A87-44302　Comparison of topographic aerial cameras with different parameters (Sravnenie topograficheskikh aerofotoapparatov s raznymi parametrami). V. G. AFREMOV and V. B. IL'IN, *Geodeziia i Kartografiia* (ISSN 0016-7126), Feb. 1987, pp. 45-47.

Principles behind the comparison of various types of topographic aerial cameras are elaborated. Particular consideration is given to the comparison of cameras with identical square frames but with different focal distances and different FOV angles; and cameras with identical FOV angles but with different sizes of the square frames and different focal distances. It is shown that an increase in the frame format leads to an increase in the photography height and scale, resulting in an increase in productivity.

A87-42938　A method for the optimization of orbits and structures of satellite systems for the periodic round-the-clock survey of the earth (Metod optimizatsii orbit i struktury sistem ISZ dlia periodicheskogo kruglosutochnogo obzora zemli). V. K. SAUL'SKII, *Issledovanie Zemli iz Kosmosa* (ISSN 0205-9614), Jan.-Feb. 1987, pp. 111-121. 8 Refs.

A quick-response algorithm is presented for optimizing the circular orbits and positions relative to each other of satellites which make up a space system for the periodic round-the-clock monitoring of the earth surface. The method helps to minimize the repetition period of the continuous scanning of a given global zone. The application of the method to a multisatellite system is demonstrated.

A87-42937　Stereoscopic visualization of aerial and space photographs in thematic mapping (Stereoskopicheskaia vizualizatsiia aero- i kosmicheskikh snimkov pri tematicheskom kartirovanii). R. IU. VITKUS, V. E. GENDLER, V. A. IL'IN, and L. P. IAROSLAVSKII, *Issledovanie Zemli iz Kosmosa* (ISSN 0205-9614), Jan.-Feb. 1987, pp. 102-110.

The paper presents a method for space-photograph interpretation in which the results obtained by the interpretation of space images containing different parameters are presented as a single stereoscopic image. The method, termed stereovision or stereoscopic visualization, uses pairs of images in which one is a brightness image (for which an original space photograph can be used) and the other determines conventional topography to synthesize artificial stereoscopic images for stereoscopic visualization. Application of the stereovision to the geological interpretation of space images is demonstrated.

A88-46068　Space-geological mapping of the USSR (Kosmogeologiia SSSR). V. N. BRIUKHANOV and N. V. MEZHELOVSKII, Eds. *Izdatel'stvo Nedra*, Moscow, 1987, 240 pp. No individual items are abstracted in this volume.

This work examines the theoretical and methodological principles underlying the use of satellite remote sensing data to compile geological maps. A 1:2,500,000-scale space-geological map of the Soviet Union is characterized, and a new interpretation of the geological evolution of large regions of the country is presented. The possible use of space-geological maps for tectonic, geodynamic, and mineralogical investigations is assessed.

A88-33832　Technique for the instrumented interpretation of space scanner imagery of the earth's cloud cover (Metodika instrumental'nogo deshifrirovaniia materialov kosmicheskoi skanernoi s'emki oblachnogo pokrova zemli). A. I. SHAROV, *Geodeziia i Aerofotos'emka* (ISSN 0536-101X), no. 5, 1987, pp. 95-98.

Results of the instrumented interpretation of scanner images obtained with meteorological satellites are presented. The MSP-4 synthesizing device is used to process bispectral imagery of the earth's cloud cover, and a masking technique is used to identify the structural features of cloud formations. The proposed technique is verified using data from the NOAA 6, 9, and 10 satellites.

A88-26099　Observations of ocean and sea bottom relief from space (Nabliudeniia rel'efa dna morei i okeanov iz kosmosa). A/ LAZAREV, V. KOVALENOK, T. DAMINOVA, and CH. VILLMANN, *Eesti NSV Teaduste Akadeemia, Toimetised, Fuusika-Matemaatika* (ISSN 0367-1429), Vol. 36, no. 4, 1987, pp. 398-404.

Visual observations of the bottom relief of the open ocean made by cosmonauts aboard the Salyut-6 orbital station are analyzed. Under certain conditions, it is possible to study the bottom relief at a depth of 100 meters. It is shown that agitation of the ocean does not significantly affect the possibility of observing submerged objects and formations whose angular dimensions exceed the resolving power of the cosmonaut's visual system.

Japanese Aerospace Literature
This month: *Spacecraft and Satellite Technology and Systems*

A88-40334　A relation between polar ionospheric disturbance and NNSS satellite positioning error. TADAHIKO OGAWA, HIDEO MAENO, KIYOSHI IGARASHI, KAZUHIRO AIKYO, and YASUKAZU KURATANI, *Radio Research Laboratory Review* (ISSN 0033-801X), Vol. 34, March 1988, pp. 1-12. 15 Refs.

An experiment for investigating a relation between ionospheric disturbance and satellite positioning error in the polar region was carried out at Syowa Station, Antarctica, in 1985 and 1986 with a two-wave (150 and 400 MHz) NNSS receiver. From the analysis of positioning data of about 10,000 passes over 245 days, it is clearly found that ionospheric disturbance affects the NNSS positioning; the positioning error increases with increasing geomagnetic disturbance level (local K-index), and the number of position fixes per day decreases by one or two when the K-index is large. It is suggested that these effects may arise from the spatial gradients of electron density and/or the radio wave scattering due to well-developed ionospheric irregularities inherent to the disturbed auroral ionosphere.

A88-38345　Inertial guidance system for the H-I launch vehicle - NICE. NAOTERU NAGAO and SYOZO TANI, *Mitsubishi Heavy Industries Technical Review* (ISSN 0026-6817), Vol. 25, Feb. 1988, pp. 61-73.

This report gives an outline of the NICE (NASDA Inertial-guidance and Control Equipment) inertial guidance system developed for the NASDA H-I launch vehicle, and to proprietary participation in the NICE system's integration support, the development of the flight program, and the data-interface unit. This system provides for first and second stage attitude control, navigation and guidance, second stage tank pressurization control, and vehicle sequencing functions. The functions and performance of the NICE system were perfectly certified through the first flight of the H-I launch vehicle (Test flight #1 mission) on August 13, 1986.

A88-38311　On-board antenna pointing mechanism for multi-beam communications satellite. EIICHI TSUKADA, SHOJIRO MIYAKE, and HISAO KURODA, *Electrical Communications Laboratories Review* (ISSN 0029-067X), Vol. 36, Jan. 1988, pp. 109-114. 8 Refs.

In a multi-beam satellite communications system, the on-board antenna reflectors must be individually driven and controlled mechanically. This paper outlines the design of a small lightweight on-board antenna pointing mechanism (APM) that takes into account satellite launching conditions and the thermal-vacuum environment of space. This APM can drive a main reflector with an aperture diameter of approximately 1 or 1.5 meters loaded in a one-ton class communications satellite with an accuracy on the order of 0.001 degrees.

A88-28974　Geostationary tether satellite system and its application to communications systems. TETSUO YASAKA and TAKESHI HATSUDA, *IEEE Transactions on Aerospace and Electronic Systems* (ISSN 0018-9251), Vol. 24, Jan. 1988, pp. 68-75. 11 Refs.

The geostationary tether satellite system expands the geostationary orbit resource from a one-dimensional arc into a two-dimensional disk. The tethered satellites, each several thousand kilometers apart and aligned along the local vertical, are stabilized at the altitude of the geosynchronous orbital speed. When this system is applied to communications systems, it is estimated that the number of satellites can be increased as much as 13 times and the communication capacity can be increased more than 17 times, compared with a conventional geostationary satellite orbit system.

A88-25854　Proposal of adaptively controlled transmitting array for microwave power transmission in space. K. KOMOYAMA and I. YOKOSHIMA, *Electronics Letters* (ISSN 0013-5194), Vol. 24, Jan. 21, 1988, pp. 87-89. 6 Refs.

An adaptively controlled transmitting antenna array system is proposed for use in microwave energy transmission between spacecraft. Monitoring detectors are used for feedback control of both main beam and sidelobe. Computer simulation shows the possibility of accurate control for the main beam and a sidelobe.

A88-40571　An energetics experiment on a space platform. KYOICHI KURIKI and HIROAKI OBARA, *Space Power* (ISSN 0951-5089), Vol. 7, no. 1, 1988, pp. 75-89. 5 Refs.

This paper discusses the Space Flyer Unit (SFU) free-flying platform and the on-board advanced-technology experiments planned for this system in relation to the Space Power Satellite (SPS) technology. Attention is given to the design of the SFU and payload integration, the energy-exploitation experiments, and to interactive experiments between SFU and

SPS. Special consideration is given to the configuration and characteristics and the experimental objectives of a two-dimensionally deployable array and a high-voltage solar array and to electric propulsion experiment, microwave energy transmission experiment, and space experiment with particle accelerators. Design diagrams of the SFU and the various experiments designed for it are included.

A88-27608   Application of front fed offset Cassegrain antennas for communications satellites. Y. KOBAYASHI, S. MAKINO, T. KATAGI, W. J. ENGLISH, and H. H. VISKUM, *AIAA 12th International Communication Satellite Systems Conference,* Arlington, VA, Mar. 13-17, 1988. (AIAA Paper 88-0878).

The paper first presents the basic beam scan performance of the FFOC (Front Fed Offset Cassegrain) antenna for different normalized diameter: D/lambda ratios to give quantitative advantages over conventional offset parabola antenna systems. Secondly, the frequency reuse limitation of the FFOC antenna is studied comparing it with that of a single offset parabola. The FFOC antenna gives 31 dB sidelobe isolation between two Intelsat zone beams for a 1 deg separation with far fewer feed horns than a conventional single offset reflector and without the requirement for sharing horns between beams. The FFOC antenna may offer distinct advantages for a highly reconfigurable antenna due to its simple feed system.

A88-27536   Thermal analysis method of high capacity communications satellite with heat pipes. HIROAKI TSUNODA, KATSUHIKO NAKA-JIMA, and AKIHIRO MIYASAKA, *AIAA 12th International Communication Satellite Systems Conference,* Arlington, VA, Mar. 13-17, 1988. (AIAA Paper 88-0776).

Thermal analysis method for heat pipe embedded communications equipment panel is treated in this paper. The main problem of the thermal analysis is how to construct the mathematical model under the limitation of computer CPU memory size. The mathematical model for the heat pipe embedded panel is first established based on the experiments. The essence of this method is to divide panel area into several small regions and perform thermal analysis independently using the fact of low thermal conductivity of honeycomb sandwich panel. To check the correctness of this method, the experiment using the test panel which thermally simulates the north communications equipment panel of two-ton class high capacity communications satellite has been conducted. The experiment shows the method works well.

A88-38336   Observations of the magnetosphere and ionosphere by Dynamics Explorer satellite. IV - Orbit and operations of DE-1. FUMI-TAKE SAWADA, MASAKI SATO, SHIN-ICHI YAMAMOTO, TOMIO YANAGIYA, and SEIJI NAGAI, *Radio Research Laboratory, Review* (ISSN 0033-801X), Vol. 33, Dec. 1987, pp. 221-225. 5 Refs.

The telemetry operation of the Dynamic Explorer-1 (DE-1) is being conducted using the computer system for satellite control (CSSC) at the Kashima Radio Research Laboratory station (Japan), which originally conducted the operation of ISS-b, ISIS-1, and ISIS-2 satellites. The CSSC consists of an 18-m-diameter antenna, a telemetry receiver, and a data recorder, all controlled by a computer; the software of the original system had to be modified so as to receive S-band signals from the DE-1. This paper describes the modified CSSC. Special consideration is given to the time predictions of the access to DE-1 for telemetry data acquisition at the Kashima station.

A88-38334   Observations of the magnetosphere and ionosphere by Dynamics Explorer satellite. II - A brief description of Dynamics Explorer Program. KAZUHIRO AIKYO, TADAHIKO OGAWA, and IWAO IWAMOTO, *Radio Research Laboratory Review* (ISSN 0033-801X), Vol. 33, Dec. 1987, pp. 205-212. 13 Refs.

The Dynamics Explorer (DE) Program is discussed with special consideration given to the DE-1 missions. The broadband radio emissions received by the long dipole antenna aboard the DE-1 spacecraft are telemetered in real time, recorded at the Kashima station (Japan), and are processed at the headquarters of the Radio Research Laboratory in Tokyo. The data are duplicated and forwarded to the principal investigator of the Plasma Wave Instrument (PWI) mission. This paper gives special consideration to the DE-1 missions, the telemetry and command systems involved in the reception at Kashima, and the PWI mission.

A88-26390   On-board antenna pointing mechanism for Multi-Beam Satellite Communications Systems. EIICHI TSUKADA, SHOJIRO MIYAKE, SHIGEKI OGAWA, and YOICHI KAWAKAMI, *JSME International Journal* (ISSN 0913-185X), Vol. 30, Dec. 1987, pp. 2011-2017. 8 Refs.

A highly accurate mechanical control for the antenna reflector is necessary for the Multi-Beam Satellite Communication System (MBSCS). This paper describes the design, development and experimental performance of the antenna pointing mechanism (APM) for the MBSCS. The mechanical

configuration and component performance of the mechanism is documented along with the launch and operational environments of the three-axis communications satellite. This model which is based on nonlubricated direct-drive actuators is particularly appropriate for the APM's requirements. These include compact size, low mass, high stiffness, low power consumption and high reliability.

A88-22605   Evaluation method of polynomial models' prediction performance for random clock error. MICHITAKA KOSAKA, *Journal of Guidance, Control, and Dynamics* (ISSN 0731-5090), Vol. 10, Nov.-Dec. 1987, pp. 523-527. 5 Refs.

In satellite navigation systems such as the Global Positioning System, clock error is one of the major sources of error in precise pointing. In order to remove clock error, it is modeled as a second-order polynomial and the clock-error correction parameters are sent to users. However, a random clock error cannot be modeled as a second-order polynomial. Therefore, the time discrepancies due to random clock error must be taken into consideration for precise pointing. This paper proposes an analytical computation method for estimating the random clock error in the current system which makes use of the Allan variance characteristics of random clock error without random clock realization and a lot of simulation studies. Moreover, a numerical example based on the proposed method shows that the first-order polynomial model is better for predicting a random clock error than the second-order polynomial.

A88-21221   Formulation of rigid multibody systems in space. KAT-SUHIKO YAMADA and KAZUO TSUCHIYA, *JSME International Journal* (ISSN 0913-185X), Vol. 30, Oct. 1987, pp. 1667-1674. 9 Refs.

The equations of motion of rigid multibody systems, such as space structures whose bases are free, are derived using the equations of motion of Kane et al. (1983). The equations of motion which set the position of the center mass of one body as generalized coordinates are first obtained. A technique for deriving the equations of motion which set the position of the center of mass of the system as generalized coordinates is then proposed in which the orbital motion and the attitude motion are treated separately. The method is shown to be applicable not only for the tree configuration system, but also for the loop configuration system with cutting loops, using Lagrange's multipliers as constrained forces.

A88-16038   A unified matrix approach applied to dynamic formulation of complex space structures with nonlinear hinge forces and torques. Y. OHKAMI, O. OKAMOTO, T. KIDA, and I. YAMAGUCHI, *IAF, 38th International Astronautical Congress,* Brighton, England, Oct. 10-17, 1987. 10 pp. 12 Refs. (IAF Paper 87-348).

In the present approach to a dynamical modeling of nonlinear hinge forces and torques for complex space structures, using the unified matrix method, emphasis is placed on the precise expression of both the relative displacements and velocities and the internal forces and torques at the hinges connecting two adjacent bodies. A computer code has been developed by means of which realistic simulation models can be implemented without cumbersome manipulation of mathematical relations. Illustrative latch-up and limiter mechanisms are presented for a space structure manipulator.

A88-15965   Status of technology for space power system in Japan. M. NAGATOMO and N. TANATSUGU, *IAF, 38th International Astronautical Congress,* Brighton, England, Oct. 10-17, 1987. 7 pp. 10 Refs. (IAF Paper 87-244).

The current status of the space power system technology of Japan is surveyed. Photovoltaic power system, fuel cell power system and solar dynamic power system technologies have been summarized with descriptions of individual subsystems. Types, characteristics and power levels of typical power systems operated in space are described. Satellite power systems for the scientific satellites and application satellites, interplanetary spacecraft and a Spacelab payload are included in this category. As for future planning, a satellite power system with GaAs solar cell, the SFU solar power system and an experimental solar dynamic system are summarized.

A88-15943   Development scenario of H-II Orbiting Plane, HOPE. T. ITO, S. MATSUBARA, H. KATSUTA, T. AKIMOTO, and Y. TAKIZAWA, *IAF, IAF, 38th International Astronautical Congress,* Brighton, England, Oct. 10-17, 1987. 9 pp. (IAF Paper 87-210).

The H-II Orbiting Plane, or 'HOPE', fully reusable manned space plane is under study by NASDA as the basis of low operational cost space transportation early in the 21st century. HOPE would be intensively used in connection with manned occupation of the Japanese Experiment Module component of the International Space Station program. Attention is presently given to the performance requirements and projected system features and capabilities of the HOPE vehicle, which would be of 10-ton gross mass. An account is given of the prospective HOPE mission profile.

A88-15922   H-I and H-II vehicles (multistage rocket vehicles for Japanese satellites). M. MOCHIZUKI, E. SOGAME, and Y. SHIBATO, *IAF, 38th International Astronautical Congress,* Brighton, England, Oct. 10-17, 1987. 16 pp. (IAF Paper 87-181).

The H-I launch vehicle design and test results from its first two flights are discussed, and the more advanced H-II, projected for 1992, is described. The H-I, with the ability to launch a 550 kg payload into GEO, contains a liquid hydrogen/oxygen engine for the second stage, a solid apogee motor, a high mass ratio solid motor for the third stage, and an inertial guidance system. The H-II employs a LH2/LOX engine (the high-performance LE-7) for the first stage, two large-scale solid rocket boosters on the first stage for thrust augmentation, and a LE-5A engine in the second stage. Furthermore, the H-II uses a strap-down inertial guidance system with laser-gyros, and has a payload fairing 4 meters in diameter and 12 meters in length.

A88-15824   On dependable intelligent system in the space. HI-ROKAZU IHARA, SATOSHI MOHRI, and SADAHARU KAWAI, *IAF, 38th International Astronautical Congress,* Brighton, England, Oct. 10-17, 1987. 9 pp. 6 Refs. (IAF Paper 87-32).

Artificial intelligence (AI) techniques and the concept of autonomous decentralization are examined as the key approaches to the development of a dependable intelligent computing system which could minimize the spacecraft crew and the number of mission specialists. The discussion covers a new design philosophy for an autonomous decentralized control system based on a biological analogy for controlling a distributed system; examples of autonomous decentralized systems; a problem solving model based on AI techniques; and the problem of AI dependability.

A87-42540   Statistical processing method of sidelobe peaks for earth-station antennas. HIROMITSU WAKANA, TSUYOSHI FUJIEDA, and KATSUHIKO KOSAKA, *IEEE Transactions on Antennas and Propagation* (ISSN 0018-926X), Vol. AP-35, April 1987, pp. 444-447.

For coordination studies and for the assessment of mutual interference between radiocommunication-satellite systems and between earth stations and radio-relay stations sharing the same frequency band, the method which represents off-axis radiation characteristics of the earth-station antenna is desirable. For this purpose, International Radio Consultative Committee Report 391-4 describes a statistical processing method of sidelobe peaks. This statistical processing method is based on the slope of reference radiation pattern, while the old one, which has been used, is based on the absolute peak value. Therefore, the results of the statistical evaluation using the current (new) method may differ from that using the old method. According to the measured data on a Cassegrain antenna of 13 m in diameter at about 12 GHz, it is shown that the worst 10-percent value of sidelobe peaks of the new processing method, which is the level exceeded by 10 percent of the peaks, is statistically about 0.8 dB lower than that of the old method.

A87-46284   On-board IF switch and controller for multi-beam communications satellite. MASATO MORI, TOSHIAKI TANAKA, and YOSHIO SHIMODA, *Electrical Communications Laboratories Review* (ISSN 0029-067X), Vol. 35, March 1987, pp. 185-190. 5 Refs.

This paper describes satellite switch control schemes and hardware implementations of a large-capacity satellite switch applicable to the 1000-kg-class domestic multibeam satellite communications system. Specifically discussed are the newly designed 'cross-point redundancy structure' for IF switch matrices and their control schemes for the controller. Additionally, an outline is presented of CMOS LSI implementation of the controller as well as methods for solving cosmic-ray-induced problems. Finally, it is confirmed that the developed prototype model has enough reliability for a 7-year space operation.

A87-39728   An adaptive multiple-beam transmitter for satellite communications. SHUNICHIRO EGAMI and MAKOTO KAWAI, *IEEE Transactions on Aerospace and Electronic Systems* (ISSN 0018-9251), Vol. AES-23, Jan. 1987, pp. 11-16. 10 Refs.

A multiple-beam satellite communications system that can adapt beam power to varying beam traffic is proposed. A new type active-array fed, single reflector antenna design and an S band, five-beam system concept including interbeam exchange are described. Based on these concepts, a high EIRP multiple-beam system with traffic adaptability similar to a single-beam system is realized.

A88-36465   Compact mobile terminals for multi-beam mobile satellite communication systems. TSUTOMU SAKAI, HITOSHI KOMAGATA, NORIYOSHI TERADA, and EIJI HAGIWARA, *GLOBECOM '87 - Global Telecommunications Conference,* Tokyo, Japan, Nov. 15-18, 1987. Institute of Electrical and Electronics Engineers, Inc., Conference Record. Vol. 3 (A88-36401 14-32). 1987, pp. 1666-1670. 9 Refs.

Two types of compact mobile terminals for multibeam mobile satellite communications systems are described. One of them is designed for telephone service with 8-kb/s or 16-kb/s APC-AB (adaptive predictive coding-asynchronous binary) codecs or corresponding nontelephone services, such as facsimile; the other is for low-speed message service. For the 8-kb/s or 16-kb/s mobile terminal, an electronically steerable switched antenna technique, a digital signal processing technique, and custom LSIs are adopted to reduce equipment size. This terminal can be mounted on a small vessel or vehicle. For the message terminal, an omnidirectional antenna with a conically shaped radiation pattern is used, and its portability allows easy and instant communications anywhere at any time.

A87-41570   Japanese Experiment Module (JEM) preliminary design status. M. SAITO, K. HIGUCHI, K. SHIRAKI, *Acta Astronautica* (ISSN 0094-5765), Vol. 16, 1987, pp. 47-53.

The first half of the present two-year study of the Japanese Experiment Module's (JEM) preliminary design has given attention to the definition of basic design requirements, major interface areas between JEM and the NASA Space Station core, and such general issues as the JEM configuration, basic development plan, and operations. The second half of the study will evaluate the technology development requirements of JEM elements' preliminary design, as well as engage in the preparation of schedules and requirements for the next two development stages.

A88-36464   Field experiment on digital maritime satellite communication systems. YUTAKA YASUDA, MASAYOSHI OHASHI, FUMIAKI SUGAYA, YASUO HIRATA, and HIDEO OKINAKA, *GLOBECOM '87 - Global Telecommunications Conference,* Tokyo, Japan, Nov. 15-18, 1987. Institute of Electrical and Electronics Engineers, Inc., Conference Record. Vol. 3 (A88-36401 14-32). 1987, pp. 1660-1665. 8 Refs.

The system configuration and results are presented for a field experiment on digital maritime satellite communication systems carried out in December 1986, using the INMARSAT Indian Ocean satellite (INTELSAT-V with maritime communication subsystem). The digital communication subsystem used for the experiment consists of a 16-kb/s APC (adaptive predictive coding) voice codec and a rate-3/4 FEC (forward-error correcting) codec using Viterbi decoding for punctured code to utilize the satellite power and bandwidth as efficiently as possible. For the ship earth station, a high-gain antenna with G/T (gain to temperature) of -4 dBK and a low-gain antenna with G/T of -10 dBK were used. The effectiveness of the digital ship earth station system was verified under the actual maritime satellite communication environment with multipath fading.

A88-34889   Computation of quadratic optimal control for linear retarded system. K. FURUTA, M. YAMAKITA, and Y. SATO, *IEEE 26th Conference on Decision and Control,* Los Angeles, CA, Dec. 9-11, 1987. Institute of Electrical and Electronics Engineers, Inc., Proceedings, Vol. 3 (A88-34702 13-63). 1987, pp. 2162-2167. 9 Refs.

A numerical algorithm is presented for calculating quadratic optimal control recursively for linear retarded multivariable systems with delays in state and input. The algorithm is based on the method of steepest descent in Hilbert space. It gives the optimal control effectively and still does not have large memory requirements. Several numerical computations have been performed that show how the effectiveness of the algorithm compares to that of other methods.

A88-17512   Phased array antennas for aeronautical satellite communications. M. YASUNAGA, F. WATANABE, T. SHIOKAWA, and M. YAMADA, *5th International Conference on Antennas and Propagation,* York, England, Mar. 30-Apr. 2, 1987, Institution of Electrical Engineers, Proceedings. Part 1 (A88-17501 05-32). 1987, pp. 47-50. 8 Refs.

In this paper, the configurations and the electrical characteristics of a microstrip array antenna (MSA) and a cross-slot array antenna (XSA), which are phased array antennas developed for aeronautical satellite communications, are described. Photographs and element arrangement of MSA and XSA are shown. The feed system of the phased array antenna satisfying the G/T of about 13 dBK and EIRP of 29 dBW is discussed.

A88-13087   A hybrid navigation system with GPS. TORU TANABE and MASATOSHI HARIGAE, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 35, no. 396, 1987, pp. 8-14. 15 Refs.

The design, characteristics, and performance of a hybrid navigation system using the GPS are described. The designs of the GPS-INS, GPS-STAR, and GPS-INS-STAR systems are discussed and compared. The performance of the GPS receiver with a digital signal processor is examined.

A88-13086   An overview of space and aircraft navigation. TATSU-KICHI KOSHIO, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 35, no. 396, 1987, pp. 2-8. 12 Refs.

Recent developments connected with the utilization of navigation satellites for the GPS and for air traffic control are reviewed. Consideration is given to the airspace management system and to the operating principles of STAR GPS. The future prospects of navigation satellites are assessed.

A87-50447   The mission function control for deployment and retrieval of subsatellite. HIRONORI FUJII and SHINTARO ISHIJIMA, *AIAA Guidance, Navigation and Control Conference,* Monterey, CA, Aug. 17-19, 1987. pp. 395-399.

Publication Date: 1987 6 Refs. Report No.: AIAA Paper 87-2326 This paper presents a new control algorithm applied to the problem of deployment and retrieval of a subsatellite connected through a tether to the main body. From control theory an idea of the 'mission function' is introduced, which is an index used to describe the concept of the mission. The mission function is defined to be positive definite and to be zero when the given mission is completed. The deployment and retrieval is thus controlled to decrease the mission function. The control law is totally different from the control laws that have been presented in the literature; linearity and simple open-loop control are not assumed. In addition the present theory can be applied equally to both the deployment and the retrieval cases. A simplified model is used to clarify the fundaments of the problem, only in-plane motion is treated and neither flexibility nor air drag is included. Results of numerical simulation show an excellent controlled behavior.

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