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THE FOURTH INTERNATIONAL SYMPOSIUM ON CLASSICAL AND CELESTIAL MECHANICS (VELIKIYE LUKI, 15–20 AUGUST 2001)†

The Symposium on Classical and Celestial Mechanics, traditional by now, was held in Velikiye Luki for the fourth time and was dedicated to the eightieth birthday of Academician V. V. Rumyantsev.

The symposium was organized by the Russian Academy of Sciences, the Division of Problems of Machine Construction, Mechanics and Control Processes, the A. A. Dorodnitsyn Computing Centre of the Russian Academy of Sciences, the Academy of Astronautics of Russia, the M. V. Lomonosov Moscow State University, the Moscow State Aviation Institute, the Moscow Academy of Instrument Making and Informatics, and the International Academy of Information Technology. The chairman of the symposium was V. V. Rumyantsev. The co-chairmen were P. S Krasil'nikov and V. N. Tkhai, and the scientific secretary was I.I. Kosenko. Scientists from Algeria, Brazil, France, Georgia, Italy, Russia and Ukraine participated in the symposium.

The ELVO Holding Company (President B. M. Karakayev) and the ZETO Company (Director-General N. N. Kozlovskii) looked after both the organization of the symposium and the relaxation of the delegates, including visits of a local nature and unforgettable excursions to Pushkinskiye Gory, and the S. V. Kovalevskaya and I. M. Vinogradov Museums.

The symposium received financial support from the Russian Foundation for Basic Research (01-0110101). Special assistance was provided to young participants.

The scientific programme comprised plenary sessions (*A*), mini-symposia, consisting of combined meetings of two sections (*B*), mini-symposia in the section on classical mechanics (*C*), mini-symposia in the section on celestial mechanics (*D*) and a computer presentation of the website of the electronic version of the Journal *Prikladnaya Matematika i Mekha*.

Section *B* comprised mini-symposia *B*1 (Methods of Classical and Celestial Mechanics) and *B*2 (Selected Problems of Classical and Celestial Mechanics). Section *C* consisted of mini-symposia *C*1 (Analytical Mechanics), *C*2 (Theory of Stability and Bifurcations), *C*3 (Regular and Chaotic Dynamics), *C*4 (Oscillations of Mechanical Systems), and *C*5 (Dynamics of Rigid and/or Deformable Bodies). Section *D* consisted of mini-symposia *D*1 (The Three-Body and *n*-Body Problems), *D*2 (Periodic and Quasi-Periodic Orbits – Resonances), *D*3 (Research on the Dynamics of the Planets of the Solar System), *D*4 (Dynamics of Rotational Motion of Celestial Bodies) and *D*5 (Dynamics of Orbital Systems).

Two invited papers were presented: A. V. Karapetyan, S. Ya. Stepanov (Moscow) and R. S. Sulikashvili (Tbilisi) entitled "Eightieth birthday tribute to Academician V. V. Rumyantsev", and Yu. P. Gupalo (Moscow), "The Journal *Prikladnaya Matematika i Mekhanika* as a catalyst in the development of research in the area of mechanics".

The following is a brief description of other papers presented at the sessions of sections *A* and *B*.

A. S. Andreyev (Ul'yanovsk). "The stability with respect to part of the variables: some results and the prospects for their development". The results of research on the stability with respect to part of the variables based on the method of Lyapunov functions from the point of view of the prospects for using them and of further development were reviewed.

A. S. Andreyev, Ye. B. Kim (Ul'yanovsk) and C. Risito (Parma, Italy). "The stability of generalized steady and quasi-steady motions". The sufficient conditions for unconditional stability of generalized steady and quasi-steady motions are derived. Examples are considered.

V. V. Beletskii, M. L. Pivovarov and A. A. Savchenko (Moscow) "Regular and chaotic attitude motions of a dumbell-shaped satellite". The attitude motion of an orbital tethered system, modelled by a dumbell-shaped satellite whose centre of mass moves in an elliptic orbit, is investigated. Regular and chaotic motions of the orbital coupling with tense tether are considered.

S. V. Bolotin (Moscow). "Poincaré chaotic solutions of the second kind in the restricted three-body problem". The problem of the motion of a particle in the field of attraction of fixed centres of small mass when there are additional smooth potential and gyroscopic forces is considered. Bernoulli representations of the chaotic trajectories with a large number of symbols are obtained for the restricted three-body problem in celestial mechanics.

†*Prikl. Mat. Mekh.* Vol. 66, No. 3, pp. 525–527, 2002.

A. D. Bryuno (Moscow). "Families of periodic solutions of Beletskii' equation". A review of results of the construction of two-parameter families of periodic functions is given. The structure of the families of symmetric and asymmetric solutions is considered. Data on resonance rotational motions in the solar system are analysed.

B. M. Darinskii and Yu. I. Sapronov (Voronezh). "Bifurcation of extremals, phase transitions and *CW*-complexes". The extremals of a smooth functional can in many cases be investigated by changing to a function in a finite-dimensional space. The fairly complete lists of bif-decompositions for an n-dimensional cusp singularity frequently encountered in the theory of crystals, defined by the quartic part of the Taylor expansion of the key function for $n \leqslant 3$, are obtained.

G. Cantarelli (Cagliari, Italy). "The stability of the equilibrium positions of scleronomous system. I". Holonomic mechanical systems with Bilateral time-independent ideal constraint are considered. Criteria of stability, uniform stability or uniform stability in a finite interval with respect to generalized velocities, are obtained by the comparison method.

A. V. Karapetyan (Moscow). "Steady motions of mechanical systems". The problem of the existence and stability of steady motions of mechanical systems, which allow of first integrals, is discussed. Systems are also considered which, together with the first integrals, allow of a function which is non-increasing along all the motions of the system. A class of mechanical systems is distinguished for which the use of these results does not require a knowledge of the explicit form of all the first integrals, apart from an integral which is quadratic with respect to the quasi-velocities (a non-increasing function). The general results are illustrated by examples of the dynamics of a rigid body in various force fields.

V. V. Kozlov (Moscow). "The general theory of vortices, the dynamics of variable systems and Lie groups". A range of problems, related to the motion of variable mechanical systems, when a change occurs in their mass geometry due to internal forces, is discussed. The equations of motion are reduced to a non-autonomous system of first-order differential equations on a Lie group. A hydrodynamic analogy for the phase flow of the dynamic system obtained is used. The results of a general character are applied to the "falling cat" problem and to the problem of the motion of a body with a rigid envelope in a fluid.

I. I. Kosenko (Moscow). "Methods of describing shock interactions in the dynamics of orbital tethered systems". A set of computational procedures is set up, which enables various models of the dynamics of an orbital tethered system to be constructed. Two approaches are considered: modelling of successive shock interactions in an unrestricted formulation and the use of the reflection method.

P. S. Krasil'nikov (Moscow). "A generalized scheme for constructing Lyapunov functions from the first integrals". A heuristic scheme for constructing Lyapunov V-functions is described, which generalizes the classical method of constructing these functions from the first integrals, or from integrals of a comparison system. It is shown that the majority of stability problems of classical mechanics which have been solved belong to the generalized scheme. Some algebraically unsolvable stability problems of the theory of critical cases are investigated.

A. L. Kunitsyn (Moscow). "Libration points of the photogravitational three-body problem". The problem of the positions of relative equilibrium and their stability in the restricted photogravitational three-body problem is considered. A review of the results obtained by different researchers on establishing, classifying and investigating the stability of possible libration points both in the circular and elliptical version of the problem is given. The stability conditions obtained previously are analysed from new points of view, which enable a clearer representation of these to be obtained.

A. P. Markeyev (Moscow). "The non-local problem of the stability of periodic motions of Hamiltonian systems". It is supposed that a periodic motion exists that is orbitally unstable due to the presence of a second or third-order resonance in the system. The trajectories of the perturbed motion may consistently remain in a bounded neighbourhood of the unperturbed periodic motion. Interesting applications in describing instability in the asteroid belt are considered.

V. M. Matrosov (Moscow) and I. A. Finogenko (Irkutsk). "Analytical dynamics of systems of rigid bodies with friction". Analytical dynamics of systems of rigid bodies with Coulomb friction in single-power kinematic pairs, developed by the authors, is described. The results explain well-known Painlevé paradoxes and they develop a theory of the motion of mechanical systems with friction.

V. V. Rumyantsev (Moscow). "Routh's equations and variational principles". For holonomic mechanical systems and Routh variables expressions are given for the d'Alembert–Lagrange, Hamilton–Ostrogradskii and Hamilton (third form) variational principals and also the Hölder principle and the principle of least action in Lagrange and Jacobi forms.

A. S. Sumbatov (Moscow). "A quasi-static model of the motion of a particle over a plane with dry friction". The three-dimensional motion of a particle acted upon by an elastic force and viscous friction is considered. The particle moves over a plane and can leave it. A dry friction force acts on the

particle from the side of the plane. The conditions of non-uniqueness and the absence of motion are investigated. The general case when the matrix of the elasticity coefficients is permanently positive is considered.

V. N. Tkhai (Moscow). "Reversible dynamic models of celestial mechanics". The idea of the importance of using the properties of reversibility when investigating problems of celestial mechanics is developed. By considering reversibility one can achieve a deeper understanding of well-known factors and reveal new factors previously unknown. The following are analysed in detail: the three-body problem, its photogravitational version, Hill's problem, a satellite in the plane of an elliptic orbit, and the orbital coupling of two bodies.

D. P. Chevallier (Paris). "Physical invariance and dynamics of a generalized rigid body". The importance of the principle of invariance in continuum mechanics was pointed out by Noll. However, its application in dynamics has so far given rise to problems in relation to the problem of the invariance of inertia forces. It is shown that the majority of the properties of the dynamics of an ordinary or generalized rigid body are actually mathematical consequences of the principle of invariance of the inertia forces and the properties of the group of motions.

Forty-four papers were presented at the mini-symposia on classical mechanics (*C*) and 21 communications were presented at the section on celestial mechanics (*D*). The conference was extremely interesting and the papers gave rise to lively discussions.

V. N. Tkhai, Symposium Co-chairman
I. I. Kosenko, Scientific Secretary of the Scientific Committee

INFORMATION

The International Union of Theoretical and Applied Mechanics (IUTAM) together with the Polish National Committee of IUTAM, the Institute of Fundamental Technological Research of the Polish Academy of Sciences and the Warsaw Technical University are holding the 21st International Congress on Theoretical and Applied Mechanics (ICTAM04) in Warsaw on 15–20 August 2004.

For more details and to register for the congress visit the official congress website (http://ictam04.ippt.gov.pl).

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