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Russian and Japanese Aerospace Literature

During 1996 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian 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 Satellite Orbits from Russia and Advanced Materials from Japan.

Support for assembling and publishing the selected abstracts has been provided by the Innovative Science and Technology Directorate of the Strategic Defense Initiative Organization (SDIO), with the sponsorship and technical management of the abstract service by the Office of Naval Research (ONR) under ONR Grant N00014-93-I-1074.

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Russian Aerospace Literature This month: *Satellite Orbits*

A95-45146 Minimum-time impulse transfer between coplanar circular orbits with allowance for the time of motion along the initial orbit (Naiskorejshij impul'snyj polet mezhdu krugovymi komplanarnymi orbitami s uchetom vremeni dvizheniya po nachal'noj orbite). S. N. KIRPICHNIKOV, L. A. KULESHOVA, and R. O. NIYAZOVA, Sankt-Peterburgskij Universitet, Vestnik, *Seriya 1—Matematika, Mekhanika, Astronomiya* (ISSN 0024-0850), No. 4, 1994, pp. 53–65. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

The coplanar problem of minimizing the time of impulse transfer between specified circular boundary orbits in a central Newtonian force field is stated and analyzed. The qualitative characteristics of the optimal orbits of single-impulse transfers are examined. It is shown that there exists an inverse relationships between the specified characteristic speed of the maneuver and its optimal duration: an increase in the former always leads to a decrease in the latter. The local optimality of minimum-time single-pulse transfers in a class of multiple-impulse transfers is investigated.

N95-28257 JPRS Report: Science and Technology. Central Eurasia. Documents available from Aeroplus Dispatch.

Translated articles cover the following topics: Increasing the speed associated with accurate computation of satellite orbits with large eccentricities; Comparison of optimal and locally optimal geocentric boosts of a solar-sail-equipped spacecraft; Use of a laser altimeter in satellite remote sensing of the Earth's surface; Method of determining optical state of the atmosphere and surface Albedo from multiangle convergent observations; Effect of number of gradations of brightness levels on textural features of radar images; Displaying sea state with Synthetic-Aperture Radars (Comparative analysis of data obtained by Almaz-1 and ERS-1 Satellites); Problems with Russian Elektro Weather Satellite described; and Threats to Russian space program.

A95-39565 The EUVITA experiment onboard the Spectrum-X-Gamma mission. A. YASKOVICH, M. PAVLINSKIJ, R. SUNYAEV (Russian Academy of Sciences, Space Research Inst., Moscow, Russia), A. Zehnder, R. Henneck, A. Mchedlishvili, (Paul Scherrer Inst., Villigen, Switzerland), T. J.-L. Courvoisier, A. Orr, (Geneva Observatory, Sauverny, Switzerland) P. Buehler, (Paul Scherrer Inst., Villigen; Geneva Observatory, Sauverny, Switzerland), and E. Kornev, (OKB Aalam, Bishkek, Kyrgyzstan) ET AL., *Advances in Space Research* (ISSN 0273-1177), Vol. 16, No. 3, 1995, pp. 127–130. Documents available from Aeroplus Dispatch.

EUVITA (Extreme UV Imaging Telescope Array) experiment will be flown on the Russian Spectrum-X-Gamma satellite along with several other experiments. The satellite will be launched in a highly eccentric orbit with a period of four days, allowing long, uninterrupted observations. EUVITA is a set of six extreme UV normal incidence imaging telescopes each of them has 200 mm multilayer silicon mirror and is sensitive in a narrow band, centered at wavelengths between 50 and 135 A. Each telescope has a few sq cm effective area, a field of view of 1.2 and a spatial resolution of 10 arcsec. EUVITA's narrow spectral bands allow the measurement of source parameters such as temperature or power law index as well as interstellar absorption. All EUVITA telescopes will be operated simultaneously and so the variability of the spectral properties of sources will be monitored continuously. Simulations of various types of sources show EUVITA's capability to detect Galactic and extragalactic EUV sources. (Author)

A95-34147 Comparison of probabilistic and deterministic models for predicting the motion parameters of space objects (Sravnenie veroyatnostnykh i determinirovannykh modelej prognoza parametrov dvizheniya kosmicheskikh ob"ektov). A. M. CHERNITSOV and V. A. TAMAROV (Tomskij Gosudarstvennyj Univ., Tomsk, Russia), *Kinematika i Fizika Nebesnykh Tel* (ISSN 0233-7665), Vol. 11, No. 1, 1995, pp. 68–74. In Russian. 5 Refs. Documents available from Aeroplus Dispatch.

An a posteriori probabilistic approach to the problem of predicting the motion parameters of space objects is considered. Sufficiently simple systems of equations in terms of deviations are obtained which can be used for expert estimates in making a choice between probabilistic and deterministic models of space object motion. They can also be used for the direct calculation of the most probable characteristics of the vector of current space object parameters.

A95-33039 Control of the orbital elements of an illuminator satellite (Upravlenie ehlementami orbity sputnika-osvetitelya). M. A. EGOROV, V. A. EGOROV, and V. V. SAZONOV (RAN, Inst. Prikladnoj Matematiki, Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 33, No. 2, 1995, pp. 220–224. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

A satellite equipped with a large flat mirror, which can be used as a source of reflected solar light to provide illumination in polar regions of the Earth during the polar night, is treated as a solar sail spacecraft. Here, a solar sail control law, which would make it possible to maintain the orbital elements of illuminator satellites within the required limits, is described. The control law, which is based on locally optimal programming, will ensure the proper functioning of a system of such satellites providing for the continuous illumination of a region during the polar night.

A95-31622 Quasi-satellite orbits in the elliptic restricted three body problem (O kvazisputnikovykh orbitakh v ogranichennoj ehllipticheskoj zadache trekh tel). M. L. LIDOV and M. A. VASHKOV'YAK (RAN, Inst. Prikladnoj Matematiki, Moscow, Russia), *Pis'ma v Astronomicheskij Zhurnal* (ISSN 0320-0108), Vol. 20, No. 10, 1994, pp. 781–795. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

We consider, within the framework of the elliptic restricted three body problem, the quasi-satellite orbits with retrogressive movement, encompassing the lower-mass body and located outside the sphere of action of the latter. We provide two methodological approaches to studying such orbits for arbitrary values of system parameters, which include mass ratio and orbit eccentricity for two attracting bodies. The first approach is to find numerically the flat symmetric periodic solutions of the elliptic restricted three body problem; the second approach involves numerical and analytical calculations of long-term evolution for quasi-satellite orbits and is based on an averaging scheme. We trace the transformation of simplest periodical orbits into typical quasi-satellite orbits. We compare the results of calculations carried out independently with the two methods. (Author)

A95-25476 Dual algorithms of optimal guaranteed estimation and a trimmed least squares method (satellite orbital motion) (Dvojstvennye algoritmy optimal'nogo garantiruyushchego otsenivaniya i usechennyj metod naimen'shikh kvadratov). V. N. SOLOV'EV (Moskovskij Aviatsionnyj Inst., Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 33, No. 1, 1995, pp. 3–11. In Russian. 14 Refs. Documents available from Aeroplus Dispatch.

The problem of calculating optimal guaranteed estimates has previously been reduced to that of unconstrained minimization of a differentiable convex function on the whole state space which can be solved by gradient methods and a minimax least squares method. In the preset paper, we describe an application of the Newton method to solving the dual problem which turned out to be closely connected with the weighted least squares method on trimmed observation samples. To compare the efficiencies of the three methods, we apply them to the problem of estimating parameters of satellite motion in the near vicinity of a circular orbit. Numerical examples show that the new method is preferable for estimation problems with a not very great number of parameters. (Author)

A95-23457 Optimal transfers of spacecraft with high limited thrust rocket engines between an Earth satellite orbit and the moon (Optimal'nye traektorii pereletov kosmicheskogo apparata s reaktivnymi dvigatelyami bol'shoj ogranichennoj tyagi mezhdu orbitoj iskusstvennogo sputnika zemli i lunoj). K. G. GRIGOR'EV and I. S. GRIGOR'EV (Moskovskij Gosudarstvennyj Univ., Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 108–129. In Russian. 23 Refs. Documents available from Aeroplus Dispatch.

Optimal transfers of spacecraft with high limited thrust rocket engines between an Earth satellite orbit and the moon are determined in the context of the restricted circular three-body problem using the shooting method. Minimum-mass transfers in the moon orbit plane within a limited time and minimum-time transfers with limited mass expenditure are being considered. The optimal trajectories to the moon, soft landing on its surface, and launching of a moon satellite to a specified circular orbit are discussed. (Author)

A95-23455 Three-dimensional version of the problem of the deformable planet-satellite system in the field of an attracting center (Prostranstvennyj variant zadachi 'deformiruemaya planeta-sputnik' v pole prityagivayushchego tsentra). Y. G. MARKOV and I. S. MINYAEV (Moskovskij Gosudarstvennyj Aviatsionnyj Inst., Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 89–98. In Russian. 5 Refs. Documents available from Aeroplus Dispatch.

The translational-rotational motion of a system consisting of a deformable planet and a satellite in the field of an attracting center is considered. Approximate equations are obtained in canonical variables. It is shown that, during the tidal evolution, the satellite orbit tends toward a circular one, and the orbit radius decreases monotonically. Qualitative conclusions about the evolution of the system characteristics are presented. (Author)

A95-23453 On the estimation problem allowing for the effect of unmodeled accelerations (dynamic characteristics of space vehicles) (K voprosu o zadache otsenivaniya s uchetom vliyaniya nemodeliruemykh uskorenij). L. Y. BELOUSOV (Rossijskij NII Kosmicheskogo Priborostroeniya, Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 66–76. In Russian. 12 Refs. Documents available from Aeroplus Dispatch.

Results of the solution of a real estimation problem with allowance for the effect of unmodeled accelerations are presented. In order to obtain practical results, significant revisions were required both in theoretical proofs and software. The main feature of the solution method is that the simplex procedure is combined with a plan computation algorithms whose volume exceeds the order of the basis matrix. (Author)

A95-23451 A plane rotational motion of a satellite in an elliptic orbit (Ob odnom ploskom vrashchatel'nom dvizhenii sputnika na ehllipticheskoj orbite). A. P. MARKEEV and B. S. BARDIN (RAN, Inst. Problem Mekhaniki, Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 43–49. In Russian. 18 Refs. Documents available from Aeroplus Dispatch.

The problem of the stability of the plane rotation of a rigid body (satellite) relative to the center of mass in an elliptic orbit of arbitrary eccentricity is solved in the case where the satellite does one revolution with respect to the center of mass for each two revolutions of the center of mass along the orbit. The problem of the existence of the plane motions of the satellite that are asymptotic with respect to this rotation is studied. (Author)

A95-23450 Periodic and conditionally periodic motions of an axisymmetric satellite/gyrostat around the center of mass in circular orbit—The case of a small angular momentum of the rotors (Periodicheskie i uslovno-periodicheskie dvizheniya osesimmetrichnogo sputnika-girostata vokrug tsentra mass, dvizhushchegosya po krugovoj orbite—Sluchaj malogo kineticheskogo momenta rotorov). V. G. DEMIN, M. V. DEMIN, and A. A. PANKRATOV (Moskovskij Gosudarstvennyj Univ.; Moskovskij Gosudarstvennyj Tekhnicheskij Univ., Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 34–42. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

In the case of a small angular momentum of the rotors and a nearly spherical ellipsoid of inertia of a gyrostat/satellite, families of periodic and conditionally periodic motions are identified. These include three two-parameter, three three-parameter, four four-parameter, and three five-parameter families of periodic and conditionally periodic rotations of the gyrostat/satellite for resonance conditions between the mean orbital motion and the unperturbed angular velocity of the gyrostat/satellite. (Author)

A95-23449 Dynamics of a satellite with a passive aerodynamic orientation system (Dinamika sputnika s passivnoi aerodinamicheskoi sistemoi orientatsii). V. A. SARYCHEV and M. Y. OVCHINNIKOV, (RAN, Inst. Prikladnoj Matematiki, Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 16–33. In Russian. 13 Refs. Documents available from Aeroplus Dispatch.

The dynamics of an axisymmetrical satellite in the single-axis aerodynamic orientation mode is studied. The restoring aerodynamic torque is provided by shifting the center of aerodynamic pressure from the center of mass. The disturbed initial motion of the satellite is damped by remagnetizing the hysteresis rods, which are placed into the satellite body, in the geomagnetic field. The transient and steady-state motions of the satellite are investigated. The rod configuration, which leads to an acceptable precision and fast response of the stabilization system, is determined. (Author)

A95-23448 Increasing the speed of the exact computation of satellite orbits with large eccentricities (Povishenie skorosti tochnogo rascheta ISZ s bol'shim ekstsentrisitetom). M. L. LIDOV and N. M. TESLENKO, (RAN, Inst. Prikladnoj Matematiki, Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 6, 1994, pp. 3–15. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

The problem arose with regard to a space mission to the vicinity of the collinear libration point L2 in the sun-Earth system with a close flyby near the moon (project Relict-2). At the initial part of the space trajectory, the spacecraft performs 2.5 revolutions around the Earth in the orbit with a perigee close to the Earth surface and an apogee in the vicinity of the moon's orbit. The computational time on a PC proves to be excessive. Solving boundary value control problems in real time needs multiple computations of such trajectories. A technique of splitting the trajectory into segments is proposed to solve this problem. For segments located at distances over 150,000 km from the Earth, the orbit determination is carried out by numerical integration, while for the near Earth segments, the computations are based on the main concepts of perturbation theory. A computational perturbation theory algorithm is given along with numerical estimates of the accuracy which can be reached for near Earth segments by using this technique. (Author)

A95-22425 Coordinate systems in space photogrammetry (Sistemy koordinat v kosmicheskoj fotogrammetrii). Y. S. TYUFLIN, *Geodeziya i Kartografiya* (ISSN 0016-7126), No. 10, 1994, pp. 26–31. In Russian. Documents available from Aeroplus Dispatch.

The principal coordinate systems employed in the processing of the space imagery of the Earth surface are examined, and relationships between the different coordinate systems are discussed. In particular, attention is given to the camera coordinate system Sxyz; the spacecraft coordinate system Sx(c)y(c)z(c); geocentric geoequatorial coordinates systems, object-centric geoequatorial systems; object-centric orbital systems; and geocentric orbital systems.

A95-22157 Radio remote sensing of atmosphere by two satellites. B. M. SHEVTSOV (Russian Academy of Sciences, Pacific Oceanological Inst., Vladivostok, Russia), *Optics in atmospheric propagation and random phenomena; Proceedings of the Conference*, Rome, Italy, 1994 (A95-22151 05-74), Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 2312), 1994, pp. 60–64. 7 Refs. Documents available from Aeroplus Dispatch.

The possibility of atmosphere remote sensing by radio signals is considered. The basis of this approach is the solution of the inverse problem for the EM wave propagation from the stationary or nonstationary source in the spherical layered atmosphere. The inverse problem procedure is found by the imbedding method. The procedure allows one to restore the height profiles of the atmosphere refraction index by the measuring of the spatial time or spatial frequency distribution of the field. The cases of the impulse and monochromatic sources and the method of obtaining data are discussed. The various polarizations of the source and the inversion of the atmosphere dissipation are discussed. (Author)

A95-19915 Numerical analysis of relativistic effects in calculating the orbits of geodynamic satellites of the Earth (Chislennyj analiz relyativistskikh ehffektov pri opredelenii orbit geodinamicheskikh iskusstvennykh sputnikov zemli). M. D. KISLIK, Y. F. KOLYUKA, E. O. MARTSINYUK, and V. F. TIKHONOV (Tsentr Upravleniya Poletom, Moscow, Russia), *Astronomicheskij Zhurnal* (ISSN 0004-6299), Vol. 71, No. 5, 1994. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

Numerical modeling of relativistic effects in determining the orbits of geodynamic satellites is considered. This modeling is used to develop procedures for calculating relativistic terms in the satellite equations of motion and light propagation effects in range measurements with an accuracy of better than 1 mm. (Author)

A94-29266 Periodic and quasi-periodic solutions for the problem of the rotation of an axisymmetric satellite in a circular orbit (Periodicheskie i kvaziperiodicheskie resheniya zadachi o vrashchenii osesimmetrichnogo sputnika, obrashchayushchegosya po krugovoj orbite). M. V. DEMIN and A. A. PANKRATOV (Moskovskij Gosudarstvennyj Tekhnicheskij Univ., Moscow, Russia), *Kosmicheskie Issledovaniya* (ISSN 0023-4206), Vol. 32, No. 2, 1994, pp. 118–122. In Russian. 4 Refs. Documents available from Aeroplus Dispatch.

The problem investigated here concerns the rotation around the center of mass of a dynamically symmetric satellite in a circular Keplerian orbit. By using the Poincare small parameter method, the existence of periodic and conditionally periodic solutions with periods close to that of the generating solution is demonstrated.