 Å) and Table Mountain (4000 Å). It is suggested that, in the future, coordinated observations employ area scanning in the ultraviolet.

ODD, C. W.

0003 Ground Level Ultraviolet Solar Flux in Pasadena, California

J. Ajello, J. King, Jr., A. L. Lane, and C. W. Odd

Bull. Am. Meteorol. Soc., Vol. 54, No. 2, pp. 114–115, February 1973

For abstract, see Ajello, J.

OHLSON, J. E.

0004 *DSN Progress Report for May–June 1973: Faraday Rotation Observations During the 1970 Pioneer 9 Solar Occultation*

A. R. Cannon (University of California, Berkeley), C. T. Stelzried, and J. E. Ohlson (Naval Postgraduate School)

Technical Report 32-1526, Vol. XVI, pp. 87–93, August 15, 1973

For abstract, see Cannon, A. R.

OLIVER, R. E.

0005 Furlable Spacecraft Antenna Development: Second Interim Report

R. E. Oliver and A. H. Wilson

Technical Memorandum 33-606, May 15, 1973

This memorandum describes recent activities at JPL directed toward the development of large, furlable spacecraft antennas using conical main reflectors. Development of two basic antenna configurations conceived at JPL and utilizing conical main reflectors has been pursued. A 4.3-m(14-ft)-diameter model based on the two-reflection conical–Gregorian concept and a 1.8-m(6-ft)-diameter model based on the four-reflection Quadreflex concept have been made and RF tested.

RF gain measurements for the 4.3-m(14-ft)-diameter conical–Gregorian model were 48.83 dB at X-band (8.448 GHz) and 37.82 dB at S-band (2.297 GHz). These gains correspond to efficiencies of 53.6 and 57.5%, respectively. RF gain measurements for the 1.8-m(6-ft)-diameter Quadreflex model were 47.59 dB at Ku-band (16.33 GHz) and 41.30 dB at X-band (8.448 GHz), corresponding to efficiencies of 58.6 and 51.5%, respectively.

OLLI, E. E.

0006 Temperature Dependence of the Accommodation Coefficient of Liquid-Helium Film

T. G. Wang, D. D. Elleman, E. E. Olli, and M. M. Saffren

Phys. Rev. Lett., Vol. 30, No. 11, pp. 485–487, March 12, 1973

For abstract, see Wang, T. G.

OLSEN, E. T.

0007 Radio Observations of Cygnus X-3 and the Surrounding Region

B. Gary, E. T. Olsen, and P. W. Rosenkranz

Nature Phys. Sci., Vol. 239, No. 95, pp. 128–130, October 23, 1972

For abstract, see Gary, B.

ONG, K. M.

0008 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

OTOSHI, T. Y.

0009 DSN Progress Report for November–December 1972: S/X-Band Experiment: Development of Special Telecommunications Development Laboratory Support Test Equipment

T. Y. Otoshi and O. B. Parham

Technical Report 32-1526, Vol. XIII, pp. 72–81, February 15, 1973

This article documents the design of an X-band down converter and a doppler-extractor receiver that were specially developed and supplied to the Telecommunications Development Laboratory in July 1971. The special equipment enabled preliminary tests to be made on the performance of a combined S/X-band radio system similar to that which will be used for the Mariner Venus–Mercury 1973 mission.

0010 DSN Progress Report for January–February 1973: S/X-Band Experiment: Zero Delay Device

T. Y. Otoshi and P. D. Batelaan

Technical Report 32-1526, Vol. XIV, pp. 73–80, April 15, 1973

This article describes a zero-delay device currently being developed for the S/X-band experiment. Preliminary group-delay and transmission-coefficient phase data are presented for some of the components in the zero-delay device.

0011 DSN Progress Report for March–April 1973:S/X-Band Experiment: Zero-Delay-Device Step Attenuator Evaluation

T. Y. Otoshi

Technical Report 32-1526, Vol. XV, pp. 84–87, June 15, 1973

This article presents test results for a coaxial step attenuator to be used in the zero-delay device for the S/X-band experiment. The test results at 182, 2113, 2295, 6302, and 8415 MHz indicate that the attenuator group-delay changes about 0.07 ns over a 69-dB range. Tests made over a temperature range from 4.4°C (40°F) to 37.8°C (100°F) indicate that group delay and phase changes, as functions of temperature, are small.

0012 DSN Progress Report for July–August 1973: S/X Experiment: Preliminary Tests of the Zero Delay Device

T. Y. Otoshi and P. D. Batelaan

Technical Report 32-1526, Vol. XVII, pp. 68–77, October 15, 1973

This article describes preliminary testing of the zero-delay device for the S/X band experiment performed at the Telecommunications Development Laboratory. The test setup consisted of a Block IV exciter, the zero-delay device under test, a Block III receiver for S-band reception, a Block IV receiver for X-band reception, and a Mini-Mu ranging machine. Group delay through the system was measured as a function of received signal level and zero-delay-device temperature. The test results are presented and discussed.

0013 Precision Reflectivity Loss Measurements of Perforated-Plate Mesh Materials by a Waveguide Technique

T. Y. Otoshi

IEEE Trans. Instr. Meas., Vol. IM-21, No. 4, pp. 451–457, November 1972

A waveguide method is described for improving the precision and accuracy of reflectivity loss measurements of perforated-plate mesh materials. Overall accuracies of the order of ±0.005 dB can be achieved through the use of a dual-channel tuned reflectometer system and high-precision insertion loss test set.

O014 An Analytical Expression for the Limits of Error in the Measurement of Reflection-Coefficient Phase

T. Y. Otoshi

IEEE Trans. Microwave Theor. Techniq., Vol. MTT-21, No. 3, pp. 151–153, March 1973

An exact analytical expression for calculating the limits of phase error that can occur when the reflection coefficient of a load is measured through a lossless two-port network is presented. An empirical expression previously reported agrees well with the exact expression, except when the reflection coefficients of the lossless two-port and the load are nearly the same in magnitude.

PALECKI, G. S.

P001 DSN Progress Report for May–June 1973: Measurement of High Isolation

G. S. Palecki

Technical Report 32-1526, Vol. XVI, pp. 94–96, August 15, 1973

A technique for measuring high isolation values of X-band components has been demonstrated. The test technique utilizes available commercial test equipment and provides swept-frequency data. Isolation up to 125 dB is readily measured.

PANCINO, M.

P002 DSN Progress Report for May–June 1973: Pioneer F and G Telemetry and Command Processor Core Dump Program

R. L. Chafin and M. Pancino

Technical Report 32-1526, Vol. XVI, pp. 174–177, August 15, 1973

For abstract, see Chafin, R. L.

PARHAM, O. B.

P003 DSN Progress Report for November–December 1972: S/X-Band Experiment: Development of Special Telecommunications Development Laboratory Support Test Equipment

T. Y. Otoshi and O. B. Parham

Technical Report 32-1526, Vol. XIII, pp. 72–81, February 15, 1973

For abstract, see Otoshi, T. Y.

PARKER, R. H.

P004 A Study of the Compatibility of Science Instruments With the Solar Electric Propulsion Space Vehicle

R. H. Parker, J. Ajello, A. Bratenahl, D. R. Clay, and B. Tsurutani

Technical Memorandum 33-641, October 15, 1973

This memorandum presents a study of the compatibility of science instruments with a solar-electric propulsion space vehicle. The study uses the space vehicle design developed by the Solar-Electric Propulsion System Integration Technology (SEPSIT) effort. Two payload sets for comet Encke missions (a slow flyby and a rendezvous), as well as several instruments which are not included in the two payload sets, are analyzed to determine requirements on the space vehicle imposed by the instruments in order to meet their objectives. Environmental requirements for the sets of instruments are developed and compared to both the SEPSIT design criteria and the environment as it is presently understood. Electromagnetic interference and field-of-view constraints are identified as the areas of most concern to science on solar-electric propulsion space vehicles.

P005 Effects of Proton Irradiation on Several Spacecraft Science Components

R. H. Parker

IEEE Trans. Nucl. Sci., Vol. NS-19, No. 6, pp. 156–159, December 1972

During the course of the Thermoelectric Outer Planets Spacecraft/Outer Planets Grand Tour programs and Mariner Jupiter/Saturn 1977, several models have been developed and used to analyze the radiation hazard to the spacecraft. During this time typical components found in space flight science instruments have been selected and, using very small sample sizes, tested to determine their capability to function properly before, after, and, in some cases, during exposures to energy equivalenced levels predicted by the models. This article describes the proton irradiation tests performed and analyzes the test results.

PARTHASARATHY, S. P.

P006 Experimental Evaluation of Fluctuating Density and Radiated Noise

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

Technical Memorandum 33-643, October 1, 1973

For abstract, see Massier, P. F.

P007 Evaluation of the Noise Autocorrelation Function of Stationary and Moving Noise Sources by a Cross Correlation Method

S. P. Parthasarathy

AIAA Preprint 73-186, AIAA Eleventh Aerospace Sciences Meeting, Washington, D.C., January 10–12, 1973

This article presents a theory for the evaluation of the autocorrelation function (or intensity and spectrum) in the frame of reference of motion of noise sources from known cross correlations. Stationary sources are considered first and then the theory is extended to moving sources such as those that occur in both subsonic and in supersonic jet flows. This method of obtaining the autocorrelation is illustrated by application to a high-temperature subsonic jet flow. The experimental values of the cross correlation obtained in the noise field are used together with a least squares method of inversion to determine the autocorrelation as a function of time and time delay.

PATAPOFF, M.

P008 Temperature and Pressure Dependence of CO_2 Extinction Coefficients

W. B. DeMore and M. Patapoff

J. Geophys. Res., Space Physics, Vol. 77, No. 31, pp. 6291–6293, November 1, 1972

For abstract, see DeMore, W. B.

PATTERSON, R. E.

P009 Parametric Performance Characteristics and Treatment of Temperature Coefficients of Silicon Solar Cells for Space Application

R. E. Patterson and R. K. Yasui

Technical Report 32-1582, May 15, 1973

This report presents the electrical performance characteristics of 2- and 10-Ω-cm n/p-type silicon solar cells at simulated solar intensities of 5, 50, 100, 140, 250, 400, 550, 700, and 850 mW/cm^2. At each intensity, the temperature was varied in increments of 20° between extremes of +160 and −160°C. Short-circuit current, open-circuit voltage, and maximum power are presented in graphical format. This report also describes three methods for predicting solar-cell electrical performance as a function of temperature and intensity. Two of the methods are suitable for use at extreme temperature-intensity conditions. These methods were used successfully to predict the performance of the short-circuit current, open-circuit voltage transducer on board the Mariner Mars 1971 spacecraft.

P010 Design and Flight Performance Evaluation of the Mariners 6, 7, and 9 Short-Circuit Current, Open-Circuit Voltage Transducers

R. E. Patterson

Technical Memorandum 33-603, April 15, 1973

The purpose of the short-circuit current, open-circuit voltage transducer is to provide engineering data to aid the evaluation of array performance during flight. This memorandum describes the design, fabrication, and calibration of these transducers and discusses their in-flight performance on board the Mariner 6, 7, and 9 spacecraft. No significant differences were observed in the in-flight electrical performance of the three transducers. There was no evidence of solar flares causing abrupt degradation, and no significant particulate-radiation cell degradation was observed. The transducers did experience significant "non-cell degradation" which refers to losses due to coverslides or adhesive darkening, increased surface reflection, or spectral shifts within coverslide assembly.

PAUL, C. K.

P011 Theoretical Weighting of Photogrammetric Equations

C. K. Paul

J. Surveying Mapping Div., Proc. ASCE, Vol. 98, No. SU2, pp. 127–135, November 1972

The fundamental resection formulas of photogrammetry suggest a weighting scheme based on the standard deviations of the ratios of image coordinates to focal length. These ratios are functions of random variables having *a posteriori* means and variances. A theoretical development and formulation of the standard deviations of these ratios indicate that (1) the weights are maximum at the photo principal point and decrease toward the photo-edges; and (2) the range of weight factors from center to edge is greater for smaller focal lengths. Weights vary by a factor of 2.00 for a camera focal length of 75 mm, 1.64 for a 100 mm focal length, 1.44 for 125 mm, 1.32 for 150 mm, 1.09 for 300 mm, 1.04 for 450 mm, and 1.02 for 600 mm.

PAWLIK, E. V.

P012 Ion Thruster Thermal Characteristics and Performance

L. C. Wen, J. D. Crotty, and E. V. Pawlik

J. Spacecraft Rockets, Vol. 10, No. 1, pp. 35–41, January 1973

For abstract, see Wen, L. C.

P013 Ion Thruster Performance Calibration

E. V. Pawlik, R. Goldstein, D. J. Fitzgerald, and R. W. Adams

J. Spacecraft Rockets, Vol. 10, No. 6, pp. 327–332, May 1973

The calibration of a typical 20-cm-diameter ion thruster was examined to determine performance penalties that must be assessed in projecting measured performance into a space environment. Four specific areas were investigated. These include sources of error inherent in the thruster (double ion content of the beam and beam spreading) and error sources peculiar to the test facility (back ingestion from the vacuum chamber and propellant flow rate measurements). The double ion content was measured and found to be as high as 5.5% at an arc voltage of 35V. Beam spreading reduced effective thrust on the order of 2.5%. Back ingestion was observed to become significant above tank pressures of 6×10^{-6} torr.

PEELGREN, M. L.

P014 Thermionic Reactor Ion Propulsion System (TRIPS)—Its Multi-mission Capability

M. L. Peelgren

AIAA Preprint 72-1060, AIAA/SAE Eighth Joint Propulsion Specialist Conference, New Orleans, Louisiana, November 29–December 1, 1972

The unmanned planetary exploration to be conducted the last two decades of this century includes many higher energy missions which tax all presently available propulsion systems beyond their limit. One candidate with the versatility and performance to meet these mission objectives is Nuclear Electric Propulsion (NEP). Additionally, the NEP System is feasible in orbit raising operations with the Shuttle or Shuttle/Tug combination. In this article a representative planetary mission is described (Uranus–Neptune flyby with probe) and geocentric performance and tradeoffs are discussed. The NEP system is described in more detail with particular emphasis on the power subsystem comprised of the thermionic reactor, heat rejection subsystem, and the neutron shield.

PENG, T. J.

P015 Thermomechanical Behavior of Rubberlike Materials

T. J. Peng and R. F. Landel

J. Polym. Sci., Pt. A-2: Polym. Phys., Vol. 10, No. 9, pp. 1681–1689, September 1972

A simple form of nonisothermal free energy function $A(\lambda_1, \lambda_2, \lambda_3, T)$ for rubberlike materials results from postulating that the entropy is a separable symmetric function of the extension ratios λ_i along the principal strain directions and considering the fundamental properties of rubberlike materials, i.e., that rubber elasticity is associated primarily with changes in entropy and the variation of elastic tension with changes in temperature is linear. The explicit representation of A is reduced to the Valanis–Landel strain energy function for isothermal cases.

PENZO, P. A.

P016 Mariner Jupiter/Saturn 1977—The Mission Frame

R. D. Bourke, R. F. Miles, Jr., P. A. Penzo, S. L. Van Dillen, and R. A. Wallace

Astronaut. Aeronaut., Vol. 10, No. 11, pp. 42–49, November 1972

For abstract, see Bourke, R. D.

PEREZ, R.

P017 DSN Progress Report for January–February 1973: DC Current Sensor

R. Perez

Technical Report 32-1526, Vol. XIV, pp. 173–177, April 15, 1973

A current sensor has been developed which is capable of measuring a differential dc current and also, within a few microseconds, detecting the burst of current caused by a high-voltage arc. This sensor was designed to measure the klystron body current and, in conjunction with a crowbar, protect the tube against internal high-voltage arcs. This article describes the operational characteristics of the current sensor and test results for the characteristics that were investigated.

PETERSON, L. E.

P018 Lunar Surface Radioactivity: Preliminary Results of the Apollo 15 and Apollo 16 Gamma-Ray Spectrometer Experiments

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

Science, Vol. 179, No. 4075, pp. 800–803, February 23, 1973

For abstract, see Metzger, A. E.

PHILLIPS, H. P.

P019 DSN Progress Report for July–August 1973: 64-Meter-Diameter Antenna Hydrostatic Bearing Runner Joint Leak Tests

G. P. Gale and H. P. Phillips

Technical Report 32-1526, Vol. XVII, pp. 89–92, October 15, 1973

For abstract, see Gale, G. P.

PHILLIPS, R. J.

P020 Mascons: Progress Toward a Unique Solution for Mass Distribution

R. J. Phillips, J. E. Conel, E. A. Abbott, W. L. Sjogren, and J. B. Morton

J. Geophys. Res., Vol. 77, No. 35, pp. 7106–7114, December 10, 1972

Through a series of analyses with high-altitude Lunar Orbiter and low-altitude Apollo 15 doppler gravity data, it is shown that the Serenity mascon is a thin body whose horizontal dimensions are well-determined and show a strong correlation with circular wrinkle ridge structure. Analysis to date has not uniquely determined the depth of the anomalous mass. However, geologic evidence strongly suggests that the mass excess is near the surface, because (1) the surface solution has a geometry highly suggestive of the partial filling of a ringed circular basin, and (2) the boundaries of the anomalous mass separate regions of shallow and deep mare flooding.

P021 Mars: Crustal Structure Inferred from Bouguer Gravity Anomalies

R. J. Phillips, R. S. Saunders, and J. E. Conel

J. Geophys. Res., Vol. 78, No. 23, pp. 4815–4820, August 10, 1973

Bouguer gravity has been computed for the equatorial region of Mars by differencing free air gravity and the gravity predicted from topographic variations. The free air gravity was generated from an eighth-order set of spherical harmonic coefficients. The gravity from topographic variations was generated by integrating a two-dimensional Green's function over each contour level. The Bouguer gravity indicates crustal inhomogeneities on Mars that we postulate are variations in crustal thickness. The Tharsis ridge is a region of thick continental type crust. The gravity data, structural patterns, topography, and surface geology of this region lead to the interpretation of the Tharsis topographic high as a broad crustal upwarp possibly associated with local formation of lower-density crustal material and subsequent rise of a thicker crust. The Amazonis region is one of several basins of relatively thin crust, analogous to terrestrial ocean basins. The Libya and Hellas basins, which are probable impact features, are also underlain by thin crust and are possible regions of mantle upwelling like those proposed earlier for mascon basins on the moon.

PHILLIPS, W. M.

P022 Postoperational Examination of an Externally Configured Thermionic Converter

W. M. Phillips

Technical Memorandum 33-597, March 15, 1973

An externally configured thermionic converter was operated for 200 h. The converter was disassembled and examined to determine internal changes as a result of operation. The metal/ceramic seals and all joints were unaffected by operation. Converter output voltage and operation time were sufficient to produce electrolysis of stabilized zirconia spacers used in the converter.

Surface analysis of the electrode surfaces indicated the presence of only oxygen, carbon, and silicon on the tungsten emitter. The niobium collector was, however, 25 to 40% covered with other elements. This coverage was composed of all elements present within the converter as construction materials except for silicon and tungsten, which were not detected on the collector, and carbon, which was detected only in small amounts.

P023 Uranium Nitride Behavior at Thermionic Temperatures

W. M. Phillips

Technical Memorandum 33-602, April 1, 1973

The feasibility of using uranium nitride for in-core thermionic applications was evaluated in electrically heated thermal-gradient tests and in flat-plate thermionic converters. These tests indicated that grain-boundary penetration of uranium nitride into both tungsten and rhenium will occur under thermal-gradient conditions. In the case of the tungsten thermionic converter, this led to grain-boundary rupture of the emitter and almost total loss of electrical output from the converter. It appears that uranium nitride is unsuitable for thermionic applications at the 2000 K temperatures used in these tests.

P024 Experimental Evaluation of Thermal Ratcheting Behavior in UO_2 Fuel Elements

W. M. Phillips

Technical Memorandum 33-622, July 1, 1973

The effects of thermal cycling of UO_2 at high temperatures has been experimentally evaluated to determine the rates of distortion of UO_2-clad fuel elements. Two cap-

sules were tested in the 1500°C range, one with a 50°C thermal cycle, the other with a 100°C thermal cycle. It was observed that eight hours at the lower cycle temperature produced sufficient UO_2 redistribution to cause clad distortion. The amount of distortion produced by the 100°C cycle was less than double that produced by the 50°C, indicating smaller thermal cycles would result in clad distortion. An incubation period was observed to occur before the onset of distortion with cycling similar to fuel swelling observed in-pile at these temperatures.

PICKERING, W. H.

P025 Some Practical Considerations in Technology Transfer

W. H. Pickering

AAS (American Astronautical Society) Science and Technology Book Series, Vol. 29, pp. 39–46, 1972

This article discusses the need for an effective transfer of the massive technological output of government science, resulting from space exploration, to the nation's socio-economic structure. Large-scale recommendations are offered, including magnitude, scope, and levels of transfer. A stronger commitment to technological transfer at every level of government is urged, as well as a scientific, engineering, and technological evaluation of the total situation in a systems sense.

PINIZZOTTO, R. F., JR.

P026 Ion–Molecule Reactions in Mixtures of Methane With Water, Hydrogen Sulfide, and Ammonia

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

J. Am. Chem. Soc., Vol. 95, No. 13, pp. 4107–4115, June 27, 1973

For abstract, see Huntress, W. T., Jr.

PINNELL, R. P.

P027 Nuclear Magnetic Resonance of Phosphorus Compounds: VII. Evidence for Steric Effects on the ^{31}P–^{77}Se Coupling and ^{31}P Chemical Shifts

R. P. Pinnell (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), C. A. Megerle (Joint Science Department: Scripps, Pitzer, and Claremont Men's Colleges), S. L. Manatt, and P. A. Kroon

J. Am. Chem. Soc., Vol. 95, No. 3, pp. 977–978, February 7, 1973

In connection with an investigation of the question of p_π–d_π bonding involving phosphorus, there has been occasion to synthesize and study the phosphorus nmr spectra of a number of triarylphosphines and triarylphosphine selenides. This article presents evidence that indicates how the nmr parameters for phosphorus whose local electronic environment is sterically perturbed can deviate from those expected on the basis of observed substituent effect correlations in less crowded molecules.

PIVIROTTO, T. J.

P028 Pressure and Current Effects on the Thermal Efficiency of an MPD Arc Used as a Plasma Source

T. J. Pivirotto

AIAA J., Vol. 11, No. 1, pp. 12–13, January 1973

In several types of laboratory experiments, such as magnetoplasmadynamic power generation, gas dynamic lasers, and basic gaseous plasma studies, a reliable and efficient continuous source of plasma is useful. This article describes one such source, the magnetoplasmadynamic arc operated without an applied magnetic field and presents data on its thermal efficiency, principal heat loss, and arc voltage over a range of argon mass flow rates not previously reported and at several arc currents. A comparison between this data and an existing empirical theory is also made with good agreement.

P029 Supersonic Electrical-Discharge Copper Vapor Laser

G. R. Russell, N. M. Nerheim, and T. J. Pivirotto

Appl. Phys. Lett., Vol. 21, No. 12, pp. 565–567, December 15, 1972

For abstract, see Russell, G. R.

PORTER, W. M.

P030 A Silicon Vidicon Camera for Slow Scan Operation

W. M. Porter

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 27–36, July 1973

A silicon vidicon camera has been designed, built, and tested to determine its potential for use aboard future Mariner spacecraft. Slow-scan operation is made possible by cooling the vidicon to −40°C. Cooling is achieved by a simple thermal conduction path between the vidicon and a radiator mounted on top of the camera head. The camera has been successfully operated under simulated space flight conditions and has survived vibration designed to simulate the launch of a Mariner spacecraft.

This article presents a description of the camera and its operation along with the results of the testing.

POSNER, E. C.

P031 Epsilon Entropy of Stochastic Processes With Continuous Paths

E. C. Posner and E. R. Rodemich

Ann. Prob., Vol. 1, No. 4, pp. 674–689, August 1973

This article shows that the epsilon entropy in the sup norm of a wide variety of processes with continuous paths on the unit interval is finite. In fact, the class coincides with the class of processes for which proofs of continuity have been given from a covariance condition. This suggests the conjecture that the epsilon entropy of any process continuous on the unit interval is finite in the sup norm of continuous functions. The epsilon entropy considered here is defined as the minimum Shannon entropy of any partition by sets of diameter at most epsilon of the space of continuous functions on the unit interval, where the probability is the one inherited from the given process. The proof proceeds by constructing partitions and estimating their entropy using probability bounds.

P032 Hiding and Covering in a Compact Metric Space

R. J. McEliece and E. C. Posner

Ann. Stat., Vol. 1, No. 4, pp. 729–739, July 1973

For abstract, see McEliece, R. J.

POTTER, P. D.

P033 DSN Progress Report for November–December 1972: Efficient Antenna Systems: A New Computer Program for the Design and Analysis of High-Performance Conical Feedhorns

P. D. Potter

Technical Report 32-1526, Vol. XIII, pp. 92–107, February 15, 1973

It is well known that paraboloidal-antenna aperture efficiency is enhanced by providing aperture illumination which approaches uniformity in amplitude, phase, and polarization. For dual-reflector antenna systems, such as those used in the DSN, a high degree of uniformity is possible by use of specially shaped reflector surfaces. As a long-range solution to the problem of achieving high aperture efficiency, this approach is attractive because it is inherently broadband and requires only a simple feedhorn of the type presently being utilized in the DSN. An alternate approach for achieving high aperture efficiency involves use of the existing antenna reflecting surfaces together with a more complex multimode feedhorn. This approach is attractive from an implementation standpoint. Preliminary experimental results are promising. The multimode technique does, however, suffer from bandwidth difficulties, at least with presently known mode-generation techniques. To assist and guide the multimode-feedhorn experimental effort, a new computer program has been developed which computes horn radiation patterns and bandwidth properties as a function of horn geometry. This article describes the analytical technique utilized and the agreement with existing experimental data.

P034 DSN Progress Report for March–April 1973: S- and X-Band Feed System

P. D. Potter

Technical Report 32-1526, Vol. XV, pp. 54–62, June 15, 1973

In support of the Mariner Venus/Mercury 1973 X-band experiment, it is necessary to provide the Mars Deep Space Station (DSS 14) 64-m-diameter antenna with a dual-frequency microwave feed system. To fulfill this requirement, a particularly attractive approach, the reflex feed system, has been implemented. Completion of the reflex-feed-system installation into the DSS 14 antenna was accomplished on January 24, 1973 and the performance of this system was evaluated from January 25 to January 30, 1973.

This evaluation established the reflex-feed-system performance as completely acceptable to the Mariner Venus/Mercury 1973 X-band experiment. In two cases, S-band antenna gain and S-band system noise temperature, the reflex-feed-system performance is actually superior to that of the standard S-band feed system. This article briefly reviews the feed-system design, including a new dichroic reflector developed at JPL, and presents performance data.

P035 DSN Progress Report for May–June 1973: Efficient Antenna Systems: Calibration of the Mars Deep Space Station 64-m Antenna System Noise Temperature Degradation Due to Quadripod Scatter

P. D. Potter

Technical Report 32-1526, Vol. XVI, pp. 22–29, August 15, 1973

In January 1973 extensive tests were performed of Mars Deep Space Station system noise temperature as a function of antenna elevation angle. These tests were performed under the ideal conditions of cold, dry weather, for which atmospheric absorption is well known. These data have been completely reduced and show a remark-

ably low residual to an elevation angle curve fit (less than 0.1 K).

A new computer program has been developed which yields ground noise contribution as a function of antenna pointing direction and (known) direct feed system spillover. By subtracting the atmospheric and direct spillover effects out of the measured system temperature data, the noise temperature contribution of the quadripod scattering has been established to an accuracy of a few tenths of a kelvin. At low to moderate elevation angles, the effect is roughly twice as severe as at zenith. In this reporting, the data reduction procedure, computer program formulation and the results are presented.

P036 DSN Progress Report for July–August 1973: Efficient Antenna Systems: DSS 14 64-Meter-Diameter Antenna Polarization Properties

P. D. Potter

Technical Report 32-1526, Vol. XVII, pp. 28–38, October 15, 1973

The polarization clock angle of a linearly polarized paraboloidal antenna is a function of both its secondary pattern characteristics and the pointing error relative to the antenna axis of revolution. For polarization-tracking experiments such as those planned in support of Project Helios, it is necessary to have an understanding of the relationship between the feed system polarization clock angle (a physically measured quantity) and the overall antenna-polarization clock angle. In particular, the S- and X-band reflex feed system introduces significant antenna-beam asymmetry which gives rise to polarization error.

In this article, the Mars Deep Space Station 64-m-diameter antenna secondary pattern characteristics are developed as a function of the reflex feed characteristics previously reported. The polarization-angle error is computed as a function of antenna-pointing error, typical antenna open-loop pointing errors are reviewed, and the expected polarization distortion is given.

P037 NASA/JPL Deep Space Network 64-Meter-Diameter Antenna Dual-Frequency Feed System

P. D. Potter

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 23–26, July 1973

To support the Mariner 1973 X-band experiment, it was necessary to implement a dual-frequency microwave feed system for the Cassegrainian-fed Mars Deep Space Station (DSS 14) 64-m-diameter antenna. This system must be capable of simultaneous low-noise reception at S- and X-bands and high-power transmission at S-band. This article describes the design and measured performance of the DSS 14 reflex feed system.

POWELL, W. B.

P038 Analysis of Transient Heat Flow to Thick-Walled Plates and Cylinders

W. B. Powell

Technical Report 32-1588, December 1, 1973

This report describes a methodology for the analysis of a transient temperature measurement made in a flat or curved plate subjected to convective heat transfer, such that the surface heat flux, the hot-gas temperature, and the gas heat-transfer coefficient can be determined. It is shown that if the transient temperature measurement is made at a particular point located nearly midway in the thickness of the plate there is an important simplification in the data analysis process, in that the factor relating the surface heat flux to the measured rate of rise of temperature becomes invariant for a Fourier Number above 0.60 and for all values of the Biot Number. Parameters are derived, tabulated, and plotted which enable straightforward determination of the surface heat flux, the hot-gas temperature, and the gas heat-transfer coefficient from the measured time, the interior temperature of the plate, the rate of rise of temperature, the plate thickness and curvature, and the mean thermal properties of the plate material at the test temperature.

The design and method of fabricating and installing a "thermocouple plug" which enables measurement of the temperature at an internal position within a plate with a minimum of thermal disturbance are described. It is shown that OFHC copper is the preferred material for the experimental determination of heat transfer parameters using the described methodology.

P039 Simplified Procedures for Correlation of Experimentally Measured and Predicted Thrust Chamber Performance

W. B. Powell

Technical Memorandum 33-548, April 1, 1973

Thrust-chamber performance should be evaluated in terms of an analytical model incorporating all the loss processes that occur in a real rocket motor. The Joint Army–Navy–NASA–Air Force (JANNAF) Performance Standardization Working Group has identified the important loss processes in the real thrust chamber, and has developed a methodology and a recommended procedure for predicting real thrust-chamber vacuum specific impulse.

Simplified equations, based on the JANNAF reference procedure for calculating vacuum specific impulse, are developed to relate the delivered performance (both vacuum specific impulse and characteristic velocity) to the ideal performance as degraded by the losses corresponding to a specified list of loss processes. These sim-

plified equations enable the various performance loss components, and the corresponding efficiencies, to be quantified separately (except that interaction effects are necessarily arbitrarily assigned in the process).

The loss and efficiency expressions presented can be used to evaluate experimentally measured thrust-chamber performance, to direct development effort into the areas most likely to yield improvements in performance, and to predict performance of related thrust-chamber configurations.

POYNTER, R.

P040 Thermal Radio Emission From Jupiter and Saturn

S. Gulkis and R. Poynter

Phys. Earth Planet. Interiors, Vol. 6, Nos. 1–3, pp. 36–43, December 1972

For abstract, see Gulkis, S.

PRICE, A. L.

P041 DSN Progress Report for November–December 1972: Development Support Group

E. B. Jackson and A. L. Price

Technical Report 32-1526, Vol. XIII, pp. 127–129, February 15, 1973

For abstract, see Jackson, E. B.

P042 DSN Progress Report for March–April 1973: DSN Research and Technology Support

E. B. Jackson, A. L. Price, and R. B. Kolbly

Technical Report 32-1526, Vol. XV, pp. 138–142, June 15, 1973

For abstract, see Jackson, E. B.

PURDUE, R. E.

P043 Tracking and Data System Support for the Pioneer Project: Pioneer 10—Prelaunch Planning Through Second Trajectory Correction: December 4, 1969 to April 1, 1972

A. J. Siegmeth, R. E. Purdue, and R. E. Ryan

Technical Memorandum 33-584, Vol. I, April 1, 1973

For abstract, see Siegmeth, A. J.

QUINN, R. B.

Q001 DSN Progress Report for January–February 1973: Low-Noise Receivers: Solid-State Pump Source for S-Band Traveling-Wave Masers

R. B. Quinn

Technical Report 32-1526, Vol. XIV, pp. 50–55, April 15, 1973

Low-noise traveling-wave masers have been used by the DSN for ten years. The requirements for the maser pump source are presently met by reflex klystron oscillators, although other microwave energy sources have been tested and evaluated on the basis of cost, reliability, output power, tunability, frequency stability, and power stability. Gunn-effect diode oscillators have recently reached a stage of development that makes them superior to the reflex klystron oscillator. This article describes a Gunn-effect oscillator that has been tested, packaged, and evaluated in the laboratory and is now ready for installation in the DSN.

RAFENSTEIN, M.

R001 Planetary Quarantine Computer Applications

M. Rafenstein

Technical Memorandum 33-661, December 15, 1973

This memorandum identifies the computer programs pertaining to planetary-quarantine activities within the Project Engineering Division, both at the Air Force Eastern Test Range and on site at JPL. A brief description of each program and the program inputs are given and typical program outputs are shown.

RAMANUJAM, H. R.

R002 Decomposition of Permutation Networks

H. R. Ramanujam

IEEE Trans. Computers, Vol. C-22, No. 7, pp. 639–643, July 1973

The problem of decomposing an arbitrary permutation of a large number of elements into a number of permutations of smaller numbers of elements has become important recently in rearrangeable switching networks and in interconnectors for computer peripheral and processing units. An algorithm was previously published for decomposing an arbitrary permutation of $n = d \times q$ elements into d permutations of q elements each and $(2q - 1)$ permutations of d elements each.

This article presents a modified version of that algorithm wherein a matrix, each of whose elements is a set of

integers, is used for obtaining the d permutations of q elements each. A simpler way of obtaining the $(2q - 1)$ permutations of d elements each is also given. The modified algorithm is similar to the back-track procedure in combinatorics and leads directly to an APL (a programming language) program for any divisor d of n.

RANDALL, L. P.

R003 Monitoring of Antarctic Dry Valley Drilling Sites

F. A. Morelli, R. E. Cameron, D. R. Gensel, and L. P. Randall (Northern Illinois University)

Antarctic J. U.S., Vol. VII, No. 4, pp. 92–94, July–August 1972

For abstract, see Morelli, F. A.

RANSFORD, G. A.

R004 Cartography and Orbit Determination Using TV Data From a Mars Orbiting Spacecraft

S. N. Mohan and G. A. Ransford

J. Astronaut. Sci., Vol. XX, No. 5, pp. 275–301, March–April 1973

For abstract, see Mohan, S. N.

R005 Moon Model—An Offset Core

G. A. Ransford and W. L. Sjogren

Nature, Vol. 238, No. 5362, pp. 260–262, August 4, 1972

This article utilizes a lunar model with an asymmetric core to explain the Moon's offset center of gravity, moments of inertia, mascons, maria basins, igneous rocks, and remanent magnetism. A possible evolution theory is also presented.

RASOOL, S. I.

R006 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484–516, October 1972

For abstract, see Kliore, A. J.

RATCLIFF, M. A., JR.

R007 Thermal Decomposition of Aliphatic Monoamino-Monocarboxylic Acids

P. G. Simmonds, E. E. Medley, M. A. Ratcliff, Jr., and G. P. Shulman

Anal. Chem., Vol. 44, No. 12, pp. 2060–2066, October 1972

For abstract, see Simmonds, P. G.

REDMANN, G. H.

R008 Information Management System for the California State Water Resources Control Board (SWRCB)

T. C. Heald and G. H. Redmann

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 53–61, January 1973

For abstract, see Heald, T. C.

REEDY, R. C.

R009 Lunar Surface Radioactivity: Preliminary Results of the Apollo 15 and Apollo 16 Gamma-Ray Spectrometer Experiments

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

Science, Vol. 179, No. 4075, pp. 800–803, February 23, 1973

For abstract, see Metzger, A. E.

REICHLEY, P. E.

R010 DSN Progress Report for March–April 1973: Simultaneous Detection of Pulsar Radiation at S- and X-Bands

P. E. Reichley, G. S. Downs, and G. A. Morris

Technical Report 32-1526, Vol. XV, pp. 133–137, June 15, 1973

The reflex feed system installed in January 1973 on the 64-m-diameter antenna at the Goldstone Deep Space Communications Complex was used to receive weak wide-band signals from pulsars. This article illustrates the use of wide-band sources of radiation to test multi-frequency antenna and receiver systems.

R011 Pulsar Detections at Frequencies of 8.4 and 15.1 GHz

G. S. Downs, P. E. Reichley, and G. A. Morris

Astrophys. J., Vol. 181, No. 3, Part 2, pp. L143–L146, May 1, 1973

For abstract, see Downs, G. S.

R012 Martian Topography and Surface Properties as Seen by Radar: The 1971 Opposition

G. S. Downs, R. M. Goldstein, R. R. Green, G. A. Morris, and P. E. Reichley

Icarus, Vol. 18, No. 1, pp. 8–21, January 1973

For abstract, see Downs, G. S.

REID, M. S.

R013 DSN Progress Report for January–February 1973: An Analysis of Noise Bursts on the 64-m-Diameter Antenna at Goldstone

M. S. Reid and C. T. Stelzried

Technical Report 32-1526, Vol. XIV, pp. 46–49, April 15, 1973

To provide more information for the noise-burst study, a comparison of noise bursts with the polarization-diversity S-band (PDS) and S-band megawatt-transmit (SMT) cones was made. For a period of approximately one month, the Mars Deep Space Station conducted its regular tracking missions alternately with the PDS and SMT cones. The S-band total-power-system temperature strip-chart recordings were analyzed for noise bursts. The conclusion is that, with respect to noise-burst performance, the PDS and SMT cones are similar.

R014 DSN Progress Report for January–February 1973: Tracking and Ground-Based Navigation: Precision System Temperature Measurements at Goldstone

M. S. Reid, R. A. Gardner, and A. J. Freiley

Technical Report 32-1526, Vol. XIV, pp. 60–67, April 15, 1973

This article reports the system operating noise-temperature performance of the low-noise research cones at the Goldstone Deep Space Communications Complex for the period October 1, 1972 through January 31, 1973. System temperatures are reported for the S-band radar operational cone at the Venus Deep Space Station (DSS 13), the S-band megawatt-transmit cone, and the polarization-diversity S-band cone at the Mars Deep Space Station (DSS 14). In addition to these measurements, system-temperature calibrations and antenna-elevation profiles are reported for the 26-m-diameter antenna at DSS 13 with and without the quadripod, and for the 64-m-diameter antenna at DSS 14 at S- and X-bands with and without the reflex feed system.

R015 DSN Progress Report for March–April 1973: S-Band Microwave Weather Project Data for CY 1971

M. S. Reid and R. W. D. Booth

Technical Report 32-1526, Vol. XV, pp. 88–91, June 15, 1973

The Weather Project forms part of an overall Radio Systems Development Project which seeks to optimize the spacecraft-to-ground communications link. The objective of the Weather Project is the statistical prediction of the performance of the DSN at X-band, and in the future at K-band. This article reports on the analysis of the S-band data for calendar year 1971, with results presented in tabular form. Cumulative frequency distribution of percentages of excess system temperature is tabulated as a function of time (whole year and quarterly periods) and of antenna elevation angle (four elevation ranges and for all elevation angles); averages, standard deviations, and confidence limits are also tabulated.

R016 DSN Progress Report for May–June 1973: The Development of a New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVI, pp. 78–86, August 15, 1973

A new broadband constant law detector has been developed for precision power measurements, radio metric measurements and other applications. It has a wider dynamic range and a more accurate square law response than has been available in the past. Other desirable characteristics are high-level dc output with immunity to ground loop problems, fast response times, ability to insert known time constants, and good thermal stability. This article briefly reviews the history of this development work and describes in detail the new detector and its performance.

R017 DSN Progress Report for September–October 1973: Improvement in the Accuracy of the New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVIII, pp. 94–98, December 15, 1973

Broadband square-law detectors are required for precision power measurements and a wide variety of other detector applications. A new square-law detector has been developed with a wider dynamic range and a more accurate square-law response than available in the past. Other desirable characteristics are high-level dc output with immunity to ground loop problems, fast response times, ability to insert known time constants, and good thermal stability. This article reports on further develop-

ment work and shows how the new detector can be operated in a programmable system with a ten-fold increase in accuracy.

REINBOLD, S. J.

R018 Earth–Moon Mass Ratio From Mariner 9 Radio Tracking Data

S. K. Wong and S. J. Reinbold

Nature, Vol. 241, No. 5385, pp. 111–112, January 12, 1973

For abstract, see Wong, S. K.

REISS, B. J.

R019 The Technology Transfer Process—Where's the Bridge

M. R. Licciarello (Science Applications, Inc.) and B. J. Reiss (City of Fresno)

AIAA Preprint 73-977, Third Urban Technology Conference and Technical Display, Boston, Massachusetts, September 25–28, 1973.

For abstract, see Licciarello, M. R.

REMBAUM, A.

R020 Alkali Metal Intercalates of Molybdenum Disulfide

R. B. Somoano; V. Hadek, and A. Rembaum

J. Chem. Phys., Vol. 58, No. 2, pp. 697–701, January 15, 1973

For abstract, see Somoano, R. B.

R021 The Polymerization of 3-Dimethylamino-n-Propyl Chloride and the Formation of Star-Shaped and Branched Polyelectrolytes

S. P. S. Yen, D. Casson, and A. Rembaum

Water-Soluble Polymers, pp. 291–312, Plenum Publishing Corporation, New York, 1973

For abstract, see Yen, S. P. S.

RENZETTI, N. A.

R022 DSN Progress Report for November–December 1972: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XIII, pp. 1–4, February 15, 1973

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.

R023 DSN Progress Report for January–February 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XIV, pp. 1–4, April 15, 1973

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.

R024 DSN Progress Report for March–April 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XV, pp. 1–4, June 15, 1973

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.

R025 DSN Progress Report for May–June 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XVI, pp. 1–4, August 15, 1973

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and un-

der 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.

R026 DSN Progress Report for July–August 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XVII, pp. 1–4, October 15, 1973

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.

R027 DSN Progress Report for September–October 1973: DSN Functions and Facilities

N. A. Renzetti

Technical Report 32-1526, Vol. XVIII, pp. 1–4, December 15, 1973

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.

R028 Tracking and Data System Support for the Pioneer Project: Pioneers 6–9. Extended Missions: July 1, 1971–July 1, 1972

N. A. Renzetti and A. J. Siegmeth

Technical Memorandum 33-426, Vol. XI, May 1, 1973

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.

R029 Tracking and Data System Support for the Mariner Mars 1971 Mission: Orbit Insertion Through End of Primary Mission

P. W. Barnum, N. A. Renzetti, G. P. Textor, and L. B. Kelly

Technical Memorandum 33-523, Vol. III, May 15, 1973

For abstract, see Barnum, P. W.

R030 Tracking and Data System Support for the Mariner Mars 1971 Mission: Extended Mission Operations

P. W. Barnum and N. A. Renzetti

Technical Memorandum 33-523, Vol. IV, December 15, 1973

For abstract, see Barnum, P. W.

RHEIN, R. A.

R031 The Formation of Hydrochloric Acid Aerosol From the Interaction of the Space Shuttle Rocket Exhaust With the Atmosphere

R. A. Rhein

Technical Memorandum 33-619, June 1, 1973

This memorandum describes the conditions of atmospheric temperature and relative humidity under which hydrochloric-acid aerosol is expected upon interaction of the proposed Space-Shuttle-rocket exhaust products with the atmosphere. It was found that aerosol is expected under conditions of cool weather and high humidity. Including the effect of after burning results in a predicted small increase in the amount of aerosol.

R032 Hydrochloric Acid Aerosol Formation by the Interaction of Hydrogen Chloride With Humid Air

R. A. Rhein

Technical Memorandum 33-658, November 15, 1973

This memorandum describes the conditions under which hydrochloric acid aerosol is predicted to occur through the interaction of hydrogen chloride gas with the water vapor in humid air. The liquid–gas phase equilibrium for the HCl–H_2O system is expressed in terms of relative

humidity and hydrogen chloride concentration in parts per million, units commonly used in pollution studies. The concentration of HCl (wt %) in the aerosol and the predicted concentration of aerosol (ppm) are presented.

R033 Some Environmental Considerations Relating to the Interaction of the Solid Rocket Motor Exhaust With the Atmosphere: Predicted Chemical Composition of Exhaust Species and Predicted Conditions for the Formation of HCl Aerosol

R. A. Rhein

Technical Memorandum 33-659, December 1, 1973

The exhaust products of a solid rocket motor (SRM) using as propellant 14% binder, 16% aluminum, and 70% (wt) ammonium perchlorate consist of hydrogen chloride (HCl) water, alumina, and other compounds. The equilibrium and some frozen compositions of the chemical species upon interaction with the atmosphere were computed. The conditions under which HCl interacts with the water vapor in humid air to form an aerosol containing hydrochloric acid were derived for various weight ratios of air/exhaust products. These computations were also performed for the case of a combined SRM and hydrogen-oxygen rocket engine. Regimes of temperature and relative humidity where this aerosol is expected were identified, and, within these regimes, the concentration of HCl in the aerosol and the weight fraction of aerosol to gas phase were plotted. Hydrochloric acid aerosol formation was found to be particularly likely in cool humid weather.

RHO, J. H.

R034 Spectrofluorometric Search for Porphyrins in Apollo 14 Surface Fines

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

"Proceedings of the Third Lunar Science Conference," *Supplement 3, Geochimica et Cosmochimica Acta*, Vol. 2, pp. 2149–2155, 1972

Benzene-methanol extracts of surface fines 14163, 179, 181 from Fra Mauro have been analyzed for porphyrins by means of fluorescence spectroscopy augmented by computer data treatment. Signal averaging and background removal revealed no porphyrin fluorescence features under conditions expected to produce a signal-to-noise ratio of 2:1 for 1.6×10^{-14} moles of extractable metalloporphyrin per gram of fines. These results are based upon the assumption that if metalloporphyrins were present they would be demetallated with the same efficiency as is Ni-mesoporphyrin IX.

R035 Fluorescence Spectroscopy

J. H. Rho

Space Life Sci., Vol. 3, No. 4, pp. 360–373, October 1972

This article discusses some practical aspects of the use of spectrophotofluorometers as applied to the organic analyses of returned lunar samples and other geological materials. Because of the single beam nature of spectrophotofluorometers many instrumental artifacts such as grating anomalies, irregular spectral output of light sources and response characteristics of photodetectors are apparent in sample spectra. In order to avoid some of these instrumental artifacts from influencing sample spectra, the performance characteristics of each optical component have been described and the necessity of instrumental calibration has been emphasized.

R036 Analyses of the Returned Lunar Surface Fines for Porphyrins

J. H. Rho, A. J. Bauman, E. A. Cohen, T. F. Yen (University of Southern California), and J. Bonner (California Institute of Technology)

Space Life Sci., Vol. 3, No. 4, pp. 415–418, October 1972

In the present studies, no porphyrins were found in the lunar surface fines collected from the Sea of Tranquillity by the Apollo 11 mission, from the Ocean of Storms by the Apollo 12 mission, and from the nonmare Fra Mauro Formation by the Apollo 14 expedition under the conditions in which porphyrins would have been detected had they been present in amounts as small as 10^{-14} mole.

R037 A Search for Porphyrin Biomarkers in Nonesuch Shale and Extraterrestrial Samples

J. H. Rho, A. J. Bauman, H. G. Boettger, and T. F. Yen (University of Southern California)

Space Life Sci., Vol. 4, No. 1, pp. 69–77, January 1973

An organic solvent extract of billion year old Nonesuch shale was examined for porphyrins by means of fluorometry and high resolution mass spectrometry. The extract appeared to contain at least three or more classes of porphyrins, one similar to tetraphenyl porphin and the others more complex. Many are apparently chelated with copper, nickel, zinc, iron and vanadyl and are highly aromatic. Also examined were the extracts of Apollo 11, 12 and 14 surface fines for porphyrins by spectrophotofluorometry but none were found even though the method used was capable of detecting 10^{-13} moles per gm of sample.

RHOADS, J. W.

R038 A Technique for Computation of Star Magnitudes Relative to an Optical Sensor

J. W. Rhoads

Technical Memorandum 33-586, December 30, 1972

This memorandum describes the theory and techniques used to compute star magnitudes relative to any optical detector (such as the Mariner Mars 1971 Canopus star tracker). Results for various star detectors are presented.

RIEBLING, R. W.

R039 Unmanned Planetary Spacecraft Chemical Rocket Propulsion

H. Burlage, Jr., W. Gin, and R. W. Riebling

J. Spacecraft Rockets, Vol. 9, No. 10, pp. 729–737, October 1972

For abstract, see Burlage, H., Jr.

RODEMICH, E. R.

R040 Epsilon Entropy of Stochastic Processes With Continuous Paths

E. C. Posner and E. R. Rodemich

Ann. Prob., Vol. 1, No. 4, pp. 674–689, August 1973

For abstract, see Posner, E. C.

ROSCHKE, E. J.

R041 Shear-Layer Flow Regimes and Wave Instabilities and Reattachment Lengths Downstream of an Abrupt Circular Channel Expansion

L. H. Back and E. J. Roschke

Trans. ASME, Ser. E: J. Appl. Mech., Vol. 39, No. 3, pp. 677–681, September 1972

For abstract, see Back, L. H.

ROSENKRANZ, P. W.

R042 Microwave Radiometric Measurements of Atmospheric Temperature and Water From an Aircraft

P. W. Rosenkranz, F. T. Barath, J. C. Blinn III, and E. J. Johnston

J. Geophys. Res., Vol. 77, No. 30, pp. 5833–5844, October 20, 1972

A five-channel microwave spectrometer operating near the 1.35-cm wavelength water vapor and the 5-mm wavelength oxygen resonances was flown in the NASA Convair 990 aircraft at altitudes near 12 km and used to infer layer thicknesses, water vapor, and liquid water abundances in the troposphere. The calibration of the spectrometer and a multiple regression method of interpretation of the data obtained from the flights are described. Possible errors from clouds and from the terrestrial surface are discussed. Values of atmospheric layer thicknesses, water vapor content, and liquid water content inferred from microwave data obtained over two frontal systems are presented. The inferred values of 1000- to 500-mb and 500- to 250-mb thicknesses agree with directly measured values to within 15 m at the places where the direct measurements were made. This agreement is equivalent to errors $<1^{\circ}$K in mean temperature.

R043 Microwave Emissivity of Ocean Foam and Its Effect on Nadiral Radiometric Measurements

P. W. Rosenkranz and D. H. Staelin (Massachusetts Institute of Technology)

J. Geophys. Res., Vol. 77, No. 33, pp. 6528–6538, November 20, 1972

Emissivities at a normal look angle have been computed for two models of ocean foam: a porous dielectric and a series of thin water films. The two models give nearly the same results for low foam densities. They show an emissivity spectrum that is roughly constant from 20 to 60 GHz and that tends to decrease at lower frequencies, depending on the thickness and density of the foam. A whitecap model (with graded density) shows less change of emissivity with frequency. Radiometric measurements are described that show the increased emissivity of rough seas due to white water at frequencies of 10.7, 19.4, 22.2, and 31.4 GHz. The effect of increased emissivity of the surface on radiometrically inferred values of atmospheric parameters such as water vapor and liquid water contents is discussed.

R044 Radio Observations of Cygnus X-3 and the Surrounding Region

B. Gary, E. T. Olsen, and P. W. Rosenkranz

Nature Phys. Sci., Vol. 239, No. 95, pp. 128–130, October 23, 1972

For abstract, see Gary, B.

ROSENTHAL, L. A.

R045 Generation of Narrow High Current Pulses

V. J. Menichelli and L. A. Rosenthal

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 38–43, January 1973

For abstract, see Menichelli, V. J.

R046 Impulsive Firing Method for Electroexplosive Devices

L. A. Rosenthal and V. J. Menichelli

IEEE Trans. Instr. Meas., Vol. IM-22, No. 2, pp. 119–123, June, 1973

An apparatus employing a half-sine-wave pulse for the adiabatic firing of electroexplosive devices is described. Basic energy equations and their interpretation are developed, and some experimental observations for characterizing an insensitive electroexplosive device are presented.

ROSS, R. G., JR.

R047 Slosh Testing of a Spherical Mercury Propellant Tank With Positive-Expulsion Diaphragm

R. G. Ross, Jr., and J. R. Womack

Technical Memorandum 33-632, July 15, 1973

A preliminary investigation was conducted to evaluate the lateral slosh characteristics of a 23-cm- (9-in.-) diam mercury propellant tank with a positive-expulsion diaphragm and 17.5% ullage. Data are presented for tank sinusoidal acceleration levels between 0.05 and 0.5 g at frequencies ranging from 5 to 50 Hz. Results indicate that the slosh characteristics are highly nonlinear at acceleration levels approaching those in flight, and depend heavily on the shape and stiffness of the diaphragm. Nyquist plots of driving force over acceleration are shown to be a useful tool for determining natural frequency, damping, and modal mass characteristics. A computerized nonlinear least-squares method for extracting the modal parameters from the Nyquist plots is described and results of applying the method are presented.

R048 *RUSAP—A Computer Program for the Calculation* of Roll-up Solar Array Performance Characteristics

R. G. Ross, Jr. and J. V. Coyner, Jr.

Technical Memorandum 33-634, October 1, 1973

RUSAP (Roll-up Solar Array Performance) is a FORTRAN IV computer program designed to determine the performance characteristics (power-to-weight ratio, blanket tension, structural-member section dimensions, and resonant frequencies) of large-area, roll-up solar arrays of the single-boom, tensioned-substrate design. The program includes the determination of the size and weight of the base structure supporting the boom and blanket and the determination of the blanket tension and deployable boom stiffness needed to achieve the minimum-weight design for a specified frequency for the first mode of vibration. This memorandum provides a complete listing of the program, a description of the theoretical background, and all information necessary to use the program.

R049 Optimum Shell Design

A. M. Salama and R. G. Ross, Jr.

AIAA J., Vol. 11, No. 3, pp. 366–368, March 1973

For abstract, see Salama, A. M.

ROURKE, K. H.

R050 DSN Progress Report for November–December 1972: Filtering Dual-Frequency Radio Metric Data

K. H. Rourke

Technical Report 32-1526, Vol. XIII, pp. 66–71, February 15, 1973

This article introduces a technique for reducing the effect of ionospheric and space-plasma charged particles on radio metric measurements. Development of the method is motivated by the difficulty in obtaining complete, two-way range calibrations when dual-frequency measurements are available for only the radio downlink. Using least-squares theory, estimation techniques are derived that allow the downlink calibration to be "fed back" to correct unobserved uplink errors. Plausible numerical examples are presented, indicating that such techniques are applicable to precision range measurements of two-station tracking.

R051 DSN Progress Report for September–October 1973: Spacecraft Orbit Determination Using Long Tracking Arcs

J. K. Campbell and K. H. Rourke

Technical Report 32-1526, Vol. XVIII, pp. 57–65, December 15, 1973

For abstract, see Campbell, J. K.

ROWE, W. M.

R052 Thermoelastic Analysis of Solar Cell Arrays and Their Material Properties

A. M. Salama, W. M. Rowe, and R. K. Yasui

Technical Memorandum 33-626,
September 1, 1973

For abstract, see Salama, A. M.

RUIZ, R. M.

R053 A User's Guide to the Mariner 9 Television Reduced Data Record

J. B. Seidman, W. B. Green, P. L. Jepsen, R. M. Ruiz, and T. E. Thorpe

Technical Memorandum 33-628,
September 1, 1973

For abstract, see Seidman, J. B.

RUSCH, W. V. T.

R054 Determination of the Maximum Scan-Gain Contours of a Beam-Scanning Paraboloid and Their Relation to the Petzval Surface

W. V. T. Rusch and A. C. Ludwig

IEEE Trans. Anten. Prop., Vol. AP-21, No. 2, pp. 141–147, March 1973

The scan-plane fields in the focal region of a beam-scanning paraboloid are determined from physical optics. Amplitude and phase contours are presented, and comparisons are made with the geometrical-optics results. Contours for maximum scan-gain are determined as a function of F/D and illumination taper and compared with the Petzval surface. Unless the F/D is very large or spillover is excessive, a higher scan gain is achieved when the axis of a directional feed is parallel to the axis of the reflector than when the feed is directed toward the vertex. The contour of maximum scan-gain is a function of both illumination taper and F/D. In general, larger F/D values tend to have a maximum-gain contour close to the focal plane, while the smaller F/D values tend to have a maximum-gain contour closer to the Petzval surface. Increasing the illumination taper moves the maximum-gain contour closer to the Petzval surface. Normalized maximum-gain contours are presented as a function of beamwidths of scan. The frequency dependence of these results is discussed.

R055 Net-Field Polarization in a Magnetically Biased Plasma

W. V. T. Rusch (University of Southern California) and C. T. Stelzried

Radio Sci., Vol. 7, No. 12, pp. 1131–1141, December 1972

The net-field polarization of a plane wave propagating in a magnetically biased cold plasma has been treated in a systematic fashion. Under quasi-longitudinal conditions the polarization transformations are particularly simple and as such have been treated in the literature. However, under more general conditions the polarization transformations are relatively complex. The axial ratio, tilt angle, rotation rate, and polarization sense all become functions of the initial conditions and the constants of the medium. Under quasi-longitudinal conditions the polarization ellipse rocks between two extremes, while the axial ratio also changes periodically between a minimum and a maximum value. The wide variety of polarization transformations available suggests the usefulness of slabs of magnetically biased plasma to synthesize microwave polarizers and depolarizers. The theory of net-field polarization when applied to data obtained during the 1968 solar occultation of *Pioneer 6* verified that the usual quasi-longitudinal approximation (Faraday rotation) is adequate to describe S-band polarization in the solar corona.

RUSSELL, G. R.

R056 Supersonic Electrical-Discharge Copper Vapor Laser

G. R. Russell, N. M. Nerheim, and T. J. Pivirotto

Appl. Phys. Lett., Vol. 21, No. 12, pp. 565–567, December 15, 1972

A copper vapor laser, utilizing a pulsed discharge transverse to a supersonic flow of copper vapor, argon, and helium and oscillating at 5106 and 5782 Å, has been built and tested. Laser energy densities per pulse of 2.5 μJ cm^{-3} have been achieved to date. Laser pulse widths of up to 185 ns have been obtained with delay times after initiation of the current pulse of 220–250 ns. Both the delay time and pulse width are in good agreement with theoretical predictions. Quenching of the laser pulse is shown to be due to a rapid increase in the differential pumping of the lasing levels from the ground state because of a decay in the electron temperature.

R057 Double-Discharge Copper Vapor Laser With Copper Chloride as a Lasant

C. J. Chen, N. M. Nerheim, and G. R. Russell

Appl. Phys. Lett., Vol. 23, No. 9, pp. 514–515, November 1, 1973

For abstract, see Chen, C. J.

RYAN, R. E.

R058 *Tracking and Data System Support for the Pioneer* Project: Pioneer 10—Prelaunch Planning Through Second Trajectory Correction: December 4, 1969 to April 1, 1972

A. J. Siegmeth, R. E. Purdue, and R. E. Ryan

Technical Memorandum 33-584, Vol. I, April 1, 1973

For abstract, see Siegmeth, A. J.

RYDGIG, R. C.

R059 DSN Progress Report for January–February 1973: Overseas 64-m Station Implementation Status

R. C. Rydgig

Technical Report 32-1526, Vol. XIV, pp. 146–148, April 15, 1973

This article presents the activities associated with implementing the overseas 64-m-diameter antenna stations in Australia (DSS 43) and Spain (DSS 63). It gives the current status of the project, describes the system configuration as implemented, and discusses the activities involved in reaching the desired configuration.

SAFFREN, M. M.

S001 Temperature Dependence of the Accommodation Coefficient of Liquid-Helium Film

T. G. Wang, D. D. Elleman, E. E. Olli, and M. M. Saffren

Phys. Rev. Lett., Vol. 30, No. 11, pp. 485–487, March 12, 1973

For abstract, see Wang, T. G.

SALAMA, A. M.

S002 Thermoelastic Analysis of Solar Cell Arrays and Their Material Properties

A. M. Salama, W. M. Rowe, and R. K. Yasui

Technical Memorandum 33-626, September 1, 1973

This memorandum presents a thermoelastic stress analysis procedure for predicting the thermally induced stresses and failures in silicon solar cell arrays. A prerequisite for the analysis is the characterization of the temperature-dependent thermal and mechanical properties of the solar cell materials. Extensive material property testing was carried out in the temperature range −200 to +200°C for the filter glass, P- and N-type silicon, interconnector metals, solder, and several candidate silicone rubber adhesives. Results are included.

The analysis procedure is applied to several solar cell array design configurations, which were tested in the Space Molecular Sink. Results of the analysis indicate the optimum design configuration with respect to compatible materials, effect of the solder coating, and effect of the interconnector geometry. Good agreement was found between results of the analysis and the test program.

S003 Optimum Shell Design

A. M. Salama and R. G. Ross, Jr.

AIAA J., Vol. 11, No. 3, pp. 366–368, March 1973

Two methods for obtaining the minimum weight of rotational shells under certain constraints are compared. The constraints may be one or any combination of (1) manufacturing limits on the shell thickness (2) constraints on the jth buckling load or the mth natural frequency (3) a maximum allowable deflection may be required or (4) using a suitable yield criterion, the shell may be required to withstand the applied loads without yielding.

The two minimization techniques employed here are the simplex method and the variable metric method. While the simplex method requires only function evaluation during the search, the variable metric method requires both function and partial derivative evaluation. The objective function to be minimized is the shell total weight (or material volume) subjected to one or more of the above mentioned constraints.

SALOMON, P. M.

S004 Evaluation of the Electro-optic Direction Sensor: Final Report

A. R. Johnston and P. M. Salomon

Technical Memorandum 33-598, February 1, 1973

For abstract, see Johnston, A. R.

SANDER, M. J.

S005 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

SATO, T.

S006 Search for Small-Scale Anisotropy in the 2.7° K Cosmic Background Radiation at a Wavelength of 3.56 Centimeters

R. L. Carpenter (California State University, Los Angeles), S. Gulkis, and T. Sato

Astrophys. J., Vol. 182, No. 2, Pt. 2, pp. L61–L64, June 1, 1973

For abstract, see Carpenter, R. L.

SAUER, C. G., JR.

S007 SEP Thrust Subsystem Performance Sensitivity Analysis

K. L. Atkins, C. G. Sauer, Jr., and D. J. Kerrisk

Technical Memorandum 33-611, August 15, 1973

For abstract, see Atkins, K. L.

SAUNDERS, R. S.

S008 Mars: Crustal Structure Inferred from Bouguer Gravity Anomalies

R. J. Phillips, R. S. Saunders, and J. E. Conel

J. Geophys. Res., Vol. 78, No. 23, pp. 4815–4820, August 10, 1973

For abstract, see Phillips, R. J.

SAVAGE, J. E.

S009 DSN Progress Report for November–December 1972: Matrix Multiplication With Fixed Matrices and Polynomial Evaluation With Fixed Polynomials

J. E. Savage

Technical Report 32-1526, Vol. XIII, pp. 194–202, February 15, 1973

It has been shown that the conventional method for computing $m \times n$ matrix-vector products and Horner's rule for evaluating polynomials are optimal when matrix and vector elements as well as polynomial coefficients and polynomial variables are indeterminate. This article treats the calculation of matrix-vector products and the evaluation of polynomials when the matrix elements and polynomial coefficients are known and drawn from a set of size s. It is shown that the algorithms which are optimal for indeterminate matrix entries and polynomial coefficients are nonoptimal when s is fixed and the entries and coefficients are known. Good algorithms for this case are given and tight bounds are derived on the combinational complexity of the most complex matrix-vector function and the most complex polynomial-evaluation function.

SCHINDLER, R. A.

S010 An Interference Spectrometer for the Remote Sensing of Pollutants

R. A. Schindler

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 714–715, September 1972

A small, high-resolution interference spectrometer for sensing environmental pollutants from spacecraft or aircraft has been developed. The instrument takes less than 3 min to generate an interferogram of the electromagnetic radiation in the 1.2–5.5 μ wavelength interval (8000–1800 cm^{-1}) which can be transformed into a spectrum displaying a resolution 0.2 cm^{-1}. The high speed with which the interferogram can be recorded is sufficient to make the instrument usable in a 1000-km altitude polar orbiting satellite for a global survey of pollutants. The resolution capability and wavelength coverage is such that unequivocable identifications and concentration measurements can be made of many molecules such as CO, NO_2 and O_3 by the methods of high-resolution IR spectroscopy.

SCHMIT, D. D.

S011 From Earth to Mars Orbit—Mariner 9 Propulsion Flight Performance With Analytical Correlations

M. J. Cork, R. L. French, C. J. Leising, and D. D. Schmit

AIAA Preprint 72-1185, AIAA/SAE Eighth Joint Propulsion Specialist Conference, New Orleans, Louisiana, November 29–December 1, 1972

For abstract, see Cork, M. J.

SCHUMACHER, L.

S012 Mariner Mars 1971 Attitude Control Subsystem Flight Performance

L. Schumacher

Technical Memorandum 33-600, March 15, 1973

This report describes the flight performance of the Mariner Mars 1971 Attitude Control Subsystem. Each phase of the mission is delineated and the attitude control subsystem performance is evaluated within the observed operational environment. Performance anomalies are introduced and discussed briefly within the context of general performance. More serious problems, such as the sun-sensor-interface incompatibility, gas-valve leaks, and scan-platform dynamic-coupling effects are given detailed analytical consideration. It is concluded that the Mariner Mars 1971 attitude control subsystem flight performance was satisfactory.

S013 Mariner Mars 1971 Sun Sensor Model Development and Simulation

L. Schumacher

Technical Memorandum 33-610, May 1, 1973

The Mariner Mars 1971 spacecraft was launched with an incorrectly sized resistor at the Sun-sensor circuit interface with its power supply. The design error caused 72 days of anomalous spacecraft operation. This memorandum analyzes the Sun-sensor flight-performance data and the results of a newly developed cruise-sensor life test.

A set of mathematical models was constructed which closely approximated the observed Sun-sensor flight and laboratory test results. These models revealed that (1) the aging phenomena in the sintered-cadmium-sulfide light detector varies across the detector width in proportion to the illumination history, (2) the current cruise Sun-sensor design is extremely sensitive to changes in the reflected illumination within the sensor housing, (3) the reflected illumination within the detector housing is proportional to the area and intensity of the solar disk observed at the spacecraft, and (4) the acquisition Sun sensor becomes a low-impedance path across the sensor bridge when in the vicinity of a large-angular-diameter, low-intensity light source. It is concluded that a computer model can be developed which will accurately predict Sun-sensor performance in a variety of flight conditions.

S014 Analysis and Simulation of the Mariner Mars 1971 Scan Platform: Spacecraft Dynamic Interaction

L. Schumacher

Technical Memorandum 33-624, August 15, 1973

The Mariner spacecraft have instrument platforms, antennas, etc., which must move relative to the attitude controlled spacecraft bus structure. As the appendages are moved, reaction forces and torques are produced disturbing the spacecraft attitude. This memorandum develops the equations of motion which describe the dynamic interaction between the spacecraft bus and the movable appendages about a single axis, evaluates the effect of the dynamic interaction on the attitude-control subsystem with computer simulations, and makes design recommendations to reduce the impact of this interaction on future attitude-control subsystems.

SCULL, J. R.

S015 The Mariner Mars 1971 Orbiter

J. R. Scull

Proceedings of the Fifth International Federation of Automatic Control World Congress, Paris, France, June 12–17, 1972, pp. 17.3.1–17.3.10

The Mariner Mars 1971 (MM'71) orbiter spacecraft, launched toward Mars in the spring of 1971, was designed to offer the first opportunity for sustained observations in the near vicinity of another planet of our solar system. Primary differences between the MM'71 spacecraft and previous Mariners lie in the systems required for injection into planetary orbit and for orbital operations. New systems include a 136-kg-thrust rocket engine, a completely redesigned autopilot having compensation for large thrust and center of gravity offsets, a 2-degree-of-freedom thrust gimballing control system, and a four times larger Central Computer and Sequencer memory to handle the greater number and complexity of commands during orbital injection and operations.

Specific descriptions are given of the MM'71 orbiter mission and system design; the trajectory and orbit characteristics; the new guidance, control, computer, and navigation systems; and the changes in the mission operations system required to handle the increased flow of both data and commands from previous planetary missions.

SEIDEL, B. L.

S016 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484–516, October 1972

For abstract, see Kliore, A. J.

S017 The Shape of Mars From the Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, and M. J. Sykes

Icarus, Vol. 17, No. 2, pp. 517–524, October 1972

For abstract, see Cain, D. L.

S018 S Band Radio Occultation Measurements of the Atmosphere and Topography of Mars with Mariner 9: Extended Mission Coverage of Polar and Intermediate Latitudes

A. J. Kliore, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4331–4351, July 10, 1973

For abstract, see Kliore, A. J.

S019 Approximations to the Mean Surface of Mars and Mars Atmosphere Using Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4352–4354, July 10, 1973

For abstract, see Cain, D. L.

SEIDMAN, J. B.

S020 A User's Guide to the Mariner 9 Television Reduced Data Record

J. B. Seidman, W. B. Green, P. L. Jepsen, R. M. Ruiz, and T. E. Thorpe

Technical Memorandum 33-628, September 1, 1973

The Mariner 9 television experiment used two cameras to photograph Mars from an orbiting spacecraft. For quantitative analysis of the image data transmitted to Earth, the pictures were processed by digital computer to remove camera-induced distortions. The removal process was performed by the JPL Image Processing Laboratory (IPL) using calibration data measured during prelaunch testing of the cameras. The Reduced Data Record (RDR) is the set of data which results from the distortion-removal, or "decalibration," process. The principal elements of the RDR are numerical data on magnetic tape and photographic data. Numerical data are the result of correcting for geometric and photometric distortions and residual-image effects. Photographic data are reproduced on negative and positive transparency films, strip contact and enlargement prints, and microfiche positive transparency film. The photographic data consist of two versions of each TV frame created by applying two special enhancement processes to the numerical data.

This memorandum describes the RDR data, including picture identification, numerical data, picture data, picture label information, microfiche, and RDR data tapes; data processing algorithms; picture processing documentation, including the particulars of the IPL Enhancement Catalog; and limb profile plots.

S021 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

SEQUEIRA, E. A.

S022 Mariner 9 Solar Array Design, Manufacture, and Performance

E. A. Sequeira

Technical Memorandum 33-615, May 15, 1973

Throughout the Mars orbital mission, the Mariner 9 solar array successfully supported the power requirements of the spacecraft without experiencing anomalies. Basically, the design of the solar array was similar to those of Mariners 6 and 7; however, Mariner 9 had the additional flight-operational requirement to perform in a Mars-orbit-environment mode. The special array tests provided information on the current–voltage characteristics and array degradation. Tests indicated that total solar-array current degradation was 3.5%. Flight data also verified that the solar panels had successfully survived the Sun occultation periods without additional degradation or failures. Final array tests indicated very close correlation between predicted and actual flight-array performance with no significant additional current degradation.

SHAPIRO, I. I.

S023 Mariner 9 Celestial Mechanics Experiment: A Status Report

J. Lorell and I. I. Shapiro (Massachusetts Institute of Technology)

J. Geophys. Res., Vol. 78, No. 20, pp. 4327–4329, July 10, 1973

For abstract, see Lorell, J.

SHAW, D. T.

S024 Measurement of Electron-Ion Recombination Rate of a Dense High-Temperature Cesium Plasma

C. J. Chen, J. Wu (State University of New York), F. T. Wu (State University of New York), and D. T. Shaw (State University of New York)

J. Appl. Phys., Vol. 44, No. 7, pp. 3052–3054, July 1973

For abstract, see Chen, C. J.

SHINOZUKA, M.

S025 On the First-Excursion Probability in Stationary Narrow-Band Random Vibration, II

J.-N. Yang and M. Shinozuka (Columbia University)

Trans. ASME, Ser. E: J. Appl. Mech., Vol. 39, No. 3, pp. 733–738, September 1972

For abstract, see Yang, J.-N.

SHOEMAKE, G. R.

S026 A Portable Self-Contained Gas Chromatograph

M. R. Stevens, C. E. Giffin, G. R. Shoemake, and P. G. Simmonds

Rev. Sci. Instr., Vol. 43, No. 10, pp. 1530–1534, October 1972

For abstract, see Stevens, M. R.

SHULMAN, G. P.

S027 Thermal Decomposition of Aliphatic Monoamino-Monocarboxylic Acids

P. G. Simmonds, E. E. Medley, M. A. Ratcliff, Jr., and G. P. Shulman

Anal. Chem., Vol. 44, No. 12, pp. 2060–2066, October 1972

For abstract, see Simmonds, P. G.

SHUMATE, M. S.

S028 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

S029 Beat-Frequency Measurements Between $C^{12}O_2{}^{16}$ and $C^{12}O_2{}^{18}$ Lasers

R. T. Menzies and M. S. Shumate

IEEE J. Quantum Electron., Vol. QE-9, No. 8, p. 862, August 1973

For abstract, see Menzies, R. T.

SIEGMETH, A. J.

S030 Tracking and Data System Support for the Pioneer Project: Pioneers 6–9. Extended Missions: July 1, 1971–July 1, 1972

N. A. Renzetti and A. J. Siegmeth

Technical Memorandum 33-426, Vol. XI, May 1, 1973

For abstract, see Renzetti, N. A.

S031 Tracking and Data System Support for the Pioneer Project: Pioneer 10—Prelaunch Planning Through Second Trajectory Correction: December 4, 1969 to April 1, 1972

A. J. Siegmeth, R. E. Purdue, and R. E. Ryan

Technical Memorandum 33-584, Vol. I, April 1, 1973

This report describes the Tracking and Data System support of the launch, near-Earth, and deep-space phases (through second trajectory correction) of the Pioneer 10 mission, which sent a Pioneer spacecraft into a flyby of Jupiter that would eventually allow the spacecraft to escape the solar system. During this period, scientific instruments aboard the spacecraft registered information about interplanetary particles and fields, and the radio metric data generated by the DSN 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.

SIMMONDS, P. G.

S032 Thermal Decomposition of Aliphatic Monoamino-Monocarboxylic Acids

P. G. Simmonds, E. E. Medley, M. A. Ratcliff, Jr., and G. P. Shulman

Anal. Chem., Vol. 44, No. 12, pp. 2060–2066, October 1972

Products from the thermal decompositions of a selected group of aliphatic monoamino-monocarboxylic acids have been analyzed by combined gas chromatography–mass spectrometry. Careful identification of both major and minor fragments suggests that, with the possible exception of glycine, amino acids of the aliphatic series decompose by a common reaction pathway. The primary decomposition is one of decarboxylation to yield an amine as the major product. Subsequent decomposition or reaction of the amine leads to the formation of nitriles and *N*-aklylaldimines as significant secondary products.

S033 A Portable Self-Contained Gas Chromatograph

M. R. Stevens, C. E. Giffin, G. R. Shoemake, and P. G. Simmonds

Rev. Sci. Instr., Vol. 43, No. 10, pp. 1530–1534, October 1972

For abstract, see Stevens, M. R.

SIMMS, W. T.

S034 A New Ion and Electron Detector for Ion Cyclotron Resonance Spectroscopy

W. T. Huntress, Jr., and W. T. Simms

Rev. Sci. Instr., Vol. 44, No. 9, pp. 1274–1277, September 1973

For abstract, see Huntress, W. T., Jr.

SIMON, M. K.

S035 The Theory, Design, and Operation of the Suppressed Carrier Data-Aided Tracking Receiver

M. K. Simon and J. C. Springett

Technical Report 32-1583, June 15, 1973

This report describes a viable, efficient, and easily mechanized carrier-regenerating receiver for use in suppressed carrier-tracking systems. The receiver, referred to as a data-aided receiver (DAR), incorporates a data-aided loop (DAL) which provides the required carrier reference signal. The DAL employs the principle of decision feedback and as such is more efficient than other forms of suppressed carrier-tracking loops.

The analysis, design, and implementation of the DAR are covered in detail. Performance comparisons and mechanization tradeoffs are made, wherever possible, with discrete carrier systems and other suppressed carrier systems presently in use. Experimental performance verification is given throughout in support of the theory presented.

S036 L-Orthogonal Signal Transmission and Detection

W. C. Lindsey (University of Southern California) and M. K. Simon

IEEE Trans. Commun., Vol. COM-20, No. 5, pp. 953–960, October 1972

For abstract, see Lindsey, W. C.

S037 On the Detection of Differentially Encoded Polyphase Signals

W. C. Lindsey (University of Southern California) and M. K. Simon

IEEE Trans. Commun., Vol. COM-20, No. 6, pp. 1121–1128, December 1972

For abstract, see Lindsey, W. C.

S038 The Performance of a Noncoherent FSK Receiver Preceded by a Bandpass Limiter

M. K. Simon and J. C. Springett

IEEE Trans. Commun., Vol. COM-20, No. 6, pp. 1128–1136, December 1972

Many applications of the bandpass limiter involve either coherent or noncoherent demodulation following the limiter. This article discusses the performance of a noncoherent frequency-shift keying receiver when it is preceded by a bandpass limiter. In particular, expressions for signal suppression factor, output signal-to-noise ratio, and error probability are obtained, from which one can assess the degradation in performance of the receiver due to the presence of the limiter. Both narrow-band and wide-band cases are treated, thus covering situations where no frequency uncertainty exists (i.e., known carrier frequency) as well as large-frequency uncertainties. Also discussed is the first-order signal plus noise probability density function following noncoherent demodulation.

S039 Hexagonal Multiple Phase-and-Amplitude-Shift-Keyed Signal Sets

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-21, No. 10, pp. 1108–1115, October 1973

Selection of a particular signal set array for a bandwidth-constrained multiple phase-and-amplitude-shift-keyed communication system for a linear additive gaussian noise channel requires consideration of factors such as average and/or peak power versus symbol error probability, signal amplitude dynamic range, simplicity of generation and detection, and number of bit errors per symbol error (Gray code properties).

A simple technique is presented for generating and optimally detecting the honeycomb (hexagonal) signal set, i.e., the signal set that has the tightest sphere-packing properties. The symbol and bit error probability performance of this set is compared to other two-dimensional signal sets that have been investigated in the literature, and is shown to be slightly superior from an average power standpoint. The article concludes with a comparison of all of these signal sets from the standpoint of the factors listed above.

SJOGREN, W. L.

S040 Mascons: Progress Toward a Unique Solution for Mass Distribution

R. J. Phillips, J. E. Conel, E. A. Abbott, W. L. Sjogren, and J. B. Morton

J. Geophys. Res., Vol. 77, No. 35, pp. 7106–7114, December 10, 1972

For abstract, see Phillips, R. J.

S041 Moon Model—An Offset Core

G. A. Ransford and W. L. Sjogren

Nature, Vol. 238, No. 5362, pp. 260–262, August 4, 1972

For abstract, see Ransford, G. A.

S042 Lunar Shape via the Apollo Laser Altimeter

W. L. Sjogren and W. R. Wollenhaupt

Science, Vol. 179, No. 4070, pp. 275–278, January 19, 1973

Data from the Apollo 15 and Apollo 16 laser altimeters reveal the first accurate elevation differences between distant features on both sides of the moon. The large far-side depression observed in the Apollo 15 data is not present in the Apollo 16 data. When the laser results are compared with elevations on maps from the Aeronautical Chart and Information Center, differences of 2 km over a few hundred km are detected in the Mare Nubium and Mare Tranquillitatis regions. The Apollo 16 data alone would put a 2-km bulge toward the Earth; however, the combined data are best fit by a sphere of radius 1737.7 km. The offset of the center of gravity from the optical center is about 2 km toward the Earth and 1 km eastward. The polar direction parameters are not well determined.

S043 Gravity: Mare Humorum

W. L. Sjogren and W. R. Wollenhaupt

The Moon, Vol. 8, Nos. 1 and 2, pp. 25–32, July–August 1973

Global tracking coverage of the Apollo 15 subsatellite has provided gravity measurements from 50 km altitudes over the entire Humorum basin. An estimate of surface mass points at 2-degree intervals which best fit the data reveals a mass distribution having a lesser mass excess for the very central area. When two different profiles were fit using a 2-disk model it was again found for each profile that the smaller central disk decreased the central mass by approximately 30%. The mass distribution per unit area however for the major portion of the mascon is still consistent with the other mascons (Crisium, Nectaris and Serenitatis) of approximately 800–900 kg cm^{-2}. The surface mass point solution seems to correlate somewhat with the dark areas shown on previously published maps.

SLEKYS, A.

S044 DSN Progress Report for November–December 1972: A New Pulsar Timer

A. Slekys

Technical Report 32-1526, Vol. XIII, pp. 133–138, February 15, 1973

The times-of-arrival of pulses of radiation from pulsating radio sources (pulsars) have been measured at the Venus Deep Space Station (DSS 13). This article describes a programmable high-speed timing source, designed to control the data sampling. A possible use of the timer, as part of a DSN navigation system, is to determine a spacecraft's position in inertial space. It is easily controllable by computer and is intended to be part of a demonstration of remote experiment operation in which the Sigma 5 computer at JPL will configure pulsar experiments at the Venus Deep Space Station.

S045 DSN Progress Report for May–June 1973: Implementation of a Flutter Compensator for DSN Predetection Recording

A. Slekys

Technical Report 32-1526, Vol. XVI, pp. 132–139, August 15, 1973

Baseband recordings of simulated phase-shift-keyed signals were carried out at Compatibility Test Area 21 in a DSN-compatible environment with the purpose of estimating the data degradation (measured in ST symb/N_0) caused by the record/playback process. The major cause of the lower effective signal-to-noise ratio at playback is recorder time-base instability or flutter. Incorporating a digital flutter compensator in the playback scheme significantly reduces the instantaneous phase jitter and hence the overall record/playback degradation. Results of the tests, together with a description of the compensator, are presented.

SLUSSER, R. A.

S046 Design and Construction of a Reverberation Chamber for High-Intensity Acoustic Testing

R. A. Slusser

J. Acoust. Soc. Am., Vol. 53, No. 5, pp. 1263–1269, May 1973

This article describes the design and construction of a high-intensity acoustic test facility at JPL to support the Mariner Mars 1971 project. Levels as high as 156 dB can be achieved with the chamber empty and test levels of 150 dB have been used with a full size Mariner Mars spacecraft model in the chamber. Levels as high as this must be generated using electropneumatic transducers, which modulate gaseous nitrogen to this facility.

SMARR, L.

S047 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist,
S. Christensen (University of Texas),
B. DeWitt (University of Texas),
L. Smarr (University of Texas), and
E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

For abstract, see Estabrook, F. B.

SMITH, C. A.

S048 Error Analysis for Mariner Venus/Mercury 1973 Conducted at the JPL Mesa West Antenna Range

N. L. Vincent, C. A. Smith, A. J. Brejcha, and H. A. Curtis

Technical Memorandum 33-625, June 1, 1973

For abstract, see Vincent, N. L.

SMITH, D. B.

S049 Low-Thrust Mission Risk Analysis, With Application to a 1980 Rendezvous With the Comet Encke

C. L. Yen and D. B. Smith

Technical Memorandum 33-593, March 15, 1973

For abstract, see Yen, C. L.

SMITH, E. J.

S050 Plasmaspheric Hiss

R. M. Thorne (University of California, Los Angeles), E. J. Smith, R. K. Burton (University of California, Los Angeles), and
R. E. Holzer (University of California, Los Angeles)

J. Geophys. Res., Vol. 78, No. 10, pp. 1581–1596, April 1, 1973

For abstract, see Thorne, R. M.

S051 Identification of Interplanetary Tangential and Rotational Discontinuities

E. J. Smith

J. Geophys. Res., Vol. 78, No. 13, pp. 2054–2063, May 1, 1973

Discontinuities in the interplanetary magnetic field detected by the Mariner 5 magnetometer have been analyzed to distinguish tangential and rotational discontinuities. The method used was based on finding the field component normal to the plane of the discontinuities that vanishes for tangential discontinuities and is nonzero for rotational discontinuities. The normal to each discontinuity was obtained by a variance analysis of the field vectors on both sides and within the current layer to find the direction of minimum field variation. Supplementary information concerning the existence or absence of changes in field magnitude across the discontinuities was also used to permit an unambiguous identification of both tangential and rotational discontinuities.

Slightly less than one-half of the 118 discontinuities analyzed could not be classified because neither the normal component nor the changes in field magnitude were statistically significant owing to errors in the field measurements and in finding the normal direction. The 44 rotational discontinuities that were finally identified did not exhibit changes in field magnitude in excess of 20%, an uncertainty that is consistent with the anticipated maximum error in measurement.

S052 Observed Properties of Interplanetary Rotational Discontinuities

E. J. Smith

J. Geophys. Res., Vol. 78, No. 13, pp. 2088–2093, May 1, 1973

In a prior study, discontinuities were identified as tangential or rotational principally on the basis of the existence or absence of a magnetic field component perpendicular to the plane of the discontinuity. The observed properties of the rotational discontinuities are described in this article. The normals to the discontinuities were subjected to a variance analysis and did not exhibit a statistically significant anisotropy. These normals appear to be randomly oriented. Since rotational discontinuities are large-amplitude Alfvén waves, the transverse perturbation in the magnetic field implies a corresponding jump in the solar wind velocity that is often only slightly less than the Alfvén speed. The rotational discontinuities identified are all circularly polarized and transport vorticity and angular momentum. No preferred sense of polarization is found, however, and both right-hand and left-hand polarizations occur with equal probability in the spacecraft frame.

SMITH, J. G.

S053 On the Feasibility of Efficient Multiamplitude Communication

J. G. Smith

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 62–71, January 1973

Bandwidth constraints in Earth-satellite communication systems force consideration of uncoded M-ary modulation to obtain increased data rates. M-ary phase shift keying (MPSK) at first glance seems most promising

because of the high transmitter efficiency achieved through Class C operation. Multiple phase-and-amplitude modulation candidates such as quadrature amplitude shift keying (QASK) appear less promising because the transmitter must operate at lower efficiency (in linear or multimode operation). However, initial studies indicate that QASK offers significant raw dc-power savings over MPSK, despite the reduced transmitter efficiency. For example, at S-band both solid-state and traveling-wave tube QASK transmitters can provide a 3-dB average dc-power savings over comparable 16-ary phase shift keying (PSK) for the same bit rate and error probability. The reason for this savings is that QASK requires a much smaller average signal-to-noise ratio than 16-ary PSK for the same error rate.

S054 Hexagonal Multiple Phase-and-Amplitude-Shift-Keyed Signal Sets

M. K. Simon and J. G. Smith

IEEE Trans. Commun., Vol. COM-21, No. 10, pp. 1108–1115, October 1973

For abstract, see Simon, M. K.

SMITH, L. S.

S055 The Development and Demonstration of Hybrid Programable Attitude Control Electronics

L. S. Smith and E. H. Kopf, Jr.

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 1–10, July 1973

In the course of Extended Life Attitude Control System research sponsored by the NASA Office of Advanced Space Technology (Research Electronics), a Hybrid Programable Attitude Control Electronics (HYPACE) concept was developed and demonstrated. The wide variety of future planetary missions demanded a new control approach to accommodate the automatic fault tolerance and long-life requirements of such missions.

HYPACE provides an adaptable, analog/digital design approach that permits preflight and in-flight accommodation of mission changes, component performance variations, spacecraft changes, etc., through programing. This enables broad multimission flexibility of application in a cost-effective manner. Previously, flight control computers have not been flown on planetary missions because of weight and power problems. These problems were resolved in the design of HYPACE. The HYPACE design, which was demonstrated in breadboard form on a single-axis gas-bearing spacecraft simulator, uses a single control channel to perform the attitude control functions sequentially, thus significantly reducing the number of component parts over hard-wired designs. The success of this effort resulted in the concept being selected for the Mariner Jupiter/Saturn 1977 spacecraft application.

SMITH, R. H.

S056 DSN Progress Report for March–April 1973: Data Collection System for the Dual-Carrier Exciter

R. H. Smith

Technical Report 32-1526, Vol. XV, pp. 63–65, June 15, 1973

A method was needed to monitor the dual-carrier exciter to be used at the 64-m-diameter-antenna deep space stations for the Viking Mars 1975 mission. This article describes the data-collection system to be used for diagnostic purposes to determine the status of the dual-carrier exciter. This system was developed to sample sequentially each analog test point in the dual-carrier exciter (mounted in the tricone of the antenna), digitally serialize each sample, send it over a single set of wires to the control room on the ground, convert the data from serial to parallel, and display the sampled data with digital displays or supply the sampled-data information to a computer for automatic monitoring of the dual-carrier exciter.

S057 DSN Progress Report for May–June 1973: X-Band 250-kW Klystron

R. H. Smith

Technical Report 32-1526, Vol. XVI, pp. 38–41, August 15, 1973

An X-band radar with an output of 400 kW is needed for future spacecraft mission planning. It will be used for planetary ranging of Saturn's rings, Mercury, Mars, the Jovian moons, and asteroids and to prepare for future spacecraft X-band uplink. To obtain this power level, two 250-kW klystrons will be combined for an output of 400 kW. The first 250-kW klystron has been tested by the contractor. Tests will shortly be conducted at the Goldstone High-Power Test Facility to determine the design of components for the 400-kW system.

S058 DSN Progress Report for September–October 1973: Integral Modulating Anode Resistor

R. H. Smith

Technical Report 32-1526, Vol. XVIII, pp. 120–124, December 15, 1973

The klystron in the DSN 400-kW transmitter subsystem uses a resistor to hold the modulating anode at ground potential. The resistor is connected to the klystron modulating anode through a high-voltage connector. In the past this resistor has been mounted in an air dielectric environment and has been subject to physical damage. If

a cathode arc occurs, the arc forms between the cathode and modulating anode, the modulating-anode potential is biased to the potential of the cathode by the arc current in the modulating-anode resistor, and the arc is extinguished. The modulating-anode resistor will have high-voltage (65 kV) across it during an arc. This article describes a new method in which the resistor is mounted in an enclosed cap on the side of the klystron socket tank, eliminating the above problem.

SMITH, R. M.

S059 DSN Progress Report for January–February 1973: The DSN Hydromechanical Equipment Service Program

I. D. Wells and R. M. Smith

Technical Report 32-1526, Vol. XIV, pp. 215–221, April 15, 1973

For abstract, see Wells, I. D.

SMITH, R. S. U.

S060 Eolian Deposits and Dunes on Mars

J. A. Cutts and R. S. U. Smith (California Institute of Technology)

J. Geophys. Res., Vol. 78, No. 20, pp. 4139–4153, July 10, 1973

For abstract, see Cutts, J. A.

SNYDER, C. W.

S061 Solar Wind Observations on the Lunar Surface With the Apollo-12 ALSEP

M. Neugebauer, C. W. Snyder, D. R. Clay, and B. E. Goldstein

Planet. Space Sci., Vol. 20, No. 20, pp. 1577–1591, October 1972

For abstract, see Neugebauer, M.

SODERBLOM, L. A.

S062 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

SOHN, R. L.

S063 Navigation Requirements for Advanced Deep Space Missions

L. D. Friedman, J. W. Moore, and R. L. Sohn

Navigation: J. Institute Nav., Vol. 19, No. 3, pp. 266–280, Fall 1972

For abstract, see Friedman, L. D.

SOLID PROPELLANT ENGINEERING SECTION STAFF

S064 Alternate Propellants for the Space Shuttle Solid Rocket Booster Motors

Solid Propellant Engineering Section Staff

Technical Memorandum 33-649, October 15, 1973

As part of the Shuttle Exhaust Effects Panel (SEEP) program for fiscal year 1973, a limited study was performed to determine the feasibility of minimizing the environmental impact associated with the operation of the solid rocket booster motors (SRBMs) in projected Space Shuttle launches. Eleven hypothetical and two existing limited-experience propellants were evaluated as possible alternates to a well-proven state-of-the-art reference propellant with respect to reducing emissions of primary concern: namely, hydrogen chloride (HCl) and aluminum oxide (Al_2O_3). The study showed that it would be possible to develop a new propellant to effect a considerable reduction in HCl or Al_2O_3 emissions. At the one extreme, a 23% reduction of HCl is possible along with a 11% reduction in Al_2O_3, whereas, at the other extreme, a 75% reduction of Al_2O_3 is possible, but with a resultant 5% increase in HCl.

SOMOANO, R. B.

S065 Alkali Metal Intercalates of Molybdenum Disulfide

R. B. Somoano, V. Hadek, and A. Rembaum

J. Chem. Phys., Vol. 58, No. 2, pp. 697–701, January 15, 1973

Natural molybdenite and single crystals of MoS_2 grown by chemical vapor transport were intercalated with the alkali group of metals (Li, Na, K, Rb, and Cs) by means of the liquid ammonia technique. Stoichiometries and X-ray data of all intercalates were determined and a complete indexing of the X-ray patterns of $K_{0.4}MoS_2$ and $Rb_{0.3}MoS_2$ was achieved. The X-ray results show insignificant changes in the a_o axis and considerable expansion of the c_o axis after intercalation. All intercalated crystals were superconducting. The superconductivity is believed to be due to an electron transfer from the alkali metal to an empty band of MoS_2, resulting in an increase in

electron density as well as in the density of states at the Fermi surface.

SPRINGETT, J. C.

S066 The Theory, Design, and Operation of the Suppressed Carrier Data-Aided Tracking Receiver

M. K. Simon and J. C. Springett

Technical Report 32-1583, June 15, 1973

For abstract, see Simon, M. K.

S067 The Performance of a Noncoherent FSK Receiver Preceded by a Bandpass Limiter

M. K. Simon and J. C. Springett

IEEE Trans. Commun., Vol. COM-20, No. 6, pp. 1128–1136, December 1972

For abstract, see Simon, M. K.

STAELIN, D. H.

S068 Microwave Emissivity of Ocean Foam and Its Effect on Nadiral Radiometric Measurements

P. W. Rosenkranz and D. H. Staelin (Massachusetts Institute of Technology)

J. Geophys. Res., Vol. 77, No. 33, pp. 6528–6538, November 20, 1972

For abstract, see Rosenkranz, P. W.

STANLEY, R. P.

S069 DSN Progress Report for January–February 1973: A Study of Varshamov Codes for Asymmetric Channels

R. P. Stanley and M. F. Yoder

Technical Report 32-1526, Vol. XIV, pp. 117–123, April 15, 1973

This article presents a study of an important class of single-error-correcting codes for binary and nonbinary discrete asymmetric channels recently discovered by Varshamov. A wide generalization of Varshamov's construction is given, and the complete weight distribution of Varshamov's codes is calculated.

STANTON, R. H.

S070 Estimating Trajectory Correction Requirements for Multiple Outer Planet Missions

L. D. Friedman, T. W. Hamilton, and R. H. Stanton

J. Spacecraft Rockets, Vol. 9, No. 12, pp. 909–914, December 1972

For abstract, see Friedman, L. D.

STELZRIED, C. T.

S071 DSN Progress Report for January–February 1973: An Analysis of Noise Bursts on the 64-m-Diameter Antenna at Goldstone

M. S. Reid and C. T. Stelzried

Technical Report 32-1526, Vol. XIV, pp. 46–49, April 15, 1973

For abstract, see Reid, M. S.

S072 DSN Progress Report for May–June 1973: The Development of a New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVI, pp. 78–86, August 15, 1973

For abstract, see Reid, M. S.

S073 DSN Progress Report for May–June 1973: Faraday Rotation Observations During the 1970 Pioneer 9 Solar Occultation

A. R. Cannon (University of California, Berkeley), C. T. Stelzried, and J. E. Ohlson (Naval Postgraduate School)

Technical Report 32-1526, Vol. XVI, pp. 87–93, August 15, 1973

For abstract, see Cannon, A. R.

S074 DSN Progress Report for September–October 1973: Improvement in the Accuracy of the New Broadband Square Law Detector

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

Technical Report 32-1526, Vol. XVIII, pp. 94–98, December 15, 1973

For abstract, see Reid, M. S.

S075 Observations of Jupiter at 13-cm Wavelength During 1969 and 1971

S. Gulkis, B. Gary, M. Klein, and C. T. Stelzried

Icarus, Vol. 18, No. 2, pp. 181–191, February 1973

For abstract, see Gulkis, S.

S076 Net-Field Polarization in a Magnetically Biased Plasma

W. V. T. Rusch (University of Southern California) and C. T. Stelzried

Radio Sci., Vol. 7, No. 12, pp. 1131–1141, December 1972

For abstract, see Rusch, W. V. T.

STEVENS, M. R.

S077 A Portable Self-Contained Gas Chromatograph

M. R. Stevens, C. E. Giffin, G. R. Shoemake, and P. G. Simmonds

Rev. Sci. Instr., Vol. 43, No. 10, pp. 1530–1534, October 1972

This article describes the design and fabrication of a completely portable, self-contained gas chromatograph. This instrument utilizes a closed-loop hydrogen carrier gas flow as maintained by a hydrogen generator-separator. It employs an auxiliary hydrogen generator to keep a positive flow of hydrogen through the detector. The detector is an ionization cross section detector. The only maintenance required is the addition of water (5–15 cc/day) to the auxiliary hydrogen generator. Lower limit of detection for the present system is of the order of 1–10 ppm ethane.

STEWART, A. I.

S078 Mariner 9 Ultraviolet Spectrometer Experiment: Afternoon Terminator Observations of Mars

J. Ajello, C. W. Hord (University of Colorado), C. A. Barth (University of Colorado), A. I. Stewart (University of Colorado), and A. L. Lane

J. Geophys. Res., Vol. 78, No. 20, pp. 4279–4290, July 10, 1973

For abstract, see Ajello, J.

STICKFORD, G. H., JR.

S079 Measurements of the Hβ Line Shape Using a Fiber Optics Slit System

G. H. Stickford, Jr.

AIAA J., Vol. 10, No. 10, pp. 1269–1270, October 1972

The presence of electrons and ions in a plasma has a large effect on the discrete or line emission from bound-bound atomic transitions. Stark broadening of the lines, due to electron and ion collisions, is the dominant broadening mechanism in singly ionized plasmas (10,000–20,000 K). Such broadening is strongly dependent on the electron density and nearly independent of the temperature. Thus it is an excellent monitor of the electron density. This article describes a procedure whereby the electron density of a transient plasma is measured by monitoring the emission of the hydrogen Hβ line. A fiber optics slit system, coupled with electronic phototubes, is used to measure the spectral shape and absolute magnitude of the Hβ emission with a time resolution of 0.1 μs.

STIMPSON, L. D.

S080 Effects of Overlaps, Stitches, and Patches on Multilayer Insulation

L. D. Stimpson and W. Jaworski

Progr. Astronaut. Aeronaut., Vol. 31, pp. 247–266, 1973

The effects of spacecraft installation-type discontinuities on aluminized Mylar multilayer insulation have been measured, using an electrically heated cylindrical calorimeter. The experimental results have been reproducible within ±10% or better for identical blankets and less than ±5% for the same blanket. Good blanket performance can be obtained using short interleaving for joints, eliminating stitched seams, or using small patches, particularly over the hot side of stitches. The heat loss through stitching is excessive but highly localized. Analytical models were matched to thermocouple test results. High lateral heat transfer is established as an important phenomenon in the vicinity of a discontinuity.

STIRN, R. J.

S081 Photoconductor–Metal Contact at Higher Densities

G. A. Dussel (University of Delaware), K. W. Böer (University of Delaware), and R. J. Stirn

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1443–1454, February 15, 1973

For abstract, see Dussel, G. A.

S082 CdS–Metal Contact at Higher Current Densities

R. J. Stirn, K. W. Böer (University of Delaware), and G. A. Dussel (University of Delaware)

Phys. Rev., Pt. B: Solid State, Vol. 7, No. 4, pp. 1433–1443, February 15, 1973

The current density as a function of applied voltage, optical excitation, and temperature in photoconducting CdS crystals with different non-Ohmic contacts (Au, Ag, Cu, Pt, Ni, and Sn) and the transient behavior of this current after switching-on of the applied voltage is investigated. High-field domains adjacent to these contacts are used as tools to measure the fields near the contacts. These domains are analyzed for different light intensities and temperatures. It is concluded from the experimental results that the observed high current density is caused by tunneling through the barrier and that in a slab of about 600-Å thickness at the cathode, the field must increase by about one order of magnitude from the field in the high-field domain. The space charge necessary for this must be stored in levels inaccessible for detection with conventional methods. It is proposed that in CdS about 10^{18}-cm^{-3} levels caused by native defects at about 0.8 eV below the conduction band are responsible for this space charge. These levels are probably also responsible for the fact that CdS is never observed to be *p* type under equilibrium doping conditions.

S083 Solar and Laser Energy Conversion With Schottky Barrier Solar Cells

R. J. Stirn and Y.-C. M. Yeh

Proceedings of the IEEE Tenth Photovoltaic Specialists Conference, Palo Alto, California, November 13–15, 1973, pp. 15–24

Photovoltaic devices have been fabricated for solar and short wavelength laser energy conversion using the thin metal film-semiconductor (Schottky barrier) approach. Studies of the metal film optical characteristics and the voltage outputs were emphasized. AMO efficiencies of 8–9% in GaAs and laser conversion efficiencies of 25% at 4880 Å in $GaAs_{0.6}P_{0.4}$ are presently measured, with projected efficiencies of 15% and 45%, respectively. The techniques, if applied successfully to semiconductor thin films, could have an impact in solar energy terrestrial application.

STRAND, J. N.

S084 On-Surface and Laboratory Size Measurements of Fine Lunar Particles

L. D. Jaffe and J. N. Strand

Nature Phys. Sci., Vol. 241, No. 107, pp. 57–59, January 15, 1973

For abstract, see Jaffe, L. D.

SYDNOR, R. L.

S085 DSN Progress Report for May–June 1973: Tracking Assistor for DSN Receivers

R. L. Sydnor and J. W. MacConnell

Technical Report 32-1526, Vol. XVI, pp. 30–32, August 15, 1973

The tracking assistor improves the performance of DSN receivers at fast doppler rate and high noise level by removing the stress in the phase-locked loop of the receiver. The assistor is basically a down-up converter inserted in the 24-MHz feedback path of the receiver that removes the loop stress by subtracting the doppler, which is computed by a programmed local oscillator. Since the input and output frequencies are nearly identical, special filtering and construction techniques are required to achieve the extremely high isolation necessary to prevent undesired phase modulation within the loop.

The synchronous assistor was employed during superior conjunction of Mariner Mars 1971. During this period it was possible to obtain ranging data, a measurement not possible with either of the receivers in their standard or third-order loop configuration.

SYKES, M. J.

S086 The Atmosphere of Mars From Mariner 9 Radio Occultation Measurements

A. J. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and S. I. Rasool (National Aeronautics and Space Administration)

Icarus, Vol. 17, No. 2, pp. 484–516, October 1972

For abstract, see Kliore, A. J.

S087 The Shape of Mars From the Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, and M. J. Sykes

Icarus, Vol. 17, No. 2, pp. 517–524, October 1972

For abstract, see Cain, D. L.

S088 S Band Radio Occultation Measurements of the Atmosphere and Topography of Mars with Mariner 9: Extended Mission Coverage of Polar and Intermediate Latitudes

A. J. Kliore, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4331–4351, July 10, 1973

For abstract, see Kliore, A. J.

S089 Approximations to the Mean Surface of Mars and Mars Atmosphere Using Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4352–4354, July 10, 1973

For abstract, see Cain, D. L.

TAHERZADEH, M.

T001 The Analytically Determined Response of Silicon Detectors to a Polyenergetic Neutron Beam

M. Taherzadeh

Nucl. Technol., Vol. 18, No. 1, pp. 15–24, April 1973

The response of a 300-μm-thick silicon detector to an incident polyenergetic neutron beam has been evaluated by the use of analytical techniques. The analysis indicates that for neutrons <6 MeV the response of a 300-μm silicon detector to neutrons emanating from a plutonium *dioxide radioisotope thermoelectric generator heat* source is basically due to elastic scattering reactions and the contribution from other reactions, i.e., (n,p) and (n,α), is <2%. The contribution from radiative reactions, i.e., (n,γ) and $(n,n'\gamma)$, is even smaller and therefore is ignored. For neutron energies up to 6 MeV, the maximum response for a 300-μm silicon detector is $<4 \times 10^{-3}$ counts/n within the range of bias energies 25 to 250 keV. If the effects of pulse height defect and the true angular distribution of scattered neutrons are included, the response will be reduced to 1.3×10^{-3} counts/n.

TAUSWORTHE, R. C.

T002 A Bibliography of the Theory and Application of the Phase-Lock Principle

W. C. Lindsey (University of Southern California) and R. C. Tausworthe

Technical Report 32-1581, April 1, 1973

For abstract, see Lindsey, W. C.

T003 DSN Progress Report for November–December 1972: Block IV Subcarrier Demodulator Assembly Acquisition Problem

R. B. Crow, J. K. Holmes, and R. C. Tausworthe

Technical Report 32-1526, Vol. XIII, pp. 42–47, February 15, 1973

For abstract, see Crow, R. B.

T004 Improvements in Deep-Space Tracking by Use of Third-Order Loops

R. C. Tausworthe and R. B. Crow

Proceedings of the 1972 International Telemetering Conference, Los Angeles, California, October 10–12, 1972, pp. 577–583

Third-order phase-locked receivers have not yet found wide application in deep-space communications systems because the second-order systems now used have performed adequately on past spacecraft missions. However, a survey of the doppler profiles for future missions shows that an unaided second-order loop may be unable to perform within reasonable error bounds. This article discusses the characteristics of a simple third-order extension to present second-order systems that not only extends doppler-tracking capability, but widens the pull-in range and decreases pull-in time as well.

TAYLOR, F. W.

T005 A Model of the Physical Properties of Comet Encke

F. W. Taylor, C. M. Michaux, and R. L. Newburn, Jr.

Technical Report 32-1590, October 1, 1973

This report presents a model of comet Encke constructed from the available observational data on the comet. The model is intended for use in the design of scientific experiments and spacecraft systems to be used on future missions to Encke. Numerical values and ranges of uncertainty are given for all of the important structural, compositional, and photometric parameters with references to the original research from which these were calculated or estimated.

T006 The Abundance of CH_3D and the D/H Ratio in Jupiter

R. Beer and F. W. Taylor

Astrophys. J., Vol. 179, No. 1, Pt. 1, pp. 309–327, January 1, 1973

For abstract, see Beer, R.

T007 The Equilibration of Deuterium in the Jovian Atmosphere

R. Beer and F. W. Taylor

Astrophys. J., Vol. 182, No. 3, Part 2, pp. L131–L132, June 15, 1973

For abstract, see Beer, R.

T008 Preliminary Data on the Optical Properties of Solid Ammonia and Scattering Parameters for Ammonia Cloud Particles

F. W. Taylor

J. Atmos. Sci., Vol. 30, No. 4, pp. 677-683, May 1973

The infrared absorption spectrum of solid ammonia is obtained from 2 to 125 μm as a composite of the published measurements. From this, the absorption coefficient and the complex refractive index are calculated as a function of frequency by integration of the Kramers-Krönig dispersion relations. These data are used in a Mie theory analysis to obtain the basic parameters for scattering of long wavelength radiation by solid ammonia particles; this is believed to be an important process in radiative transfer within the atmospheres of the giant planets.

T009 Spectral Data for the ν_2 Bands of Ammonia With Applications to Radiative Transfer in the Atmosphere of Jupiter

F. W. Taylor

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 11, pp. 1181-1217, November 1973

Data are presented on the positions, intensities, half widths and ground state energies of approximately 1700 of the strongest spectral lines in the ν_2 band of ammonia and its first overtone. The values are used to compute the transmission function for dilute mixtures of ammonia in hydrogen, approximating the Jovian environment, and these are compared to laboratory measured transmissions for the same conditions. The application of the data to theoretical studies of radiative transfer in the atmosphere of Jupiter and the interpretation of observations in the 8-20 μ range is discussed.

T010 Remote Sounding From Artificial Satellites and Space Probes of the Atmospheres of the Earth and the Planets

J. T. Houghton (University of Oxford) and F. W. Taylor

Rep. Prog. Phys., Vol. 36, No. 7, pp. 827-919, July 1973

For abstract, see Houghton, J. T.

TEXTOR, G. P.

T011 Tracking and Data System Support for the Mariner Mars 1971 Mission: Orbit Insertion Through End of Primary Mission

P. W. Barnum, N. A. Renzetti, G. P. Textor, and L. B. Kelly

Technical Memorandum 33-523, Vol. III, May 15, 1973

For abstract, see Barnum, P. W.

THOMAS, J. B.

T012 DSN Progress Report for May-June 1973: An Analysis of Long Baseline Radio Interferometry, Part III

J. B. Thomas

Technical Report 32-1526, Vol. XVI, pp. 47-64, August 15, 1973

This article is the third installment in a series of articles presenting an analysis of long-baseline radio interferometry. The practical data reduction steps that are required to extract fringe amplitude, fringe phase, and delay are described. These data reduction steps include bit stream manipulations, fringe stopping. Fourier analysis, and phase tracking. In addition, a detailed analysis is presented for the two-channel approach to bandwidth synthesis, a technique used for making accurate delay measurements.

THOMAS, N. E.

T013 Mariner 9 Data Storage Subsystem Flight Performance Summary

N. E. Thomas and B. T. Larman

Technical Memorandum 33-638, August 1, 1973

This memorandum summarizes the performance of the Mariner 9 Data Storage Subsystem (DSS) throughout the primary and extended missions. Information presented is limited to reporting of anomalies which occurred during the playback sequences. Tables and figures describe the anomalies (dropouts, missing and added bits, in the imaging data) as a function of time (accumulated tape passes). The data results indicate that the performance of the DSS was satisfactory and within specification throughout the mission. The data presented is taken from the Spacecraft Team Incident/Surprise Anomaly Log recorded during the mission.

Pertinent statistics concerning the tape transport performance are given. Also presented is a brief description of DSS operation, particularly that related to the recorded anomalies. This covers the video data encoding and how it is interpreted/decoded by ground data processing and the functional operation of the DSS in abnormal conditions such as loss of lock to the playback signal.

THOMPSON, E. D.

T014 Power Flow for Josephson Elements

E. D. Thompson

IEEE Trans. Electr. Dev., Vol. ED-20, No. 8, pp. 680–683, August 1973

A Josephson element is a nonlinear lossless element that is characterized by an internal frequency ω_0, the autonomous frequency, proportional to the dc voltage across the element. Detection, mixing, generation, harmonic generation and mixing, and parametric amplification are possible using such an element. Presented here are general relations for the power flow at the frequencies of interest in such an element. These general power flow relations depend upon whether the autonomous frequency is phase-locked, either harmonically or subharmonically, to a frequency in the system or is unlocked. The results here generalize those given previously for the harmonically locked case.

T015 Josephson Junction Mixing

E. D. Thompson

J. Appl. Phys., Vol. 44, No. 7, pp. 3310–3311, July 1973

It is shown that a Josephson junction, biased at a voltage V_0 and driven simultaneously by two monochromatic sources at the frequencies ω_1 and ω_2, produces an output power at the frequency $\omega_3 = \omega_1 - n\omega_2$ and that this frequency is independent of the Josephson frequency $\omega_0 = 2eV_0/\hbar$. The power output depends upon the dc bias, showing fine structure with a voltage periodicity of $\hbar\omega_2/2e$.

THORNE, R. M.

T016 Plasmaspheric Hiss

R. M. Thorne (University of California, Los Angeles), E. J. Smith, R. K. Burton (University of California, Los Angeles), and R. E. Holzer (University of California, Los Angeles)

J. Geophys. Res., Vol. 78, No. 10, pp. 1581–1596, April 1, 1973

A relatively steady band of extremely low frequency hiss has been detected by the Ogo 5 search coil magnetometer on almost every passage through the plasmasphere. Except for an anomalous region on the dayside at high geomagnetic latitudes, the emissions terminate abruptly at the plasmapause, and are therefore referred to as "plasmaspheric hiss." A preliminary statistical study of the properties of the observed whistler mode turbulence has yielded the following characteristics: the waves are band limited with a sharp lower-frequency cutoff and a more diffuse upper-frequency cutoff; power spectra show a well-defined maximum near a few hundred hertz, the peak intensities generally ranging between 10^{-7} and 10^{-5} γ^2/Hz; the wave energy is spread over a bandwidth of a few hundred hertz, and corresponding wide band amplitudes are 5–50 mγ; and the waves are highly turbulent in nature and show little tendency of definite polarization.

The above properties remain essentially constant throughout the plasmasphere. Observed properties of the hiss are consistent with generation at all local times in a restricted L range just within the plasmapause. Waves subsequently propagate on complex paths to fill the plasmasphere. The most probable generation mechanism is cyclotron resonant instability with low-energy electrons that continually diffuse inward from the outer radiation zone. At lower L, hiss resonates with higher-energy electrons, and thus the electrons are scattered in pitch angle and hence lost to the atmosphere throughout the "slot" between the inner and outer radiation belts.

THORPE, T. E.

T017 A User's Guide to the Mariner 9 Television Reduced Data Record

J. B. Seidman, W. B. Green, P. L. Jepsen, R. M. Ruiz, and T. E. Thorpe

Technical Memorandum 33-628, September 1, 1973

For abstract, see Seidman, J. B.

T018 Mariner 9 Star Photography

T. E. Thorpe

Appl. Opt., Vol. 12, No. 2, pp. 359–363, February 1973

Successful photography of stars by the Mariner 9 spacecraft has confirmed both mathematical prediction of point source response by vidicons and preflight calibration results. Camera-B limiting magnitude and integrated image data are presented to provide information relevant to absolute photometric reduction. These data appear consistent to better than 15% and suggest a good calibration source. Decalibration of Mars picture information, however, requires precise knowledge of Mars spectral radiance and camera point spread function. The effect of image motion on star detection thresholds is also discussed.

T019 Verification of Performance of the Mariner 9 Television Cameras

T. E. Thorpe

Appl. Opt., Vol. 12, No. 8, pp. 1775–1784, August 1973

The large volume of picture data produced by the Mariner 9 Television Experiment, in addition to providing a description of the planet Mars, emphasizes the need for *in situ* verification of camera performance. Such data provide the basis for initial quantitative image interpretation by confirmation of the relevance of preflight measurement. This information must be the result of planned calibration sequences rather than extraction from nominal mission photography. A lack of sufficient numbers of frames restricted Mariner camera verifications to only limited operational modes under optimal conditions and required significant extrapolation over the duration of the mission. The evidence does suggest that measurable photometric changes occurred, whereas agreement with preflight data is observed for other parameters.

TOPS PROJECT

T020 Thermoelectric Outer Planets Spacecraft (TOPS) Advanced Systems Technology Project Final Report

TOPS Project

Technical Memorandum 33-589, April 1, 1973

A rare opportunity during the latter half of the 1970s to explore the planets beyond Mars prompted JPL in 1968 to initiate research and advanced development work on a ballistic-mode, outer-planet spacecraft using radioisotope-thermoelectric-generator (RTG) power. The resultant Thermoelectric Outer-Planet Spacecraft (TOPS) Project was established to provide the advanced systems technology that would allow the realistic estimates of performance, cost, reliability, and scheduling that are required for an actual flight mission. A system design of the complete RTG-powered outer-planet spacecraft was made; major technical innovations of certain hardware elements were designed, developed, and tested; and reliability and quality assurance concepts for long-life requirements were developed.

TOROLA, J., JR.

T021 Design and Operation of a 1000°C Lithium–Cesium Test System

L. G. Hays, G. M. Haskins, D. E. O'Connor, and J. Torola, Jr.

Technical Memorandum 33-633, December 1, 1973

For abstract, see Hays, L. G.

TOTH, R. A.

T022 High Resolution Measurements of the Line Positions and Strengths of the $2\nu_2$ Band of H_2CO

R. A. Toth

J. Molec. Spectrosc., Vol. 46, No. 3, pp. 470–489, June 1973

Spectra of the $2\nu_2$ band of formaldehyde have been obtained with high resolution (0.035 cm^{-1}). Measurements were made with path lengths of 8, 16, and 24 m and at sample pressures from 0.1 to 0.3 mm Hg at room temperature (~296 K). From these data, rotational constants and line strengths were determined for the $2\nu_2$ band. The strengths were analyzed to determine the band strength and the rotational factors.

T023 Strengths and Air-Broadened Widths of H_2O Lines in the 2950–3400 cm^{-1} Region

R. A. Toth

J. Quant. Spectrosc. Radiat. Transfer, Vol. 13, No. 11, pp. 1127–1142, November 1973

Measurements of the strengths and air-broadened widths of 223 lines of water vapor have been made with high resolution in the region 2950–3400 cm^{-1}. The strength data of lines in the $2\nu_2$ and ν_1 bands are analyzed to determine band strengths and coefficients of F factors. The band strengths of the $2\nu_2$ and ν_1 bands were found to be 1.75 ± 0.08 and 10.3 ± 1.1 cm^{-2} atm^{-1} at 296 K, respectively. The selection rules of the lines observed in the ν_3 band are forbidden in the symmetric-rotor limit. Most measured strengths of these lines differ from calculated values because of different asymmetries in the upper and lower vibrational states. Coriolis perturbations in several lines of the ν_1 and ν_3 bands were also observed in the strength measurements.

The direct method was applied to determine the air-broadened line widths. The results are compared to previously computed values and there is good agreement for line width values greater than 0.05 cm^{-1} atm^{-1}. However, for line widths less than 0.05 cm^{-1} atm^{-1}, the measured values are smaller than the computed widths. A value of 0.018 cm^{-1} atm^{-1} is given for the width of the line at 3378.071 cm^{-1}, whereas the calculated value is 0.032 cm^{-1} atm^{-1}.

TRAJMAR, S.

T024 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

Technical Memorandum 33-646, July 15, 1973

For abstract, see Hall, R. I.

T025 Electron Scattering by Molecules With and Without Vibrational Excitation—IV. Elastic Scattering and Excitation of the First Vibrational Level for N_2 and CO at 20 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, and W. Williams

J. Chem. Phys., Vol. 57, No. 8, pp. 3250–3259, October 15, 1972

For abstract, see Truhlar, D. G.

T026 Electron Scattering by Molecules With and Without Vibrational Excitation—VI. Elastic Scattering by CO at 6–80 eV

D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

J. Chem. Phys., Vol. 57, No. 10, pp. 4307–4312, November 15, 1972

For abstract, see Truhlar, D. G.

T027 Electron Impact Excitation of H_2O

S. Trajmar, W. Williams, and A. Kuppermann (California Institute of Technology)

J. Chem. Phys., Vol. 58, No. 6, pp. 2521–2531, March 15, 1973

Relative differential cross sections for elastic scattering and for a number of inelastic processes corresponding to vibrational and vibronic excitation of H_2O have been determined at 53, 20, and 15 eV impact energies in the 0–90° angular range. The measurements were carried out with an instrumental resolution of about 80 meV for transitions corresponding to various energy losses. On the basis of the angular distribution of the scattered electrons, it is suggested that the 4.5 and 9.81 eV transitions are associated with excitations of triplet states, while the angular distribution of the scattered electrons at all other energy losses indicate predominantly singlet–singlet transitions. The sharpness of the 9.81 eV transition indicates that the corresponding state has an equilibrium geometry similar to that of the ground state.

T028 Electron Impact Excitation and Assignment of the Low-Lying Electronic States of CO_2

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

J. Phys. B: Atom. Molec. Phys., Vol. 6, No. 9, pp. L264–L267, September 1973

For abstract, see Hall, R. I.

T029 Differential and Integral Cross Sections for the Excitation of the 2 ^1S, 2 ^3S, and 2 ^3P States of He by Electron Impact at 29.6 and 40.1 eV

S. Trajmar

Phys. Rev. A, Vol. 8, No. 1, pp. 191–203, July 1973

Differential and integral cross sections for the electron-impact excitation of the 2 ^3S, 2 ^1S, and 2 ^3P states of He relative to the 2 ^1P state have been measured at 29.6- and 40.1-eV energies in the 3 to 138° angular range. The relative cross sections have been normalized to the absolute scale by utilizing previously determined 2 ^1P cross sections. The differential cross section for the 2 ^1S state has a deep minimum at 50°; for the 2 ^3P state it is nearly isotropic, and for the 2 ^3S state it shows a complicated structure which has not been previously reported. The experimental cross sections are compared to the results of quantum-mechanical calculations performed earlier.

None of the first-order plane-wave calculations predict the observed differential cross sections for these optically forbidden transitions. However, one approximation predicts the correct magnitude and approximate shape of the 2 ^3P differential cross sections in the whole angular range at these energies. Another approximation shows considerable improvement compared to first-order plane-wave theories in predicting the cross sections for the 2 ^1S state. However, at large scattering angles, calculation and experiment differ significantly. It is clear from the present study that more refined calculations are needed to predict angular distributions for these optically forbidden excitations in the 30–40-eV energy region.

T030 Vibrational Excitation in CO by Electron Impact in the Energy Range 10–90 eV

A. Chutjian, D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

Phys. Rev. Lett., Vol. 29, No. 24, pp. 1580–1583, December 11, 1972

For abstract, see Chutjian, A.

T031 Excitation of the $W^3\Delta_u$, $w^1\Delta_u$, $B'^3\Sigma_u^-$, and $a'^1\Sigma_u^-$ States of N_2 by Electron Impact

A. Chutjian, D. C. Cartwright (The Aerospace Corporation), and S. Trajmar

Phys. Rev. Lett., Vol. 30, No. 6, pp. 195–198, February 5, 1973

For abstract, see Chutjian, A.

TROMBKA, J. I.

T032 Lunar Surface Radioactivity: Preliminary Results of the Apollo 15 and Apollo 16 Gamma-Ray Spectrometer Experiments

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

Science, Vol. 179, No. 4075, pp. 800–803, February 23, 1973

For abstract, see Metzger, A. E.

TROWBRIDGE, D. L.

T033 DSN Progress Report for July–August 1973: X-Band Traveling Wave Maser Amplifier

D. L. Trowbridge

Technical Report 32-1526, Vol. XVII, pp. 123–130, October 15, 1973

An X-band traveling-wave maser amplifier has undergone preliminary tests in the laboratory. The maser is being developed for use in the 64-m-diameter antenna deep space stations to meet ground support requirements of the Viking Mars 1975 flight project. The maser has 53-dB net gain, with 43 MHz instantaneous 1-dB bandwidth at 8420 MHz. Mechanical tuning of the pump klystrons enables the maser to be tuned to 8600 MHz, with 43 MHz instantaneous 1-dB bandwidth at 45-dB net gain.

T034 DSN Progress Report for September–October 1973: Block III Maser Implementation Program

D. L. Trowbridge

Technical Report 32-1526, Vol. XVIII, pp. 130–135, December 15, 1973

This article discusses the implementation of the Block III maser system into the 64-m-diameter and 26-m-diameter antenna deep space stations. The Block III maser system has improved reliability and microwave performance over that of the previous Block II maser system. The Block III traveling-wave maser amplifier has 45 ± 1 dB gain at a center frequency of 2285 MHz, with an instantaneous 1-dB bandwidth of 30 MHz minimum. The higher gain and lower noise temperature of the Block III maser system have lowered the overall system temperature approximately 10 K.

TRUBERT, M. R.

T035 A Practical Approach to Spacecraft Structural Dynamics Problems

M. R. Trubert

J. Spacecraft Rockets, Vol. 9, No. 11, pp. 818–824, November 1972

This article discusses the system approach for structural dynamics. First, the concept of dynamic mass is presented. Second, the determination of a dynamic mass is given relative to the reaction forces and moments between two substructures in terms of the cantilever normal modes of one substructure. Third, it is shown how one can simply couple and uncouple substructures for dynamics problems. Fourth, an example is given for the digital simulation of a sine wave test for the purpose of calculating rotational response of the shaker. Fifth, forcing functions are mathematically determined from the measured responses of the space vehicle in flight. Finally, it is shown how one can perform a hybrid test simulation by combining a real-time analog computer with digitally determined structural characteristics, shaker properties, and actual control equipment in order to investigate the stability of the control loop.

TRUHLAR, D. G.

T036 Electron Scattering by Molecules With and Without Vibrational Excitation—IV. Elastic Scattering and Excitation of the First Vibrational Level for N_2 and CO at 20 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, and W. Williams

J. Chem. Phys., Vol. 57, No. 8, pp. 3250–3259, October 15, 1972

Normalized experimental differential cross sections for scattering angles in the range 20–85 deg are presented for elastic scattering and excitation of the fundamental vibration of N_2 and CO by electrons with impact energy 20 eV. From three or four differential cross sections the integral cross sections are estimated. The elastic scattering cross sections are compared to the predictions of the polarized Born approximation, using five model potentials (including polarization) which have been previously proposed for N_2 or CO, and other models. The vibrational excitation of both N_2 and CO appears to be dominated by resonance scattering.

T037 Electron Scattering by Molecules With and Without Vibrational Excitation—VI. Elastic Scattering by CO at 6–80 eV

D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

J. Chem. Phys., Vol. 57, No. 10, pp. 4307–4312, November 15, 1972

Elastic scattering differential cross sections in relative units for electron scattering from CO have been measured in the scattering angle range 15–85 deg and the

impact energy range 10–80 eV. The experimental results are compared to the predictions of model polarized Born approximations, using five different model interaction potentials, and other models. Such a treatment is able to account for some of the features of the angle dependence of the differential cross sections. The largest discrepancies between theory and experiment are at 10 eV and at large scattering angles, and there are also smaller discrepancies at small scattering angles. Comparisons are also made to previous experimental studies.

T038 Vibrational Excitation in CO by Electron Impact in the Energy Range 10–90 eV

A. Chutjian, D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

Phys. Rev. Lett., Vol. 29, No. 24, pp. 1580–1583, December 11, 1972

For abstract, see Chutjian, A.

TSAY, F.-D.

T039 Magnetic Phases in Lunar Fines: Metallic Fe or Ferric Oxides

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

Geochim. Cosmochim. Acta, Vol. 37, No. 2, pp. 1201–1211, May 1973

The ferromagnetic resonance ($g = 2.08 \pm 0.03$) observed for the Apollo 11 and 12 lunar fines is characterized by an asymmetric lineshape with a narrower appearance on the high field side. This asymmetry together with an anisotropy energy which varies from +640 to +500 G over the temperature range of 80 to 298 K indicates that the ferromagnetic resonance arises from metallic Fe having the body-centered cubic structure and not from hematite, magnetite or other Fe^{3+} ions in magnetite-like phases. The g-value, the lineshape asymmetry, and the temperature dependence of the linewidth for the Apollo 14 and 15 fines as reported by other workers are found to be essentially similar to those observed for the Apollo 11 and 12 fines, except a narrower linewidth is observed in the case of the Apollo 14 fines (600–650 G vs 700–800 G, at X-band and room temperature). This difference in linewidth is found to be correlated with the Ni and/or Co content in these samples. The electron spin resonance signal for the so-called "unknown ferric oxide" phase, discussed in earlier reporting, is also shown to have frequency and temperature dependences significantly different from those for the lunar fines.

TSIANG, E.

T040 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist, S. Christensen (University of Texas), B. DeWitt (University of Texas), L. Smarr (University of Texas), and E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

For abstract, see Estabrook, F. B.

TSURUTANI, B.

T041 A Study of the Compatibility of Science Instruments With the Solar Electric Propulsion Space Vehicle

R. H. Parker, J. Ajello, A. Bratenahl, D. R. Clay, and B. Tsurutani

Technical Memorandum 33-641, October 15, 1973

For abstract, see Parker, R. H.

UCHIYAMA, A. A.

U001 Leak Rates in Sealed Cells

H. A. Frank and A. A. Uchiyama

J. Electrochem. Soc., Vol. 120, No. 3, pp. 313–317, March 1973

For abstract, see Frank, H. A.

UDLOCK, D. E.

U002 Formulating Propellants for Fully Case-Bonded End-Burning Motors

H. E. Marsh, Jr., and D. E. Udlock

J. Spacecraft Rockets, Vol. 9, No. 9, pp. 625–626, September 1972

For abstract, see Marsh, H. E., Jr.

UNTI, T. W. J.

U003 Note on Asymptotically Flat Empty Spaces

T. W. J. Unti

Gen. Relat. Grav., Vol. 3, No. 1, pp. 43–58, 1972

The algebraic programming system FORMAC is used to extend asymptotic solutions of spin coefficient equations reported earlier. The expansions are then applied to metrics with geodesic rays and to previously-conserved terms. It is shown how the expansion may prove useful in finding new solutions to the field equations.

VALLAS, L. J.

V001 Viking Orbiter 1975 Articulation Control Subsystem Design and Analysis

H. H. Horiuchi and L. J. Vallas

Technical Memorandum 33-599, July 15, 1973

For abstract, see Horiuchi, H. H.

VAN DILLEN, S. L.

V002 Mariner Jupiter/Saturn 1977—The Mission Frame

R. D. Bourke, R. F. Miles, Jr., P. A. Penzo, S. L. Van Dillen, and R. A. Wallace

Astronaut. Aeronaut., Vol. 10, No. 11, pp. 42–49, November 1972

For abstract, see Bourke, R. D.

VANGO, S. P.

V003 Nuclear Magnetic Resonance Determination of Water and an Oxygen Titration for Nitric Oxide in Liquid Nitrogen Tetroxide

S. P. Vango and S. L. Manatt

Anal. Chem., Vol. 45, No. 7, pp. 1060–1064, June 1973

A nuclear magnetic resonance (NMR) procedure is described for the rapid quantitative analysis of water in nitrogen tetroxide oxidizer. This technique is capable of detecting as little as 0.001 wt % of H_2O (10 μg of water per g and gives results in the concentration range of 0.01 to 0.02 wt % with a precision of about ±0.002 wt %. Because many samples of oxidizer contain NO, a procedure for O_2 titration of NO prior to NMR analysis for H_2O is described which gives the NO concentration accurate to ±0.05 wt %.

VARSI, G.

V004 Development of Propulsion for High-Atmospheric-Pressure or Dense Environments

G. Varsi, L. H. Back, and W. L. Dowler

JPL Quarterly Technical Review, Vol. 3, No. 2, pp. 45–52, July 1973

This article describes the development of a propulsion system that employs a detonating propellant and demonstrates the need for such a system and its use in certain planetary atmospheres. A theoretical formulation of the relevant gas-dynamic processes has been developed, and a related series of experimental tests have been pursued.

V005 Detonation Propulsion for High Pressure Environments

G. Varsi and L. H. Back

AIAA Preprint 73-1237, AIAA (American Institute of Aeronautics and Astronautics)/SAE (Society of Automotive Engineers) Ninth Propulsion Conference, Las Vegas, Nevada, November 5–7, 1973

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.

V006 The Multidimensional Content of the Frustrum of the Simplex

G. Varsi

Pac. J. Math., Vol. 46, No. 1, pp. 303–314, May 1973

The content of the intersection of a simplex with a semispace is computed by means of a dissection technique. An efficient algorithm, suitable for automatic calculation, is given. For an n-dimensional space, the algorithm needs only $n - 1$ storage locations at most, and requires $\sim n^2$ operations.

VINCENT, N. L.

V007 Error Analysis for Mariner Venus/Mercury 1973 Conducted at the JPL Mesa West Antenna Range

N. L. Vincent, C. A. Smith, A. J. Brejcha, and H. A. Curtis

Technical Memorandum 33-625, June 1, 1973

Theoretical analysis and experimental data are combined to yield the errors to be used with antenna gain, antenna patterns, and RF-cable insertion loss measurements for the Mariner Venus/Mercury 1973 Flight Project. These errors apply to measurements conducted at the JPL Mesa West Antenna Range, on the high-gain antenna, low-gain antenna, and RF coaxial cables.

VON ROOS, O. H.

V008 DSN Progress Report for March–April 1973: A Global Model of the Earth's Ionosphere: The Nighttime Ionosphere

O. H. von Roos and P. R. Escobal

Technical Report 32-1526, Vol. XV, pp. 32–47, June 15, 1973

This article discusses the nighttime ionosphere and considers specifically the dawn and dusk situation in which a transition from electron production by the Sun's radiation to a cessation of this production gradually occurs. The strict-nighttime ionosphere is governed by electron attachment and diffusion. The transition period depends very much on the declination angle of the Sun and the latitude of the geographical location on Earth where knowledge of the ionospheric electron distribution is desired.

Simple and concise expressions for the electron distribution in the upper ionosphere are derived so that calibrations for range corrections on a global scale are possible. The ionospheric model presented contains six empirical parameters which are considered functions of geographical location and must be determined by measurement.

V009 3-D Multilateration: A Precision Geodetic Measurement System

P. R. Escobal, K. M. Ong, O. H. von Roos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller

Technical Memorandum 33-605, March 15, 1973

For abstract, see Escobal, P. R.

V010 A Problem in Classical Mechanics

O. H. von Roos

Am. J. Phys., Vol. 41, No. 3, pp. 435–436, March 1973

Two bodies having arbitrary mass distributions exert forces and torques on each other. Each mass distribution engenders a force field, derivable from a potential, which subjects the other body to forces and torques. It is possible to change the mass distribution without changing the external potential. This article develops proof that no matter what the mass distributions of the two bodies, as long as they lead to the same external potentials, the torques will be the same and can be stated in expressions containing only external potential fields.

WAHLQUIST, H. D.

W001 Maximally Slicing a Black Hole

F. B. Estabrook, H. D. Wahlquist, S. Christensen (University of Texas), B. DeWitt (University of Texas), L. Smarr (University of Texas), and E. Tsiang (University of Texas)

Phys. Rev., Pt.D: Part. Fields, Vol. 7, No. 10, pp. 2814–2817, May 15, 1973

For abstract, see Estabrook, F. B.

WALLACE, C. J.

W002 Lipid-Absorbing Polymers

H. E. Marsh, Jr., and C. J. Wallace

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 1–6, January 1973

For abstract, see Marsh, H. E., Jr.

WALLACE, R. A.

W003 Saturn Satellite Encounter Opportunities for Mariner Jupiter/Saturn 1977

R. A. Wallace

JPL Quarterly Technical Review, Vol. 3, No. 1, pp. 14–25, April 1973

The Mariner Jupiter/Saturn 1977 mission will allow scientists to collect data from a sophisticated spacecraft flying through the Saturn system some time between November 1980 and September 1981. This opportunity to explore one of our solar system's most complex planet and satellite systems must be planned and designed for, if the mission is to take full advantage of the science value return that is possible. Part of optimizing the Saturn-encounter design for science value return will be the search for close satellite encounters.

This article investigates the opportunities for close satellite encounters which meet the planetary constraints at Saturn that are imposed by science value return and environmental conditions. Since the satellites travel at various speeds in their orbits, Saturn arrival time is critical and has been chosen as the design parameter. Arrival times are recommended which afford close satellite encounters and also meet important mission constraints. A design chart illustrates the satellite opportunities as a function of Saturn arrival date. Potential applications are given to illustrate the use of the Saturn satellite opportunity chart in encounter design.

W004 Mariner Jupiter/Saturn 1977—The Mission Frame

R. D. Bourke, R. F. Miles, Jr., P. A. Penzo, S. L. Van Dillen, and R. A. Wallace

Astronaut. Aeronaut., Vol. 10, No. 11, pp. 42–49, November 1972

For abstract, see Bourke, R. D.

WANG, T. G.

W005 Temperature Dependence of the Accommodation Coefficient of Liquid-Helium Film

T. G. Wang, D. D. Elleman, E. E. Olli, and M. M. Saffren

Phys. Rev. Lett., Vol. 30, No. 11, pp. 485–487, March 12, 1973

The accommodation coefficient γ of a helium film from 1.15 to 4°K is determined by measuring the time constant of a rotating superconducting Nb sphere levitated in vapor and covered with a saturated helium film. The conventional assumption of the phenomenological theory of superfluidity, that the order parameter ψ vanishes at the free surface of helium II, implies that γ is unity and independent of temperature. We find that γ is nearly unity above the λ point, suffers an abrupt drop close to T_λ, and gradually levels off to the value of $\cong 0.8$ at lower temperatures.

W006 Accommodation Coefficient of Unsaturated He I Films

T. G. Wang

Phys. Rev. Lett., Vol. 31, No. 6, pp. 344–346, August 6, 1973

A thickness dependence of the accommodation coefficient γ of unsaturated He I films has been determined by measuring the time constant of a magnetically levitated, slowing, rotating superconducting sphere situated in helium vapor and covered with an unsaturated helium film. The deviation of γ from unity and the linear temperature dependence of the experimental values are in direct contrast to the saturated condition. The abrupt drop of γ at the film thickness of two atomic layers for all the temperatures that have been measured has been interpreted as a direct evidence of solid layers (or the solid-like layers) of helium film.

WARDLE, M. D.

W007 Planetary Quarantine Goes to Work in the Hospital

M. D. Wardle, A. S. Irons, and R. H. Green

Astronaut. Aeronaut., Vol. 11, No. 6, pp. 32–38, June 1973

In a recent survey it was found that approximately 5% of the patients who enter hospitals in the United States contract infections while hospitalized. In an effort to reduce this statistic, JPL, under a program funded by NASA's Technology Applications Office, has studied the merits of applying aerospace technology to the problem. This article describes the contributing hospital conditions encountered during the investigation, and the successful application of planetary-quarantine techniques developed in space exploration and research.

WEBER, C. L.

W008 DSN Progress Report for November–December 1972: Convolutional Codes With a Frequency-Shift-Keying Modem

C. L. Weber

Technical Report 32-1526, Vol. XIII, pp. 114–126, February 15, 1973

This article presents an analytic approximation to the probability of error per bit for the Viterbi maximum-likelihood decoder of convolutional codes which employs an arbitrary modem. The effect of the decoder's limited path memory on performance is determined. The method is applied in particular to the quantized binary-frequency shift-keying modem. This may be useful for entry direct links.

WEBER, W. P.

W009 Negative Ion Mass Spectrometry—A New Analytical Method for Detection of Trinitrotoluene

J. Yinon, H. G. Boettger, and W. P. Weber (University of Southern California)

Anal. Chem., Vol. 44, No. 13, pp. 2235–2237, November 1972

For abstract, see Yinon, J.

WEETALL, H. H.

W010 Behavior of Antidinitrophenyl Antigen–Antibody Complexes in Hydrochloric Acid and Guanidine

N. Weliky and H. H. Weetall

Immunochemistry, Vol. 9, No. 11, pp. 1121–1127, November 1972

For abstract, see Weliky, N.

WELCH, L. R.

W011 DSN Progress Report for September–October 1973: Coded Interleaving for Burst Error Correction

L. R. Welch (University of Southern California)

Technical Report 32-1526, Vol. XVIII, pp. 73–75, December 15, 1973

This paper introduces a generalization of the concept of code interleaving which has proved to be a very useful technique for dealing with complicated communications channels. One of the most recent applications of this concept is the Golay–Viterbi concatenation scheme proposed for use on the Mariner Jupiter/Saturn 1977 Mission. When two or more codes are suitably combined using interleaving, the decoding algorithm for the first code can supply information about the location of errors for the remaining codes, thereby reducing the redundancy requirements for these codes.

WELIKY, N.

W012 Behavior of Antidinitrophenyl Antigen–Antibody Complexes in Hydrochloric Acid and Guanidine

N. Weliky and H. H. Weetall

Immunochemistry, Vol. 9, No. 11, pp. 1121–1127, November 1972

Proteins, azophenylarsonate hapten and other ionizable antigens are completely dissociated from antibody at acidities below pH 3.0, or in 6*M* guanidine at pH 5.5. Complexes of antidinitrophenyl antibody and dinitrophenyl hapten coupled to bovine serum albumin, fibrinogen, or insoluble carboxymethylcellulose did not appreciably dissociate at these concentrations of acid or guanidine, indicating that the interaction of hydrocarbons in the specific interaction site was sufficient to prevent dissociation under conditions where antibody and hapten carrier protein ionic bonds are largely disrupted.

WELLS, I. D.

W013 DSN Progress Report for January–February 1973: The DSN Hydromechanical Equipment Service Program

I. D. Wells and R. M. Smith

Technical Report 32-1526, Vol. XIV, pp. 215–221, April 15, 1973

Operational experience from the first 64-m-diameter antenna indicated that the increase in the quantity of spares required to support the system was becoming prohibitive. With additional antennas becoming operational, it was obvious that an efficient, controllable program was necessary to support the DSN. A study was conducted to determine the optimum method for providing repair, test, and calibration service in support of hydromechanical equipment. Several possible sources of service were considered; the governing factors throughout the comparison phase of the study were cost and reliability. Major consideration was given to conservation of skilled personnel, control of service environment, turnaround time, and the adoption of an oil-sampling and contamination-control program. This article summarizes the results of the study and the present and future status of the program.

WEN, L. C.

W014 Ion Thruster Thermal Characteristics and Performance

L. C. Wen, J. D. Crotty, and E. V. Pawlik

J. Spacecraft Rockets, Vol. 10, No. 1, pp. 35–41, January 1973

Experimental and analytical results for a typical 20-cm-diam, hollow-cathode ion thruster are reported. The foundation of the investigation was the application of thermal model correction techniques. Pertinent thermal properties and plasma heating characteristics of the thruster were determined through correlation and integration of temperature measurement data with a single-state Wiener–Kalman filter. The thruster self-heating levels on various parts were realistically estimated. Analytically predicted temperatures were forced to agree with the measured values for the purpose of constructing a corrected thermal model, which could then be used to evaluate more realistic thruster circumstances and environments. The expected accuracy of the resultant analytical network model was demonstrated to be ±10 K. Thruster thermal performance data for a typical five-thruster array are presented as functions of environmental solar intensities. The thermal analyses are also extended to a 30-cm thruster system.

WETHERILL, G. W.

W015 Minor Planets and Related Objects: XIII. Long-Term Orbital Evolution of (1685) Toro

J. G. Williams and G. W. Wetherill

Astron. J., Vol. 78, No. 6, pp. 510–515, August 1973

For abstract, see Williams, J. G.

WHITEHEAD, P. B.

W016 The Mariner Venus Mercury Flight Data Subsystem

P. B. Whitehead

Proceedings of the National Telecommunications Conference, Houston, Texas, December 4–6, 1972, pp. 28B-1–28B-5

On previous Mariners the Flight Telemetry Subsystem and the Data Automation Subsystem shared responsibility for data handling on the spacecraft. The Flight Telemetry Subsystem handled engineering measurements and the Data Automation Subsystem handled scientific measurements. On Mariner Venus/Mercury 1973 the Flight Data Subsystem (FDS) will combine both these functions.

The FDS collects science and engineering data, formats it into serial data streams, and sends it to the Modulation/Demodulation Subsystem for transmission to the ground or to the Data Storage Subsystem for storage on a digital tape recorder. The FDS is controlled by serial digital words called coded commands received either from the Central Computer and Sequencer or from the ground via the Modulation/Demodulation Subsystem. The FDS is divided into eight major blocks: power converter, timing and control, engineering data, memory, memory input/output and control, nonimaging data, imaging data, and data output. The subsystem consists of some 4000 components. It weighs 17 kg (35 lb) and uses 35 W of power.

WHITTLESEY, A. C.

W017 Electromagnetic Interference of Power Conditioners for Solar Electric Propulsion

A. C. Whittlesey and T. W. Macie

Technical Memorandum 33-623, July 1, 1973

Electrical, multi-kilowatt power-conditioning (PC) equipment needed on board a spacecraft utilizing solar-electric propulsion creates an electromagnetic environment that is potentially detrimental to the science, navigation, and radio-communication hardware. Three lightweight, 2.5-kW PCs were evaluated in terms of their electromagnetic characteristics. It was found that the levels of radiated and conducted interference exceeded the levels anticipated for a solar-electric-propulsion mission. These noise emissions, however, were the result of deficient interference design in these models, rather than a basic inability of this type of PC to control interference.

It is essential that PC design specifications clearly define the electromagnetic-interference (EMI) and electromagnetic-compatibility requirements, that milestones of design evaluation be established, and that the quality assurance plan include provisions for satisfying the EMI requirements as well as an EMI test to verify adequacy of the design.

WIEBE, E.

W018 DSN Progress Report for November–December 1972: Low-Noise Receivers: Microwave Maser Development

E. Wiebe

Technical Report 32-1526, Vol. XIII, pp. 61–65, February 15, 1973

This article summarizes the operational status of the closed-cycle refrigerators (CCRs) used to cool traveling-wave masers in the DSN. The improved CCRs have now replaced virtually all the old Model 210s. The reliability of the new system has lived up to all expectations, but a continuing effort is being made to simplify the system in order to further improve its reliability. The second part of this article describes a simple way of eliminating the oil pump which is used to cool and lubricate the compressor.

WIGGINS, C. P.

W019 DSN Progress Report for July–August 1973: High-Power Microwave Transmitter Switch

C. P. Wiggins, H. R. Buchanan, and R. L. Leu

Technical Report 32-1526, Vol. XVII, pp. 21–27, October 15, 1973

This article describes a technique for high-speed switching or pulse-modulating the X-band radar transmitter. Additional equipment is not needed, and mechanical switches and a high-power modulator are eliminated. Conventional modulation schemes usually result in early failure of the klystron amplifier tubes from thermal stresses; this approach does not have this limitation.

WILCK, H. C.

W020 DSN Progress Report for November–December 1972: The LEAPSIG Sigma 5–Mac 16 Cross-Assembler

H. C. Wilck

Technical Report 32-1526, Vol. XIII, pp. 177–182, February 15, 1973

A cross-assembler, called LEAPSIG, has been developed to permit the Sigma 5 computer to assemble programs for the Mac 16 minicomputer. It was obtained by translating the Mac 16 assembler into a Sigma 5 program by means of Sigma 5 METASYMBOL "procedures." This article describes the LEAPSIG program, discusses the method by which it was generated, and presents information for using LEAPSIG on the Sigma 5.

WILLIAMS, H. E.

W021 Analysis of a Ring With a Hinged Cross Section

H. E. Williams (Harvey Mudd College)

J. Spacecraft Rockets, Vol. 9, No. 11, pp. 787–788, November 1972

In searching for a ring structure that could be folded and stored in minimum space, it has been proposed to construct a ring by lacing together three elements—the upper flange, lower flange, and a web—into a basic channel cross section. The resulting assembly constitutes a ring whose cross section may distort a limited amount. The ring assembly is analyzed in this article as an application of the principle of virtual work taken within the framework of small displacement theory.

WILLIAMS, J. G.

W022 Minor Planets and Related Objects: XIII. Long-Term Orbital Evolution of (1685) Toro

J. G. Williams and G. W. Wetherill

Astron. J., Vol. 78, No. 6, pp. 510–515, August 1973

The orbital evolution of (1685) Toro has been investigated over 5000 yr. The asteroid exhibits a locked resonance through an 8:5 commensurability with the Earth for the first 3400 yr of integration and a locked resonance with Venus through a 13:5 commensurability for the last 1000 yr. Control of these resonances passes from the Earth to Venus as the distance from the Earth's orbit gets greater and the distance to Venus' orbit gets closer as a consequence of the precession of the argument of perihelion. The double resonance may give Toro the ability to avoid collisions with the Earth and Venus at the present time but this is still uncertain. Mars perturbations could remove Toro from the deepest part of the resonance in about 3 million yr. Thus Toro's lifetime can be only marginally lengthened over the normally expected value of 10–30 million yr by the resonance.

WILLIAMS, W.

W023 Electron Scattering by Molecules With and Without Vibrational Excitation—IV. Elastic Scattering and Excitation of the First Vibrational Level for N_2 and CO at 20 eV

D. G. Truhlar (University of Minnesota), S. Trajmar, and W. Williams

J. Chem. Phys., Vol. 57, No. 8, pp. 3250–3259, October 15, 1972

For abstract, see Truhlar, D. G.

W024 Electron Scattering by Molecules With and Without Vibrational Excitation—VI. Elastic Scattering by CO at 6–80 eV

D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

J. Chem. Phys., Vol. 57, No. 10, pp. 4307–4312, November 15, 1972

For abstract, see Truhlar, D. G.

W025 Electron Impact Excitation of H_2O

S. Trajmar, W. Williams, and A. Kuppermann (California Institute of Technology)

J. Chem. Phys., Vol. 58, No. 6, pp. 2521–2531, March 15, 1973

For abstract, see Trajmar, S.

W026 Vibrational Excitation in CO by Electron Impact in the Energy Range 10–90 eV

A. Chutjian, D. G. Truhlar (University of Minnesota), W. Williams, and S. Trajmar

Phys. Rev. Lett., Vol. 29, No. 24, pp. 1580–1583, December 11, 1972

For abstract, see Chutjian, A.

WILLSON, R. C.

W027 Active Cavity Radiometer

R. C. Willson

Appl. Opt., Vol. 12, No. 4, pp. 810–817, April 1973

The active cavity radiometer (ACR) is a pyrheliometer that accurately defines the absolute radiation scale. The physics of the pyrheliometric method and the ACR approach to this method are presented in detail. A mathematical abstraction of the method is generated through a quasi-equilibrium analysis of the power balance of the ACR's cavity detector. An error analysis is carried out on the quasi-equilibrium equation to determine the uncertainties of ACR measurements relative to the absolute radiation scale. The uncertainty of ACR measurements as a function of irradiance level is presented in graphical form.

W028 Experimental Comparisons of the International Pyrheliometric Scale With the Absolute Radiation Scale

R. C. Willson

Nature, Vol. 239, No. 5369, pp. 208–209, September 22, 1972

A series of radiometer comparison tests has been carried out at the JPL Table Mountain Observatory during the period May 1968 to August 1970. Solar irradiance measurements by instruments (Eppley Angstrom Pyrheliometers) reproducing the International Pyrheliometric Scale (IPS) have been compared with measurements made simultaneously by a number of JPL active cavity radiometers (ACRs) and practical absolute cavity radiometers (PACRADs). This article presents the results of these tests which demonstrate a systematic difference between the absolute radiation scale, as defined by the ACR and PACRAD measurements, and the IPS. An IPS absolute error of 2.2 ± 0.5% is indicated.

W029 New Radiometric Techniques and Solar Constant Measurements

R. C. Willson

Solar Energy, Vol. 14, No. 2, pp. 203–211, January 1973

A series of absolute cavity radiometers, designed to measure solar irradiance, has been developed at JPL. Analysis indicates the absolute uncertainty of irradiance measurements made by the most recent devices to be less than ±0.5 mW/cm^2. In experiments the radiometric scale defined by the JPL instruments has been compared with the International Pyrheliometric Scale (IPS). A systematic 2.2% difference has been observed with the IPS producing consistently lower measurements.

The solar constant and spectral distribution have been derived from high-altitude balloon flight measurements made by two types of JPL cavity radiometers. Measurements at 25 km in 1968 produced a solar constant value of 137.0 mW/cm^2. From 1969 measurements at 36 km, a value of 136.6 mW/cm^2 was derived, with an estimated absolute uncertainty of ±0.5%.

WILSON, A. H.

W030 Furlable Spacecraft Antenna Development: Second Interim Report

R. E. Oliver and A. H. Wilson

Technical Memorandum 33-606, May 15, 1973

For abstract, see Oliver, R. E.

WILSON, J. H.

W031 Mariner Venus Mercury 1973

J. H. Wilson

Technical Memorandum 33-657, October 15, 1973

The Mariner Venus/Mercury 1973 spacecraft will fly by Venus in February, 1974, and Mercury in March. It will be the first spacecraft to use one planet's gravitation to reach another, and it will also provide the first closeup photographs of both Venus and Mercury. This memorandum presents a general description and summary of the Mariner Venus/Mercury 1973 Project. Specific descriptions are given of the launch vehicle and spacecraft; trajectory and navigation strategy; scientific instruments and experiments; tracking and data system support; and mission operations and objectives.

WOICESHYN, P.

W032 Approximations to the Mean Surface of Mars and Mars Atmosphere Using Mariner 9 Occultations

D. L. Cain, A. J. Kliore, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4352–4354, July 10, 1973

For abstract, see Cain, D. L.

W033 S Band Radio Occultation Measurements of the Atmosphere and Topography of Mars with Mariner 9: Extended Mission Coverage of Polar and Intermediate Latitudes

A. J. Kliore, G. Fjeldbo, B. L. Seidel, M. J. Sykes, and P. Woiceshyn

J. Geophys. Res., Vol. 78, No. 20, pp. 4331–4351, July 10, 1973

For abstract, see Kliore, A. J.

WOLLENHAUPT, W. R.

W034 Lunar Shape via the Apollo Laser Altimeter

W. L. Sjogren and W. R. Wollenhaupt

Science, Vol. 179, No. 4070, pp. 275–278, January 19, 1973

For abstract, see Sjogren, W. L.

W035 Gravity: Mare Humorum

W. L. Sjogren and W. R. Wollenhaupt

The Moon, Vol. 8, Nos. 1 and 2, pp. 25–32, July–August 1973

For abstract, see Sjogren, W. L.

WOMACK, J. R.

W036 Slosh Testing of a Spherical Mercury Propellant Tank With Positive-Expulsion Diaphragm

R. G. Ross, Jr., and J. R. Womack

Technical Memorandum 33-632, July 15, 1973

For abstract, see Ross, R. G., Jr.

WONG, S. K.

W037 DSN Progress Report for September–October 1973: Short Baseline QVLBI Demonstrations—Part I

C. C. Chao, S. K. Wong, and A. Lubeley (Philco-Ford Corporation)

Technical Report 32-1526, Vol. XVIII, pp. 47–56, December 15, 1973

For abstract, see Chao, C. C.

W038 Earth–Moon Mass Ratio From Mariner 9 Radio Tracking Data

S. K. Wong and S. J. Reinbold

Nature, Vol. 241, No. 5385, pp. 111–112, January 12, 1973

The navigation of the Mariner 9 spacecraft from Earth to Mars was performed using phase-coherent range and doppler radio metric data recorded by the JPL Deep Space Network. These data also determine the Earth–moon mass ratio, which involves the following physics: as the Earth revolves about the center of mass of the Earth–moon system, a sinusoidal curve is impressed on the range and doppler radio metric data with a frequency equal to the sidereal mean motion of the moon. This sinusoidal variation in the radio metric data can be eliminated by finding a value for μ^{-1} (mass of Earth over mass of moon) that properly represents the amplitude of the barycenter motion of the Earth. The procedure is direct and for all practical purposes is completely uncoupled from other parameters used in reducing the radio metric data.

The mass ratio was determined from range and doppler data obtained over a period of 15 weeks. Five solutions were examined, with all yielding nearly the same mass ratio.

WOO, J.

W039 DSN Progress Report for November–December 1972: DSS Command System Redesign

J. Woo

Technical Report 32-1526, Vol. XIII, pp. 203–208, February 15, 1973

The existing DSN Command System cannot meet project requirements through the Viking era (1975). This article describes the DSN Command System redesign that will be used to support mission command requirements through 1975. Major areas of redesign include command-stack capacity and allocation of command-stack manipulating functions from the DSN computer to the Mission Control and Computing Center. This article describes the system configuration and the functional operation of the redesign.

WOO, R.

W040 Effects of Turbulence in the Atmosphere of Venus on Pioneer Venus Radio—Phase I

R. Woo, W. Kendall, A. Ishimaru, and R. Berwin

Technical Memorandum 33-644, June 30, 1973

The purpose of this study is to predict the effects of turbulence in the atmosphere of Venus on Pioneer Venus radio. Estimates of turbulence effects depend a great deal on our knowledge of the turbulence. Although very little is known about the turbulence in the Venusian atmosphere, valuable information can be inferred from radio measurements of the planet's atmosphere made by the previous space probes Venera and Mariner 5.

A careful investigation based on a theoretical and experimental study of the power spectrum of the Mariner 5 amplitude fluctuations is carried out and the results contribute considerably to our scientific knowledge of turbulence in the atmosphere of Venus. Fully developed turbulence is seen to exist predominantly in the altitude range of 41–49 km. This result is consistent with the high wind shear and wind velocities observed by Venera 4 for altitudes higher than 40 km. The outer scale size of turbulence is on the order of 100 m, the structure constant for the dayside atmosphere 3.9×10^{-7} $m^{-1/3}$, and that for the nightside atmosphere 2.9×10^{-7} $m^{-1/3}$.

Estimates for Pioneer Venus indicate that the variance of log-amplitude fluctuations is less than 0.056, the variance of phase fluctuations less than 0.88 rad^2 and the bandwidth of both amplitude and phase fluctuations no more than a few Hz.

W041 Remote Sensing of the Turbulence Characteristics of a Planetary Atmosphere by Radio Occultation of a Space Probe

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

Radio Sci., Vol. 8, No. 2, pp. 103–108, February 1973

The purpose of this article is to analyze the effects of small-scale turbulence on radio waves propagating through a planetary atmosphere. The analysis provides a technique for inferring the turbulence characteristics of a planetary atmosphere from the radio signals received from a spacecraft as it is occulted by the planet. The planetary turbulence is assumed to be localized and smoothly varying with the structure constant varying exponentially with altitude. The variance of log-amplitude and phase fluctuations of a wave propagating through the atmosphere are derived. When the distance between the spacecraft and the planetary atmosphere exceeds L_0^2/λ, where L_0 is the outer scale of turbulence, the effects of inhomogeneity and finite size of the turbulent medium become important. A recent study, reported earlier, pointed out that the structure constant for the Venusian atmosphere inferred from the Mariner 5 occultation data was significantly lower than that inferred from the Venera 4 data. By applying the analysis developed in this article it is shown that the effects of inhomogeneity and finite size of the turbulence, which were excluded in the previous analysis, account for this difference. More important, however, is the fact that the new techniques are available for use in future radio-occultation missions.

WRIGHT, D. L.

W042 The Mesa Arizona Pupil Tracking System

D. L. Wright

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 87–92, January 1973

A computer-based pupil-tracking/teacher-monitoring system was designed for Mesa Public Schools, Mesa, Arizona. The established objectives of the system were to: (1) facilitate the economical collection and storage of student performance data necessary to objectively evaluate the relative effectiveness of teachers, instructional methods, materials, and applied concepts; and (2) identify, on a daily basis, those students requiring special attention in specific subject areas.

The system encompasses computer hardware/software and integrated curricula progression/administration devices. It provides daily evaluation and monitoring of performance as students progress at class or individualized rates. In the process, it notifies the student and collects information necessary to validate or invalidate subject presentation devices, methods, materials, and measurement devices in terms of direct benefit to the students. The system utilizes a small-scale computer (e.g., IBM 1130) to assure low-cost replicability, and may be used for many subjects of instruction.

WU, F. T.

W043 Ionization Processes in Mercury Discharges

F. T. Wu

Technical Memorandum 33-596, March 1, 1973

This report presents a summary of theoretical calculations of the ionization processes in mercury plasma. Various possible ionization processes are analyzed and discussed. It is found that the ionization due to excited-state interactions is dominant when the degree of ionization is small and that the ionization due to multistep electron impact is significant when the degree of ionization is high.

W044 Measurement of Electron Distribution Function in a Cesium Plasma

C. J. Chen, J. Wu (State University of New York), and F. T. Wu (State University of New York)

J. Appl. Phys., Vol. 43, No. 11, pp. 4570–4573, November 1972

For abstract, see Chen, C. J.

W045 Measurement of Electron-Ion Recombination Rate of a Dense High-Temperature Cesium Plasma

C. J. Chen, J. Wu (State University of New York), F. T. Wu (State University of New York), and D. T. Shaw (State University of New York)

J. Appl. Phys., Vol. 44, No. 7, pp. 3052–3054, July 1973

For abstract, see Chen, C. J.

WU, J.

W046 Measurement of Electron Distribution Function in a Cesium Plasma

C. J. Chen, J. Wu (State University of New York), and F. T. Wu (State University of New York)

J. Appl. Phys., Vol. 43, No. 11, pp. 4570–4573, November 1972

For abstract, see Chen, C. J.

W047 Measurement of Electron-Ion Recombination Rate of a Dense High-Temperature Cesium Plasma

C. J. Chen, J. Wu (State University of New York), F. T. Wu (State University of New York), and D. T. Shaw (State University of New York)

J. Appl. Phys., Vol. 44, No. 7, pp. 3052–3054, July 1973

For abstract, see Chen, C. J.

WUEST, W. S.

W048 Solid Motor Diagnostic Instrumentation

Y. Nakamura, W. E. Arens, and W. S. Wuest

Technical Memorandum 33-656, December 1, 1973

For abstract, see Nakamura, Y.

YANG, J.-N.

Y001 Probability of Stress-Corrosion Fracture Under Random Loading

J.-N. Yang

Eng. Fracture Mech., Vol. 4, No. 4, pp. 737–748, December 1972

A method is developed for predicting the probability of stress-corrosion fracture of structures under random loadings. The formulation is based on the cumulative damage hypothesis and the experimentally determined stress-corrosion characteristics. Under both stationary and nonstationary random loadings, the mean value and the variance of the cumulative damage are obtained. The probability of stress-corrosion fracture is then evaluated using the principle of maximum entropy. It is shown that, under stationary random loadings, the standard deviation of the cumulative damage increases in proportion to the square root of time, while the coefficient of variation (dispersion) decreases in inverse proportion to the square root of time. Numerical examples are worked out to illustrate the general results.

Y002 On the Normality and Accuracy of Simulated Random Processes

J.-N. Yang

J. Sound Vibr., Vol. 26, No. 3, pp. 417–428, 1973

Efficient methods of simulating stationary and nonstationary random processes and envelopes, by using a series of sine or cosine functions or by using the fast Fourier transform, have been proposed previously. Without applying the central limit theorem, it is shown in this article that the simulated random processes are asymptotically gaussian processes as the number of terms, N, of sine or cosine functions approaches infinity. The accuracy of the first-order probability densities of the simulated random processes is investigated by using the fast Fourier transform. Numerical results are computed with respect to the variation of the number of terms, N, of sine or cosine functions used for simulation. It is shown that within the practical range of N, such as 500, the accuracy is remarkably satisfactory even outside the region of 3 standard deviations. The investigation of the accuracy of the second-order probability densities by applying the fast Fourier transform is also described in detail. The study of accuracy presented herein is of vital importance in determining the applicability and practicality of methods of simulation.

Y003 First-Excursion Probability in Non-Stationary Random Vibration

J.-N. Yang

J. Sound Vibr., Vol. 27, No. 2, pp. 165–182, March 1973

The first-excursion probability of a non-stationary gaussian process with zero mean has been studied. Within the framework of the point process approach, a variety of analytical approximations applicable to stationary random processes is extended herein to non-stationary random processes. The extension is possible owing to a recent definition of non-stationary envelope processes proposed by the author. With the aid of numerical examples, merits of each approximation are examined by comparing with the results of simulation. It is found that under non-stationary excitations with short duration, the Markov approximation is the best among all the approximations discussed in this article. The efficient numerical computation of excursion statistics and the clear advantage of discretization of time domain are discussed.

Y004 Nonstationary Envelope Process and First Excursion Probability

J.-N. Yang

Struct. Mech., Vol. 1, No. 2, pp. 231–248, 1972

An earlier definition of stationary random envelope is extended in this article to the envelope of nonstationary random processes possessing evolutionary power spectral densities. The density function, the joint density function, the moment function, and the crossing rate of a level of the nonstationary envelope process are derived. Based on the envelope statistics, approximate solutions to the first excursion probability of nonstationary random processes are obtained. In particular, applications of the first excursion probability to the earthquake engineering problems are demonstrated in detail.

Y005 On the First-Excursion Probability in Stationary Narrow-Band Random Vibration, II

J.-N. Yang and M. Shinozuka (Columbia University)

Trans. ASME, Ser. E: J. Appl. Mech., Vol. 39, No. 3, pp. 733–738, September 1972

The first-excursion probability of a stationary narrow-band gaussian process with mean zero has been studied. Within the framework of point process approach, series approximations derived from the theory of random points and approximations based on the maximum entropy principle have been developed. With the aid of numerical examples, merits of the approximations proposed previously as well as of those developed in this article have been compared. The results indicate that the maximum entropy principle has not produced satisfactory approximations but the approximation based on nonapproaching random points is found to be the best among all the approximations proposed herein. A conclusion drawn from the present and the previous studies is that the point process approach produces a number of useful approximations for the first-excursion probability, particularly those based on the concepts of the Markov process, the clump-size, and the nonapproaching random points.

YANG, L. C.

Y006 A High-Efficiency, Small, Solid-State Laser for Pyrotechnic Ignition

L. C. Yang and V. J. Menichelli

JPL Quarterly Technical Review, Vol. 2, No. 4, pp. 29–37, January 1973

A completely self-contained, small, neodymium laser has been designed and demonstrated for use in a pyrotechnic ignition system. A nominal 16 J of laser energy (1.06-μm wavelength, 1-ms duration) was achieved in a rectangular 10.5- × 15.1- × 25.4-cm package weighing 5.14 kg. This high energy-to-weight ratio is encouraging for laser applications in which specific energy efficiency (energy per unit weight or volume) is important. This article describes the laser design concepts and presents some results on pyrotechnic ignition. Some details on a laser currently under construction, which will be 1/8 the size of the above laser, are included.

Y007 A Compact Glass Pulser

L. C. Yang

Laser Focus, Vol. 9, No. 7, pp. 37–39, July 1973

For aerospace applications, the value of a pulsed solid-state laser depends largely on its specific efficiency: laser energy per unit volume or weight of the system. With a neodymium system, specific efficiency of about 1.5 J/lb and 0.8 J/in.^{3} can be attained, and the concept can be extended to a higher-energy or q-switched version. This article describes the design development of such a system, and two hardware versions are shown.

YASUI, R. K.

Y008 Parametric Performance Characteristics and Treatment of Temperature Coefficients of Silicon Solar Cells for Space Application

R. E. Patterson and R. K. Yasui

Technical Report 32-1582, May 15, 1973

For abstract, see Patterson, R. E.

Y009 Thermoelastic Analysis of Solar Cell Arrays and Their Material Properties

A. M. Salama, W. M. Rowe, and R. K. Yasui

Technical Memorandum 33-626, September 1, 1973

For abstract, see Salama, A. M.

YEH, C.

Y010 Periodic Structures in Integrated Optics

C. Elachi and C. Yeh

J. Appl. Phys., Vol. 44, No. 7, pp. 3146–3152, July 1973

For abstract, see Elachi, C.

YEH, Y.-C. M.

Y011 Solar and Laser Energy Conversion With Schottky Barrier Solar Cells

R. J. Stirn and Y.-C. M. Yeh

Proceedings of the IEEE Tenth Photovoltaic Specialists Conference, Palo Alto, California, November 13–15, 1973, pp. 15–24

For abstract, see Stirn, R. J.

YEN, C. L.

Y012 Low-Thrust Mission Risk Analysis, With Application to a 1980 Rendezvous With the Comet Encke

C. L. Yen and D. B. Smith

Technical Memorandum 33-593, March 15, 1973

This memorandum presents a computerized, multistage failure-process simulation procedure used to evaluate the risk in a solar-electric space mission. The procedure uses currently available thrust-subsystem reliability data and performs approximate simulations of the thrust-subsystem burn operation, the system failure processes, and the retargeting operations. The method is applied to assess the risks in carrying out a 1980 rendezvous mission to

the comet Encke. Analysis of the results and evaluation of the effects of various risk factors on the mission show that system component-failure rates are the limiting factors in attaining a high mission reliability. It is also shown that a well-designed trajectory and system-operation mode can be used effectively to compensate partially for unreliable thruster performance.

Y013 A Preliminary Design and Implementation of the Low-Thrust Simulation and Trajectory Search Program (LOWTRAJ)

C. L. Yen

Technical Memorandum 33-648, October 15, 1973

This memorandum presents the results of one phase of research conducted for the JPL Solar-Electric Propulsion (SEP) Navigation Software System development program. It deals only with the problem of designing the flight-quality trajectory program, which is a major subset of the entire navigation software system.

In the breadboard-development phase of research, attempts were made to assess the SEP trajectory-software functional requirements, to investigate the program design method satisfying these requirements, to identify the primary anticipated problem areas, and to provide solutions to these problem areas. These efforts culminated in the development of a compact breadboard program, "LOWTRAJ." A functional description and the mathematical formulation of the program are presented. The results of tests performed using LOWTRAJ indicate that the primary requirements of the flight-quality trajectory program can be met with this type of design.

YEN, S. P. S.

Y014 The Polymerization of 3-Dimethylamino-n-Propyl Chloride and the Formation of Star-Shaped and Branched Polyelectrolytes

S. P. S. Yen, D. Casson, and A. Rembaum

Water-Soluble Polymers, pp. 291–312, Plenum Publishing Corporation, New York, 1973

In view of the present and potential applications of high-charge-density polyelectrolytes, as well as of their academic interest, the mechanism of formation and some physical and chemical properties of the 3,3-ionene chloride formed from 3-dimethylamino-*n*-propyl chloride has been investigated. As a result of a systematic study of the polymerization process as a function of concentration, solvent, temperature, and time, the conditions for the synthesis of this ionene polymer with a weight-average molecular weight of at least 60,000 are established. A preliminary study of the reaction of dimethylamino-*n*-propyl chloride with low-molecular-weight compounds and polymers containing either chloromethyl or dimethylamino groups was also carried out and it was shown that these reactions yield star-shaped and branched polyelectrolytes.

YEN, T. F.

Y015 Analyses of the Returned Lunar Surface Fines for Porphyrins

J. H. Rho, A. J. Bauman, E. A. Cohen, T. F. Yen (University of Southern California), and J. Bonner (California Institute of Technology)

Space Life Sci., Vol. 3, No. 4, pp. 415–418, October 1972

For abstract, see Rho, J. H.

Y016 A Search for Porphyrin Biomarkers in Nonesuch Shale and Extraterrestrial Samples

J. H. Rho, A. J. Bauman, H. G. Boettger, and T. F. Yen (University of Southern California)

Space Life Sci., Vol. 4, No. 1, pp. 69–77, January 1973

For abstract, see Rho, J. H.

YINON, J.

Y017 Negative Ion Mass Spectrometry—A New Analytical Method for Detection of Trinitrotoluene

J. Yinon, H. G. Boettger, and W. P. Weber (University of Southern California)

Anal. Chem., Vol. 44, No. 13, pp. 2235–2237, November 1972

The detection of poly-nitro aromatic compounds concealed in airline baggage, such as trinitrotoluene (TNT), is an extremely relevant analytical problem which requires a highly sensitive as well as specific method for its solution. One of the most sensitive analytical devices available for the detection of trace quantities of material is the mass spectrometer. The use of positive ion mass spectrometry is difficult because it is approximately equally sensitive to all types of volatile organic compounds.

Negative ion mass spectrometry, on the other hand, is extremely selective in its sensitivity. With this thought in mind, the negative ion mass spectrum of TNT has been examined. This article presents some of the findings and proposals resulting from the examination.

Y018 Modification of an AEI/GEC MS9 High-Resolution Mass Spectrometer for Electron Impact/Chemical Ionization Studies

J. Yinon and H. G. Boettger

Chem. Instr., Vol. 4, No. 2, pp. 103–113, 1972

A double-focusing MS9 mass spectrometer has been modified to permit operation in both chemical ionization (CI) and electron impact (EI) modes. The modifications consist mainly of a closed ion chamber, a high capacity pumping system, a reactant gas inlet system, a new solid sample probe, and a source pressure measuring device. Changes have also been made in the electronic system and a new ion source power supply has been incorporated.

The new ion source can be operated in the CI mode at pressures up to 1 torr while the pressure in the analyzer is better then 10^{-7} torr. The new set-up has the ability to analyze solid, liquid, and gas samples in both CI and EI.

YIP, K. W.

Y019 DSN Progress Report for July–August 1973: A System Analysis of Error Sources in the Technique Used for Ionospheric Calibration of Deep Space Probe Radio Metric Data

K. W. Yip and B. D. Mulhall

Technical Report 32-1526, Vol. XVII, pp. 48–67, October 15, 1973

This article describes a system analysis which has been performed on the error sources in the technique used for ionospheric calibration of deep-space-probe radio metric data. This analysis is based on the Chapman ionospheric model. Although it has been proven that this model is inadequate in ranging for low elevation angles (<15 deg) of the spacecraft and large solar zenith angles (>|60| deg), this analysis should still be valid for most of the daytime because of the very conservative values adopted for the variations of these Chapman ionospheric parameters. It is found that if a close-by source of total electron content (TEC) data is used, the uncertainty is ~10% at low elevation angles and less than ~3% for elevation angles higher than ~20 deg. The corresponding values for the distant mapping of TEC data are ~10% and ~8%, respectively.

YODER, M. F.

Y020 DSN Progress Report for January–February 1973: A Study of Varshamov Codes for Asymmetric Channels

R. P. Stanley and M. F. Yoder

Technical Report 32-1526, Vol. XIV, pp. 117–123, April 15, 1973

For abstract, see Stanley, R. P.

YOST, E.

Y021 Isoluminous Additive Color Method for the Detection of Small Spectral Reflectivity Differences

E. Yost (Long Island University), R. Anderson (Long Island University), and A. F. H. Goetz

Photogr. Sci. Eng., Vol. 17, No. 2, pp. 177–182, March–April 1973

A method using photographic masking techniques has been developed for the display of three-band photography in which normalized spectral reflectivity variations are shown independent of scene brightness. The method was applied to lunar orbital multispectral photography obtained on Apollo 12. The technique has subsequently been applied to earth resource applications by enhancing the color contrast of multispectral photography under varying lighting conditions.

YOUNG, A. T.

Y022 On the Temperature Distribution in a Planetary Atmosphere

L. D. G. Young and A. T. Young

Astrophys. J., Vol. 176, No. 2, Pt. 1, pp. 533–554, September 1, 1972

For abstract, see Young, L. D. G.

Y023 Comment on "The Composition of the Venus Cloud Tops in Light of Recent Spectroscopic Data"

L. D. G. Young and A. T. Young

Astrophys. J., Vol. 179, No. 1, Pt. 2, pp. L39–L43, January 1, 1973

For abstract, see Young, L. D. G.

Y024 The Planet Venus: A New Periodic Spectrum Variable

L. D. G. Young, A. T. Young, J. W. Young, and J. T. Bergstralh

Astrophys. J., Vol. 181, No. 1, Pt. 2, pp. L5–L8, April 1, 1973

For abstract, see Young, L. D. G.

Y025 Mariner 9—Image Processing and Products

E. C. Levinthal (Stanford University), W. B. Green, J. A. Cutts, E. D. Jahelka, R. A. Johansen, M. J. Sander, J. B. Seidman, A. T. Young, and L. A. Soderblom (U.S. Geological Survey)

Icarus, Vol. 18, No. 1, pp. 75–101, January 1973

For abstract, see Levinthal, E. C.

Y026 Are the Clouds of Venus Sulfuric Acid

A. T. Young

Icarus, Vol. 18, No. 4, pp. 564–582, April 1973

Water solutions of sulfuric acid, containing about 75% H_2SO_4 by weight, have a refractive index within 0.01 of the values deduced from polarimetric observations of the Venus clouds. These solutions remain liquid at the cloud temperature, thus explaining the spherical shape of the cloud particles (droplets). The equilibrium vapor pressure of water above such solutions is 0.01 that of liquid water or ice, which accounts for the observed dryness of the cloud region. Furthermore, H_2SO_4 solutions of such concentration have spectra very similar to Venus in the 8–13-μm region; in particular, they explain the 11.2-μm band. Cold sulfuric acid solutions also seem consistent with Venus spectra in the 3- to 4-μm region. The amount of acid required to make the visible clouds is quite small, and is consistent with both the cosmic abundance of sulfur and the degree of out-gassing of the planet indicated by known atmospheric constituents.

Sulfuric acid occurs naturally in volcanic gases, along with known constituents of the Venus atmosphere such as CO_2, HCl, and HF; it is produced at high temperature by reactions between these gases and common sulfate rocks. The great stability and low vapor pressure of H_2SO_4 and its water solutions explain the lack of other sulfur compounds in the atmosphere of Venus—a lack that is otherwise puzzling.

Sulfuric acid precipitation may explain some peculiarities in Venera and Mariner data. Because sulfuric acid solutions are in good agreement with the Venus data, and because no other material that has been proposed is even consistent with the polarimetric and spectroscopic data, H_2SO_4 must be considered the most probable constituent of the Venus clouds.

YOUNG, J. W.

Y027 The Planet Venus: A New Periodic Spectrum Variable

L. D. G. Young, A. T. Young, J. W. Young, and J. T. Bergstralh

Astrophys. J., Vol. 181, No. 1, Pt. 2, pp. L5–L8, April 1, 1973

For abstract, see Young, L. D. G.

YOUNG, L. D. G.

Y028 On the Temperature Distribution in a Planetary Atmosphere

L. D. G. Young and A. T. Young

Astrophys. J., Vol. 176, No. 2, Pt. 1, pp. 533–554, September 1, 1972

It has been suggested that a double maximum in one branch of a vibration-rotation band can yield information about the temperature distribution in a planetary atmosphere. Theoretical calculations indicate that a double maximum cannot occur in the intensity distribution of lines in either the *P*-branch or the *R*-branch of any diatomic or linear polyatomic molecule, unless the temperature ratio for two isothermal layers of gas exceeds ~9. A similar calculation predicts where double maxima can occur due to quantum-mechanical interactions.

This article presents a more sensitive method of estimating the range of temperature in the part of the atmosphere where spectral lines are formed, from observations made in reflected sunlight. This method is applied to the best available spectroscopic observations of Venus made in the 7820 Å CO_2 band. Statistical tests suggest that we are not seeing an isothermal layer, based on these data. However, a 100°K temperature spread is near the limit of detection with present observational techniques.

Y029 Comment on "The Composition of the Venus Cloud Tops in Light of Recent Spectroscopic Data"

L. D. G. Young and A. T. Young

Astrophys. J., Vol. 179, No. 1, Pt. 2, pp. L39–L43, January 1, 1973

It has been suggested in previous reporting that the topmost clouds of Venus are composed of concentrated aqueous HCl solutions. This article compares laboratory spectra of aqueous HCl solutions with spectra of Venus and concludes that the composition of the clouds of Venus is in much better agreement with sulfuric than with hydrochloric acid solutions.

Y030 The Planet Venus: A New Periodic Spectrum Variable

L. D. G. Young, A. T. Young, J. W. Young, and J. T. Bergstralh

Astrophys. J., Vol. 181, No. 1, Pt. 2, pp. L5–L8, April 1, 1973

This article describes a study of the transparency variations in the atmosphere of Venus as well as their correlation (if any) with ultraviolet cloud features photographed cooperatively by the Paris, New Mexico State University, and Lowell observatories. The study has shown that the

apparent strength of CO_2 absorptions in the spectrum of Venus varies by 20% in a period of 4 days. The variations are synchronous over the disk and thus represent a fundamental dynamical mode of the atmosphere.

Y031 High Resolution Spectra of Venus—A Review

L. D. G. Young

Icarus, Vol. 17, No. 3, pp. 632–658, December 1972

The existing high resolution spectra of Venus show considerable variations in the abundance of CO_2. As this is the major constituent of the atmosphere, these day-to-day variations indicate that the effective reflecting cloud layer is undergoing substantial vertical displacements over a relatively short time scale. The published observations indicate that CO is uniformly mixed with the CO_2, but that the lines of HF may be formed deeper in the atmosphere and HCl lines considerably deeper. These conclusions are based on extrapolations of laboratory measurements and could be considerably altered by new laboratory measurements made under conditions similar to those near the tropopause in Venus.

YOUNGER, H. C.

Y032 DSN Progress Report for January–February 1973: Simulated Deep Space Station Control Console Study

H. C. Younger

Technical Report 32-1526, Vol. XIV, pp. 222–225, April 15, 1973

This article describes a study of deep-space-station operations with the aid of a simulated control console which is currently being used to evaluate operations at the Echo Deep Space Station. This study is intended to improve performance and reduce operating costs by allowing the station to be operated on a system basis by system-engineering personnel. Study approach and current status are presented.

YUEN, J. H.

Y033 A Double-Loop Tracking System

J. H. Yuen

IEEE Trans. Commun., Vol. COM-20, No. 6, pp. 1142–1150, December 1972

This article presents a nonlinear analysis which can be used to assess certain statistical characteristics of double-loop tracking systems. The analysis takes into account the mutual coupling effects of the loops in the system. Two approaches are taken to obtain steady-state probability density functions of the system phase errors, ϕ_1 and ϕ_2. From these probability density functions, important system performance statistics, e.g., the phase-error variances, can be calculated, thus illustrating the application and usefulness of the analysis. The analysis is applied to a satellite transponder as an example.

ZAFONTE, L.

Z001 Hydrocarbons in Air Samples From Antarctic Dry Valley Drilling Sites

J. V. Behar (University of California, Riverside), L. Zafonte (University of California, Riverside), R. E. Cameron, and F. A. Morelli

Antarctic J. U.S., Vol. VII, No. 4, pp. 94–96, July–August 1972

For abstract, see Behar, J. V.

ŽMUIDZINAS, J. S.

Z002 Energy Storage in Solid Helium

J. S. Žmuidzinas

Technical Memorandum 33-653, September 15, 1973

This memorandum discusses the problem of storing large amounts of energy in electronically excited solid helium, He IV. Important physical processes in He IV are identified, and a study program is proposed with the aim of making energy storage in He IV a practical reality.

ZOHAR, S.

Z003 New Hardware Realizations of Nonrecursive Digital Filters

S. Zohar

IEEE Trans. Computers, Vol. C-22, No. 4, pp. 328–338, April 1973

Analysis of the bit-level operations involved in the convolution realizing a nonrecursive digital filter leads to hardware designs of digital filters based on the operation of counting. Two distinct designs are outlined: the first one is capable of very high speed but is rather expensive; the second is quite slow but has the advantages of low cost and high flexibility. The basic designs considered utilize fixed-point representation for the data and filter coefficients. Variants allowing floating-point representation of the coefficients are also described.

Z004 The Counting Recursive Digital Filter

S. Zohar

IEEE Trans. Computers, Vol. C-22, No. 4, pp. 338–347, April 1973

Analysis of the bit-level operations involved in the convolutions realizing recursive digital filters leads to hardware designs of such filters based on the operation of counting. Various designs realizing both the canonic and "direct" forms are presented with particular emphasis on low-cost, low-speed, high-flexibility machines.

Z005 Fast Hardware Fourier Transformation Through Counting

S. Zohar

IEEE Trans. Computers, Vol. C-22, No. 5, pp. 433–441, May 1973

Hardware Fourier transformations are considered with the goal of increasing speed through parallel operation. Two designs in which the basic element is a fast counter are developed. One is applicable when the number of transformed points N is prime while the other, requiring somewhat more hardware, is applicable to all N. For small N, both designs are more economical than equal-speed designs based on parallel implementation of the fast Fourier transform algorithm. An important feature of these machines (particularly the one for prime N) is very high precision.

Z006 A/D Conversion for Radix (−2)

S. Zohar

IEEE Trans. Computers, Vol. C-22, No. 7, pp. 698–701, July 1973

The direct conversion of an analog signal to its digital representation in base (−2) is considered. A successive approximation conversion strategy is developed and applied to a practical converter that is described in detail.

ZYGIELBAUM, A. I.

Z007 DSN Progress Report for January–February 1973: An Input/Output Processor for the XDS 930: An Exercise in Micro-Programmed Design

A. I. Zygielbaum

Technical Report 32-1526, Vol. XIV, pp. 131–140, April 15, 1973

A micro-programmed, stored-logic, input/output (I/O) processor has been developed to evaluate micro-programming as a digital design technique. This I/O processor can be used for investigating DSN standard computer/computer interfaces as well as for experimentation with external control of the XDS 390 computer in emulation of multiple-computer systems.

Z008 Near Sun Observations of the Solar Wind

P. S. Callahan, P. F. MacDoran, and A. I. Zygielbaum

Space Research XII, pp. 1529–1533, Akademie-Verlag, Berlin, 1972

For abstract, see Callahan, P. S.

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