

Soviet and Japanese Aerospace Literature

Throughout 1989 the *AIAA Journal* will carry selected abstracts on leading research topics from the Soviet aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Spaceflight Vehicles from the USSR and Aircraft/Spacecraft Systems from Japan.

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Soviet Aerospace Literature This month: Spaceflight Vehicles

A89-21480 Effect of phase fluctuations and additive noise on the characteristics of an SAR (Vliianie fazovykh fluktuatsii i additivnogo shuma na kharakteristiki RSA). N. A. SAZONOV, A. V. OCHEPOVSKII, G. V. ROMANENKO, P. V. FAL'KOVSKII, and A. V. FEDIUNIN, *Radiotekhnika* (ISSN 0033-8486), Oct. 1988, pp. 43-47. 8 Refs.

Relationships are derived for estimating the resolution and azimuth-determination accuracy for a synthetic aperture radar under the effect of phase fluctuations of the echo signal and additive noise for arbitrary motions of the flight vehicle and ground objects. It is shown that, under the effect of additive noise, the expectation and variance of the angular position of the object, as well as the duration of the output signal according to the angular parameter, depend on the relationship of the energy characteristics of this noise and the echo signal.

A89-18449 Investigation of the effects of a jet and thermal radiation from an electrorocket engine on a spacecraft solar array (Issledovanie vozdeistviia strui i teplovogo izlucheniia elektroraketnogo dvigatel'ia na solnechnye batarei kosmicheskogo apparata). S. N. ASKHABOV, D. P. GRDLICHKO, A. I. KOZLOV, V. A. KOLOSKOV, A. B. PETROV et al., *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Sept.-Oct. 1988.

The paper presents an investigation of the stability of a solar array under the prolonged effect of a jet and thermal radiation from an electrojet engine, simulated by two models of a stationary plasma engine. It is concluded that the results obtained reflect with sufficient accuracy the atomization of the protective coatings of solar cells and solar-array structural elements under the effect of an ion beam under conditions of sun-synchronous and lower orbits.

A89-10777 Method for the nonlinear identification of the motion of a flight vehicle (Metod nelineinnoi identifikatsii dvizheniia letatel'nogo apparata). V. V. GUKOV and A. V. KOSTROV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), July 1988, pp. 38-50. 12 Refs.

An identification method is examined which analytically continues the identification problem simultaneously according to two parameters: one parameter is introduced to regularize the number of errors of motion-parameter measurements, while the other is introduced to regularize calculation errors and the effects of the poor observability of the motion according to a specified set of measurements. The method is validated using the problem of the identification of the aerodynamic characteristics of a flight vehicle according to measurements of its free motion on a ballistic trajectory.

A89-24195 Optimization of spacecraft thermal control systems (Russian book) (Optimizatsiia sistem termoregulirovaniia kosmicheskikh apparatov). VLADIMIR V. MALOZEMOV and NATAL'IA S. KUDRI-AVTSEVA, Moscow, Izdatel'stvo Mashinostroenie, 1988, 112 pp. 35 Refs.

Mathematical models of spacecraft thermal-control units and systems are presented. A method is developed for solving thermal-control optimization problems. In addition, engineering methods and algorithms are developed for choosing appropriate design parameters for spacecraft thermal-control systems for stationary and nonstationary operating conditions.

A89-18438 Ground-based diagnostics of the state of the medium during disturbances of the charge of a geostationary satellite (Nazemnaia diagnostika sostoiianiia sredy vo vremia vozmushchenii zariada geostatsionarnogo sputnika). I. I. VAKULIN, O. S. GRAFODATSKII, L. G. DANILOVA, V. I. DEGTIAREV, G. A. ZHEREBTSOV et al., *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Sept.-Oct. 1988, pp. 725-730. 7 Refs.

The state of the medium during disturbances of the charge of the geostationary communications satellite Gorizont was evaluated on the basis of ground-based observations. It is shown that the charge disturbances occur when the satellite is located in the magnetospheric plasma sheet and coincide with substorm disturbances of energetic-particle fluxes.

A88-45467 Determination of the motion of the Salyut 6 and 7 orbital stations with respect to the mass center in the slow spin mode on the basis of measurement data (Opredelenie dvizheniia orbital'nykh stantsii 'Saliut-6' i 'Saliut-7' otnositel'no tsentra mass v rezhime medlennoi zakrutki po dannym izmerenii). V. A. SARYCHEV, M. I. U. BELIAEV, S. P. KUZ'MIN, V. V. SAZONOV, and T. N. TIAN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, May-June 1988, pp. 390-405. 10 Refs.

A method is proposed for determining the rotational motion of Salyut 6 and 7 in the slow spin mode (with an angular velocity of not greater than about 0.2 deg/s) according to the readings of onboard sensors which measure the geomagnetic field strength vector and the sun position vector. Particular attention is given to the motion of Salyut-7 with respect to the mass center over long periods of time. It is shown that, several days after the commencement of uncontrolled motion with a small initial angular velocity, the spacecraft is captured into a uniaxial gravity-gradient regime, in which its longitudinal axis undergoes stable oscillations with respect to the local vertical with an amplitude of about 40 deg.

A88-39560 Stabilization of a spacecraft by means of a minimum number of impulses (Stabilizatsiia KA minimal'nym chislom impul'sov). L. D. AKULENKO, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 227-235. 14 Refs.

The total deceleration of the rotations of a spacecraft by means of a minimum number of impulses is examined in the framework of an absolutely-rigid-body model. Stabilization is achieved through a pair of engines rigidly attached to the spacecraft. Conditions of two-impulse stabilization are defined. Expressions for the impulses and the instant of their application are derived, and the possible further optimization of two-impulse stabilization modes is considered.

A88-39558 Approximate analytical method for calculating the spatial maneuvers of a spacecraft in an atmosphere (Priblizhennyi analiticheskii metod rascheta prostranstvennykh manevrov kosmicheskogo apparata v atmosfere). N. L. SOKOLOV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 209-219. 24 Refs.

A method is proposed for calculating the atmospheric entry maneuvers of a spacecraft. Errors are evaluated for calculations of spacecraft with zero and constant values of lift-drag ratio, as well as for problems of optimal control. Particular attention is given to the determination of the trajectory parameters of the ballistic descent of spacecraft from earth-satellite orbit.

A89-23721 Nonstationary potential of a spacecraft emitting electrons into free space (Nestatsionarnyi potentsial kosmicheskogo apparata, emitiruiushchego elektrony v svobodnoe prostranstvo). A. I. U. BESSARABSKII and E. G. SHUSTIN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Nov.-Dec. 1988, pp. 953-956.

The problem of the potential of an isolated body emitting an electron beam into a rarefied gas is investigated by the method of qualitative analytical estimates and by a model experiment in a vacuum chamber with a limiting pressure of 1.6×10 to the -5th torr. Both theoretical and experimental results indicate that the electron-emitting body can be charged to a potential exceeding the accelerating voltage.

A89-22248 Double resonances in the problem of the rotational motion of a body with an electrostatic shield (O dvoimom rezonanse v zadache o vrashchatel'nom dvizhenii tela s elektrostatcheskoi zashchitой). N. V. CHIKOVA, *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia* (ISSN 0024-0850), Aug. 1988, pp. 117-118.

The paper examines the center-of-mass rotational motion of a gravity-gradient-stabilized satellite with an electrostatic shield in circular orbit, assuming that the ratios of the principal central moments of inertia correspond to the point of intersection of the resonance curves. Boundedness conditions for the motion are found in the case of double resonance.

A89-22247 Resonant oscillations of a charged body in a magnetic field (O rezonansnykh kolebaniakh zariazhennogo tela v magnitnom pole). A. A. TIKHONOV, *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia* (ISSN 0024-0850), Aug. 1988, pp. 113-115.

Consideration is given to a rigid body with an electrostatically charged shield of arbitrary shape moving in circular nonequatorial near-earth orbit. The effect of Lorentz forces on the oscillations of a gravity-gradient-stabilized body under parametric resonances is investigated. Possible resonant frequency ratios of undisturbed-system oscillations are found, and corresponding curves on the inertial-parameter plane are constructed.

A89-20748 The way to Mars. V. GLUSHKO, L. GORSHKOV, and Y. SEMENOV, *Planetary Report* (ISSN 0736-3680), Vol. 8, Nov.-Dec. 1988, pp. 4-8.

An article from the Soviet newspaper, Pravda, is presented, which discusses issues related to missions to Mars. The type of vehicle needed for a Martian mission is examined, including the propulsion system, construction of the vehicle in earth orbit, living quarters, safety considerations, and the landing vehicle. Options for the mission route and ways of returning to earth are considered. Also, a proposal for a three phase program leading up to a manned mission to Mars is outlined.

A89-18436 Dynamics of a spacecraft with direct active control of the gravity gradient stabilizer (Dinamika kosmicheskogo apparata s priamym aktivnym upravleniem gravitatsionnym stabilizatorom). E. M. POTAPENKO, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Sept.-Oct. 1988, pp. 699-708. 8 Refs.

Equations of spacecraft motion are obtained with allowance for an arbitrary but finite number of tons of elastic oscillations of a controlled gravity gradient stabilizer. A dynamic controller is used to optimize the spacecraft attitude control and stabilization system with allowance for the first tone of the elastic oscillations.

A89-18433 Nonlinear oscillations of a system of two bodies connected by a flexible rod in a central force field (Nelineinye kolebaniia sistemy dvukh tel, soedinennykh gibkim sterzhnem, v tsentral'nom silovom pole). V. I. GULIAEV, V. L. KOSHKIN, P. P. LIZUNOV, and N. N. PRUDENKO, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Sept.-Oct. 1988, pp. 669-674. 7 Refs.

An analysis is made of the oscillations of two bodies connected by a flexible rod with respect to their mass center moving in an elliptical Keplerian orbit. The effect of the reduced mass of the system and the stiffness of the rod on the stability and mode of the relative motion is investigated.

A89-18432 Motion of a gravity gradient satellite with hysteresis rods in a polar-orbit plane (Dvizhenie gravitatsionno-orientirovannogo sputnika s gisterizisnymi sterzhniami v ploskosti polarnoi orbity). V. A. SARYCHEV, V. I. PEN'KOV, M. I. OVCHINNIKOV, and A. D. GERMAN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Sept.-Oct. 1988, pp. 654-668. 21 Refs.

The small oscillations of a three-axis gravity gradient satellite are analyzed. The energy of its oscillations is dissipated in hysteresis rods as they are magnetized in the geomagnetic field. Various oscillation damping laws depending on the orientation of the rods in the body are obtained.

A89-10740 Stabilization of the Mir-Kvant complex using data of the TTM X-ray telescope (Stabilizatsiia kompleksa 'Mir'-'Kvant' po dannym rentgenovskogo teleskopa TTM). R. A. SIUNIAEV, M. R. GIL'FANOV, E. M. CHURAZOV, N. S. IAMBURENKO, A. C. BRINKMAN et al., *Pis'ma v Astronomicheskii Zhurnal* (ISSN 0320-0108), Vol. 14, Aug. 1988, pp. 695-705.

The international X-ray observatory on the Kvant module of the Mir space station has been operating since June 1987. The observation of bright X-ray sources by the TTM instrument on the Kvant module indicates that the direction to sources is held with an accuracy of about 2 arcmin in the course of about 20 min.

A89-10714 Operating safety of automatic objects (Russian book) (Bezopasnost' funktsionirovaniia avtomatizirovannykh ob'ektov). ANATOLII VLADIMIROVICH MAIOROV, GENRIKH KARLOVICH MOSKATOV, and GEORGI PETROVICH SHIBANOV, *Moscow, Izdatel'stvo Mashinostroeniia*, 1988, 264 pp. 130 Refs.

Operating-safety assurance for automatic objects (aircraft, spacecraft, and underwater vehicles) is considered in the framework of safety-automata theory and automatic-control considerations. The interaction between the operator and the safety-assurance facilities is considered. Methodological recommendations are presented on the specification of reliability requirements for the vehicles considered, as well as on automata synthesis and analysis considerations, test planning, and the analysis of test results.

A88-49510 The use of solutions to inverse structural mechanics problems in comprehensive studies of the strength of flight vehicles (O primenenii reshenii obratnykh zadach stroitel'noi mekhaniki dlia kompleksnykh issledovaniy prochnosti letatel'nykh apparatov). I. G. KOLKER and A. I. ODINOKOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 2, 1988, pp. 36-39. 12 Refs.

The use of solutions to inverse structural mechanics problems in the strength analysis of flight vehicles is examined with particular reference to the analysis of loads acting on a flight vehicle and the reconstruction of the general stress-strain state from a limited amount of experimental data. In order to obtain reliable solutions to these problems, an approach is suggested whereby the computational scheme used does not impose constraints on the warping of cross sections.

A88-49505 Synthesis of the mathematical structure of a flight vehicle assembly process (Postroenie matematicheskoi struktury tekhnologicheskogo protsessa sborki letatel'nykh apparatov). R. I. GUSEVA and A. V. MIKUNOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 2, 1988, pp. 18-21.

A mathematical structure is synthesized which is used as a framework for formalizing basic relationships between the elements of a flight vehicle assembly process. The algorithm used in the structure synthesis is examined, and the synthesis procedure is described. The properties of the synthesized mathematical structure are discussed with reference to two specific examples.

A88-54029 The influence of weightlessness on cell skeleton. B. B. EGOROV, N. L. DELONE, and V. V. ANTIPOV, *Physiologist, Supplement* (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) (ISSN 0031-9376), Vol. 31, Feb. 1988, pp. S-56 to S-60. 15 Refs.

The influence of microgravity on the cytoskeleton of microspores of *Tradescantia paludosa* was studied aboard several Soviet spacecraft. The effects of microgravity include changes in cell form and size, and redistribution of the nucleus and vacuoles leading to disturbance of genome activity and cell differentiation. The direct and indirect effects of weightlessness on the genetic apparatus of the cells are discussed. It was found that the quantity of abnormal cells increased with increased flight duration, probably due to a change in genome activity.

A88-28328 Characteristics of heat transfer and heat shielding for the Venera descent modules (Osobennosti teploobmena i teplovaia zashchita spускаemykh apparatov avtomaticheskikh mezhplanetnykh stantsii 'Venera'). I. A. ZELENKO, A. F. KLISHIN, V. M. KOVTUNENKO, and M. D. NIKITIN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 28-32.

Principles behind the calculation of heat transfer during the entry of Venera descent modules into the Venus atmosphere are described. The role of radiative heat fluxes in connection with heat transfer in the front zone is emphasized. Attention is given to requirements on the selection of heat shielding for the Venera descent modules, as well as to the actual development of such heat shielding.

A88-53936 Algorithm for the terminal control of spacecraft descent in the earth's atmosphere with a low lift-drag ratio (Informativnyi algoritim terminal'nogo upravleniia spuskom v atmosfere zemli kosmicheskikh apparatov s malym aerodinamicheskim kachestvom). N. M. IVANOV and S. I. KUDRIAVTSEV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, July-Aug. 1988, pp. 542-549.

An analysis is made of the characteristics of the radio control of spacecraft descent with a lift-drag ratio of 0.2-0.3 after the establishment of radio communication with the earth. Attention is given to a multistep terminal-control algorithm for determining the current values of the parameters of the spacecraft attainability zone and control values with constraints on the maximum loading and bank characteristics. Numerical results are presented.

A88-49432 Methods for eliminating conflicts between operation modes of an earth-resource satellite in mission planning (Metody ustraneniia konfliktov mezhdu rezhimami funktsionirovaniia KA IPRZ pri sostavlenii programmy raboty). G. P. ANSHAKOV, A. V. SOLLOGUB, and D. G. BUNDOV, *Issledovanie Zemli iz Kosmosa* (ISSN 0205-9614), May-June 1988, pp. 107-116.

This paper presents tradeoffs for achieving the maximal performance of an earth-resources satellite. Using the discrete maximum principle and a dynamic programming procedure, algorithms were developed which make it possible to assign and to schedule conflict-free operation modes (each of which is set for maximal efficiency) for information collection and transfer, thus ensuring maximal efficiency of the mission. A numerical example is included.

A88-45465 Optimal control of the terminal reorientation accuracy of a spherically symmetric spacecraft (Optimal'noe upravlenie terminal'noi tochnost'iu pereorientatsii sfericheskii simmetrichnogo KA). A. K. BAT'KIN, A. N. SIROTIIN, and K. V. SOCHNOV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, May-June 1988, pp. 374-379.

Consideration is given to the problem of the optimal control of the terminal reorientation accuracy of the axis of a spherically symmetric spacecraft. The solution is obtained using an expanded maximum principle for problems with fixed time and a free right end, the range of permissible control values of which depends on time. An analytical solution to the attitude control problem can be obtained on the basis of the necessary conditions of optimality obtained here.

A88-40867 Variations of ion composition in geostationary orbit during a geomagnetic storm (Variatsii ionnogo sostava na geostatsionarnoi orbite vo vremia geomagnitnoi buri). N. A. VLASOVA, A. S. KOVTIUKH, M. I. PANASIUK, E. N. SOSNOVETS, O. S. GRAFODATSKII et al., *Akademiia Nauk SSSR, Izvestiia, Seriya Fizicheskaiia* (ISSN 0367-6765), Vol. 52, April 1988, pp. 824-826.

Variations of ion composition in geostationary orbit during the geomagnetic storm of August 12-13, 1985 were measured with instrumentation at the Gorizont 1985-07A geostationary satellite. It is shown that a predominant acceleration of ions of ionospheric origin, $H(+)$ and $N, O(2+)$, occurs during the main storm phase. The filling of the geostationary orbit by solar ions occurs at the recovery phase and appears to be connected with dipolization of the geomagnetic field.

A88-39570 Gravity-gradient stabilization of satellites with gyroscopes (Gravitatsionnala orientatsiia iskusstvennykh sputnikov s girodynamii). V. V. SAZONOV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 315-317. 7 Refs.

The use of gyroscopes to achieve gyrodamping in a gravity-gradient stabilization system has been demonstrated. Two simple control laws for the intrinsic kinetic moment of the gyrodyn system are examined, which provide for asymptotic stability of the three-axis gravity-gradient stabilization regime.

A88-39559 Two modes of the nonlinear resonant motion of an asymmetric spacecraft in an atmosphere (Dva vida nelineinogo rezonansnogo dvizheniia asimetrichnogo KA v atmosfere). V. S. ASLANOV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 220-226. 7 Refs.

The paper examines the nonlinear motion of a slightly asymmetric reentry vehicle around its center of mass during the atmospheric descent phase. Two possible modes of resonant motion are identified: bank resonance and rotational resonance. Averaged equations are obtained, and necessary and sufficient conditions for the existence of stable resonance are established. Expressions are derived for the critical asymmetry parameters in the case of which locking into resonance occurs.

A88-34014 Theory of the plane turning of a spacecraft by a system of flywheels (K teorii ploskogo razvorota kosmicheskogo apparata sistemoi dvigatelei-makhovikov). S. A. AGAFONOV, K. B. ALEKSEEV, and N. V. NIKOLAEV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Jan.-Feb. 1988, pp. 8-11.

The problem of the spatial reorientation of a spacecraft through a single plane turn is solved for the case of an arbitrary number of flywheel drives. The solution algorithm proposed here determines a program of control stress changes at the flywheel input based on the minimum energy criterion with allowance for natural constraints. It is shown how the minimum energy requirement is related to the choice of control for each flywheel drive.

A88-39557 Motion of the tether during the deployment and retrieval of a tethered system in orbit (O dvizhenii trosha pri razvertvanii i svetyvanii trosovoi sistemy na orbite). E. M. LEVIN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 199-208. 11 Refs.

The motion of a system of two bodies connected with a tether of variable length in elliptical orbit is considered. The excitation of transverse oscillations of the tether during its deployment or retrieval are analyzed in the framework of a model of two material points connected by an inextensible flexible filament. Generative pendulum-like rigid-body motions of the system are identified. It is shown that the tether undergoes quasi-steady bending when it is deployed uniformly; the retrieval process is characterized by an increase in the transverse oscillations of the tether.

A88-34699 Circular dust formations around the earth and the moon and several structural elements of the dust formation around the sun (O pylevykh kol'tsevykh obrazovaniakh vokrug Zemli i Luny i nekotoryykh strukturnykh elementakh pylevogo obrazovaniia vokrug Solntsa). V. L. BARSUKOV and T. N. NAZAROVA, *Astronomicheskii Vestnik* (ISSN 0320-930X), Vol. 22, Jan.-Mar. 1988, pp. 61-70. 18 Refs.

An analysis of meteoroid data from the Elektron 1 and 2, HEOS 2, Luna 10, Zond 3, and Venera 2 probes reveals the existence of circumterrestrial and circumlunar dust envelopes and yields information about the elements of an analogous circumsolar dust envelope. It is shown that meteoritic matter in these envelopes is distributed not uniformly but as individual clusters which move along gravitation centers (the earth, the moon, and the sun) in more or less stable orbits.

A88-34016 Motion of a satellite relative to the center of mass with allowance for Lorentz forces and light pressure (Dvizhenie sputnika otноситel'no tsentra mass s uchedom sil Lorentsa i sil svetovogo davleniia). G. V. LIAKHOVKA, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Jan.-Feb. 1988, pp. 100-102. 5 Refs.

The paper is concerned with the rotational motion, due to the Lorentz forces and light pressure, of an artificial earth satellite enclosed in an electrostatic shield for protection against ambient radiation. It is assumed that the rotation of the satellite about the center of mass does not affect the translational motion of the center of mass; the satellite orbit orientation relative to the sun is assumed to be constant. The motion of the satellite is described by equations of perturbed motion, with averaged components of light pressure moments included into the equations.

A88-30115 Rotation stability of a deformable flight vehicle (Ob ustoiichivosti vrashcheniia deformiruемого letatel'nogo apparata). L. V. DOKUCHAEV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 52, Jan.-Feb. 1988, pp. 25-33. 10 Refs.

The Lur'e (1961) approach and the Kane (1980) method are used to obtain general equations describing the motion of a liquid-filled elastic flight vehicle in orbit. By generalizing results of earlier studies, conditions are obtained for the asymptotic stability of the rotation of a flight vehicle with allowance for damping. The analysis is illustrated by an example.

A88-28336 Statistical algorithm for pointing the Vega platform toward Comet Halley (Statisticheskii algoritim navedeniia platformy KA 'Vega' na kometu Galleia). I. U. A. BOZHOR, O. V. PAKPOV, K. G. SUKHANOV, and V. N. KHEIFETS, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 77-87.

The design of the algorithm for pointing the Vega turning platform is described in detail. Control observations of Jupiter and Saturn were made during the second half of February 1986; the axes of the TV system, the platform drive, and the optical instruments of the orientation system were adjusted with respect to one another during this period. Calculated corrections were taken into account in implementing the planned encounter with Comet Halley.

A88-28331 Simulation and interactive procedures of parameter search for Vega 1 and 2 type landing modules (Imitatsionnye i interaktivnye protsedury v zadache poiska parametrov posadochnykh ustroistv AMS tipa 'Vega-1, -2'). S. P. BUSLAEV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 41-48. 11 Refs.

The problem of determining optimal parameters for a Venus landing module is examined in the framework of a mathematical-model description of the external environment. The search for the effectiveness-function minimum in the presence of noise is considered, and attention is given to the relevant simulation and interactive procedures. Search-procedure features associated with the stochastic formulation of the problem are examined.

A88-28327 Analysis of the results of aerodynamic studies of the Vega 1 and Vega 2 landing modules (Analiz rezul'tatov aerodinamicheskikh issledovaniia posadochnykh apparatov stantsii 'Vega-1' i 'Vega-2'). S. N. ALEKSASHKIN, V. P. KARIAGIN, V. M. KOVTUNENKO, R. S. KREMNEV, K. M. PICHKHADZE et al., *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 21-27. 5 Refs.

The paper examines the engineering solutions which were required to satisfy the requirements on the motion parameters of the Vega 1 and Vega 2 landing modules. The design of aerodynamic experiments is examined in its theoretical aspects, and the choice of an appropriate experimental facility is described. Results of aerodynamic studies on the dynamics of the landing modules are presented.

A88-28329 Techniques for the provision of the appropriate thermal regime for the Venera probes in the Venus atmosphere (Metody obespecheniia teplovogo rezhima avtomaticheskikh mezhplanetnykh stantsii 'Venera' v atmosfere planety). I. A. ZELENOV, A. F. KLISHIN, V. M. KOVTUNENKO, and A. F. SHABARCHIN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 33-36.

The system that provides for the appropriate thermal regime for the second-generation Venera probes includes: (1) heat shielding for descent in the aerodynamic braking mode and (2) heat insulation during atmospheric descent and on the planetary surface. This paper examines the basic principles behind the provision of the thermal regime, with emphasis on techniques for providing for external heat insulation. A methodology for calculating the thermal regime is described, and calculation results are presented.

A88-43612 A numerical method for calculating turbulent flows and heat transfer in the engines of flight vehicles (Chislennyi metod rascheta turbulentnykh tekhenii i teploobmena v dvigatel'nykh letatel'nykh apparatov). A. M. LIPANOV, I. F. KISAROV, and I. G. KLIUCHNIKOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), no. 1, 1988, pp. 49-53.

A method is developed for the numerical modeling of turbulent flows of a viscous compressible gas and heat transfer in flight vehicle engines in the stationary operation region. The method, which uses finite difference calculations, makes it possible to evaluate the effect of the geometrical dimensions of the engine and rotation speed on the flow and heat transfer parameters. Results of calculations are presented for two engine configurations.

A88-39566 Results on the reduction of the level of discharge phenomena in the near-satellite plasma on the Aureole-3 satellite (Nekotorye rezul'taty snizheniia urovnia razriadnykh iavlenii v okolosputnikovoi plazme na sputnike 'Oreol-3'). I. U. I. GAL'PERIN, V. A. GLADYSHEV, A. I. KOZLOV, and O. A. MOLCHANOV, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Mar.-Apr. 1988, pp. 279-288. 34 Refs.

Multicomponent measurements of the low-frequency demodulated signals were measured and their polarization was evaluated in an effort to improve the EMC of the ARCAD-3 instrumentation and to reduce the level of discharge processes in the plasma near the Aureole-3 satellite. Discharge phenomena in the plasma are considered as a noise-generation factor. Particular consideration is given to the contribution of the metallization and equipotentialization of the outer surfaces of the satellite (particularly the solar-array surfaces) to reducing the level of discharge processes.

A88-28330 Thermal regime of Venera-type probes in the interplanetary trajectory (Teplovoi rezhim avtomaticheskikh mezhplanetnykh stantsii tipa 'Venera' na traektorii pereleta). V. V. BOGDANOV and M. M. IAKUBOVICH, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 26, Jan.-Feb. 1988, pp. 37-40.

In their flight to Venus the Venera probes are subject to increasing solar radiative heat flux whose density varies from 1460 W/sq m (at the beginning of the trajectory) to 2700 W/sq m (at the end). This paper presents data which permit a rational design of active, semipassive, and passive thermal control systems for the Venera probes. These systems provide for the appropriate thermal regimes for hermetically sealed chambers, separated units, and external units in the interplanetary flight segment.

Japanese Aerospace Literature This month: Aircraft/Spacecraft Systems

A89-18736 Experimental personal satellite communications system using millimeter-wave for Asia-Oceanian region. SHUNKICHI ISOBE, YOSHINORI ARIMOTO, YOSHIKI SUZUKI, SHIGETOSHI YOSHIMOTO, MASAZUMI NISHIDA et al., *Communications Research Laboratory Journal* (ISSN 0914-9260), Vol. 35, July 1988, pp. 209-224. 12 Refs.

The millimeter-wave satellite communication system for the Asia-Oceanian region is discussed. The concept of the personal satellite communication system is studied using inexpensive and simple small earth stations. The rain margin or link availability is calculated to determine the possibility of using the millimeter-wave in the Asia-Oceanian region. Transmission rates, channel capacity, and parameters of the on-board equipment and earth stations are examined and an example system configuration is presented. Plans for experiments using the Engineering Test Satellite-VI are given.

A89-26756 Novel control channel quality improvement in satellite communication systems employing high coding gain FEC (forward error correction). MASAHIRO MORIKURA, SHUJI KUBOTA, KIYOSHI ENOMOTO, and SHUZO KATO, IN: *GLOBECOM '88 - IEEE Global Telecommunications Conference and Exhibition*, Hollywood, FL, Nov. 28-Dec. 1, 1988, Conference Record. Vol. 1 (A89-26753 10-32). New York, Institute of Electrical and Electronics Engineers, Inc., 1988, pp. 136-140. 6 Refs.

The authors propose a novel control channel quality improvement scheme for satellite communication systems using a majority decision method over convolutional coding and Viterbi decoding channels. To improve majority decision performance, which is degraded by burst errors due to Viterbi decoding in conventional serial transmission methods, a parallel transmission method is proposed. The performance of the parallel and serial transmission methods has been analyzed, and experiments have been carried out using rate-1/2 convolutional encoding and Viterbi decoding (constraint length 4 and 7). It is shown that the parallel transmission method has about 1010 times lower block-error performance at $P_e = 1 \times 10^{-4}$ than the conventional method.

A89-26745 Low cost multi-channel GPS receiver. RYOBUN TACHITA, KEN IKEDA, AKIO TERANISHI, JOHN H. PAINTER, and PHILIP S. NOE, IN: *PLANS '88 - IEEE Position Location and Navigation Symposium*, Orlando, FL, Nov. 29-Dec. 2, 1988, Record (A89-26701 10-17). New York, Institute of Electrical and Electronics Engineers, Inc., 1988, pp. 455-460.

An investigation was conducted on compact, multichannel GPS (Global Positioning System) receivers. The code generator and correlation equipment were simplified, attempting to avoid downgrading the properties possessed by multichannel receivers as much as possible, and the error-increasing factors caused by such modification were examined. As a means of simplifying the receiver hardware, phases with a unit of 1/8 chip were established in the code generator. Each channel was provided with a circuit for determining correlation, and the phase differences of the carrier and the code were measured by time division. It was confirmed that sufficient accuracy of measurement can be obtained even if such simplification is carried out.

A89-19949 CAD/CAM/CAE application for design of LE-7 LOX/LH2 turbopump - CADLEX system. AKIRA OKAYASU, TOYOHIKO OHTA, SHOGO WARASHINA, TOSHIHIDE OHKI, YUKIE TAKOH et al., *Ishikawajima-Harima Engineering Review* (ISSN 0578-7904), Vol. 28, July 1988, pp. 231-235.

This paper introduces the CAD/CAM/CAE system applied to designing the LE-7 LOX/LH2 turbopump. LE-7 is the first stage engine that has been developing for the H-II rocket. CADLEX meeting with the production engineering section and the aerospace engineering system group was held to design the system suited for LE-7 development. Subsequently, application of the CAD/CAM/CAE system started and several interface and mesh-generation programs have been developed. The CADEGA system, developed for the V2500 fan jet engine, was employed to produce CAD drawing. The 3D design models were made with CATIA and passed to CAM actively to assure accuracy and to decrease production cost. As a result, with CAD/CAM/CAE application, the design period was shortened and cost were down 50 percent compared with the old system.

A88-36451 On-board baseband processor for regenerative SS/TDMA system operating with digital intersatellite links. HIDEYUKI SHINONAGA, GUNKICHI SATOH, and MICHIOHISA OHKAWA, IN: *GLOBECOM '87 - Global Telecommunications Conference*, Tokyo, Japan, Nov. 15-18, 1987, Conference Record. Vol. 2 (A88-36401 14-32). New York, Institute of Electrical and Electronics Engineers, Inc., 1987, pp. 930-936. 11 Refs.

A regenerative SS/TDMA (satellite-switched time-division multiple-access) system which is operating with digital intersatellite links (ISLs) is proposed, and detailed descriptions are given of the required on-board baseband processor. The proposed system does not impose any modifications on the current INTELSAT TDMA traffic terminals, yet provides significant advantages in transmission characteristics and geographical connectivity. A proof-of-concept model of the processor is developed. Power consumption, mass, and volume is estimated for the LSI implementation assuming current technologies.

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.