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THE THIRD INTERNATIONAL SYMPOSIUM ON CLASSICAL AND CELESTIAL MECHANICS (23–28 AUGUST 1998, VELIKIYE LUKI)†

V. N. TKHAI (Co-Chairman of the Symposium)

The symposium was organized by the Division of Problems of Machine Construction, Mechanics and Control Processes of the Russian Academy of Sciences, the Computer Centre of the Russian Academy of Sciences, the Academy of Cosmonautics of Russia, Moscow State University, the Moscow Aviation Institute, Moscow State Academy of Instrument Making and Computer Science, and the Velokolukskii State Agricultural Academy. The president of the symposium was V. V. Rumyantsev, Academician of the Russian Academy of Sciences. The Co-Chairmen were P. S. Krasil'nikov and V. N. Tkhai. The Scientific Committee included well-known scientists from Austria, Belgium, France, Germany, Greece, Hungary, Spain, Italy, Russia and the USA.

Financial support for the symposium was provided by the Russian Foundation for Basic Research (98-01-10085) and the VZVA factory in Velikiye Luki.

The symposium was dedicated to the memory of Professor V. G. Demin.

The academic programme of the symposium comprised plenary sessions and mini-symposia on: (A) methods of classical and celestial mechanics; (B) selected areas of classical and celestial mechanics, (C1) analytical mechanics; (C2) theory of stability and bifurcations; (C3) regular and chaos dynamics; (C4) the dynamics of a rigid and deformable body; (D1) three-body and N-body problems; (D2) research on the dynamics of planets of the solar system; (D3) motion under solar radiation pressure; (D4) dynamics of the rotational motion of celestial bodies. Twenty-three lectures and 73 communications were selected for presentation (in plenary sessions and at mini-symposia A and B, and at mini-symposia C and D, respectively).

There were two guest lectures by V. A. Proshkin and Ya. V. Tatarinov (Moscow): "On the creative legacy of Vladimir Grigor'yevich Demin", and by Ye. A. Grebenikov and L. V. Demina (Moscow): "The life and work of Vladimir Grigor'yevich Demin".

The following is a brief account of the remaining lectures.

M. Pascal (Paris): "A pseudo-rigid model for the dynamical simulation of flexible mechanisms". This demonstrated the possibility of using an imaginary system of rigid bodies to construct an approximate dynamic model of a system of flexible bodies.

V. V. Beletskii (Moscow): "On the evolution of the rotational motions of celestial bodies with tidal or aerodynamic dissipation". New dynamic effects of the second order of smallness that are not revealed using the averaging method are found by exact integration of the evolution equations for a celestial body with a spherical ellipsoid of inertia and a Kepler circular orbit of its centre of mass.

A. D. Bryuno (Moscow): "Power geometry and asymptotic solutions of a system of ordinary differential equations". This proposes a new algorithm for finding asymptotic solutions which tend to a fixed point or to infinity. The algorithm is based on the geometry of power indices which includes a Newtonian polyhedron, the cones perpendicular to its faces, and exponential and logarithmic transformations.

V. V. Rumyantsev (Moscow): "On the general equations of analytical dynamics". This is an introduction to the theory of general equations of Poincaré and Chetayev, based on a closed system of infinitesimal operators of virtual displacements. As a special case, the equations include all known equations of motion in independent and dependent, holonomic and non-holonomic coordinates of both holonomic and non-holonomic systems with a finite number of degrees of freedom.

V. V. Kozlov (Moscow): "The condition for freezing direction field, small denominators and chaotization of steady flows of a viscous fluid". This is an investigation of the following general problem: to find the conditions under which a given dynamical system allows direction fields to be frozen into its phase flow. The general results are applied to Hamiltonian systems and to steady flows of a viscous fluid.

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V. Poth, M. Schagerl, A. Steindl, W. Steiner and H. Troger (Vienna): "An efficient numerical calculation of large-amplitude motion of tethered satellite systems". This is an investigation of the spatial motion in a circular orbit of large amplitude of a system of two rigid bodies tethered to one another. It gives a complete, non-linear, geometrically accurate description of the motion of the two rigid bodies and of the displacements of the tether; the motion of the system is presented in visual form.

A. P. Markeyev (Moscow): "The stability and non-linear oscillations of a Hamiltonian system in the case of two zero roots". This is a study of the motion in the region of equilibrium of an autonomous two-degree-of-freedom Hamiltonian system (the case of one pair of pure imaginary roots and another pair of roots equal or close to zero). Periodic and conditionally periodic motions are analysed, and the boundedness of the motion is considered.

J. Wittenburg (Karlsruhe) and L. Lilov (Sofia): "The decomposition of a finite rotation into three consecutive rotations about fixed axes". This is a non-traditional three-parameter description of the rotation of a rigid body with a fixed point using dyads and quaternions.

V. Vujichich (Belgrade): "A non-standard interpretation of Newtonian and Lagrangian mechanics". This discusses the issue of the modification of the general equations and principles of analytical dynamics and presents one possible modification.

A. V. Karapetyan (Moscow): "The influence of non-conservative forces on the form and stability of steady motion". This considers a mechanical system with cyclic coordinates. The influence of dissipative and constant forces on the form and stability of steady motion is investigated.

Yu. A. Sadov (Moscow): "The structure of the motions in a multifrequency system with fast phases". It is shown that hierarchically ordered structures of dynamical systems corresponding to definite states of the evolution of the initial system can arise as a result of successive separations of motions. The issue on the structure of spaces of the state of subsystems, the possibility and causes of the appearance of discontinuities and discreteness in subsystems of higher rank and the role of phase variables of different levels are discussed.

V. N. Tkhai (Moscow): "Periodic rotational motions of mechanical systems". This presents a formulation of the problem of the periodic motion of mechanical systems, which includes both oscillatory and rotational motion within a unified approach. Necessary and sufficient conditions are obtained for periodic motion to exist, and the problem of continuation with respect to a parameter is solved. A detailed analysis is made of a system of standard form, reversible mechanical systems and systems with one degree of freedom.

Yu. I. Sapronov and O. V. Shvyreva (Voronezh): "Bifurcations of the extremals of smooth functionals with symmetries and restrictions in the form of integral and terminal inequalities". This gives results on the geometry of bifurcational diagrams of functions and the arrangement of bifurcating Morse extrema corresponding to semi-regular angular extremals for functions of the energy (action) integral type and some neighbouring types of angular singularities with additional degeneracies. The bifurcations are analysed using the finite-dimensional reduction schemes of Lyapunov–Schmidt and Morse–Bott.

Yu. F. Golubev (Moscow): "Estimation of parametric resonance domains for linear systems with periodic coefficients". A technique for investigating resonance effects by approximating the periodic coefficients of differential equations by piecewise-constant functions is proposed.

K. Hendrich (Nish): "A vectorial method of analysing the kinetic parameters of a rotor with two rotation axes and non-linear dynamics in a turbulent decay field". This is a study of the dynamics of a biaxial rotor in a field of turbulent decay in the case of rotation about one of the axes at a constant angular velocity.

D. Chevalier (Paris): "Curvature and dynamics of an affinely deformable body". This is a description of the dynamics of an affinely deformable body within the framework of the geometry of major stratification caused by "dynamic constraints". The corresponding homology groups are found and the possibility of the body rotating about the centre of inertia under the effect of internal forces alone is demonstrated.

A. A. Burov (Moscow) and G. V. Plotnikova (Namur): "The motion of systems with unilateral constraints". This considers the problem of describing the motion of a point mass in contact with a unilateral constraint. There is a discussion of how to realize such constraints using elastic forces or a combination of elastic and friction forces, and of the possibility of applying impact theory to the problem of the curvature of the surface of the constraint.

P. S. Krasil'nikov (Moscow): "Fast non-resonance rotations of a satellite in the three-body problem with account of magnetic field". The satellite orbit is known and is represented by conditionally periodic functions, the magnetic field is modelled by an oblique dipole, the parameter is taken to be the ratio of the mean motion of the attracting bodies to the angular velocity of the satellite, and the method of averaging is used.

V. A. Sarychev (Covilha). "Equilibrium orientations of a pendulum in an artificial satellite". This is a study of the motion of a satellite–pendulum system in a circular orbit under the effect of a gravitational moment. The pendulum is assumed to be connected to the satellite at a fixed point by means of a spherical joint and all the equilibrium positions of the satellite–pendulum system are analysed.

A. S. Shmyrov (St Petersburg): "Stable trajectories of the many-body planetary problem". A method of obtaining estimates based on the use of the variational properties of trajectories is proposed. The class of trajectories which can be estimated in an infinite time interval is indicated.

A. S. Andreyev (Ulyanovsk): The stability and stabilization of unsteady motions of mechanical systems". This presents an investigation of the influence of time-dependent potential, gyroscopic, dissipative-accelerating and non-conservative forces on the stability of equilibrium of a non-autonomous mechanical system.

The titles of mini-symposia C and D give an indication of their theme.

The symposium was generally thought to be very successful both from a scientific and organizational point of view. Important new theoretical results and research on specific problems in contemporary classical and celestial mechanics were presented. There were interesting discussions. The facilities provided participants with good working conditions and opportunities for relaxation. The success of the symposium, the work done by the various organizing committees and the crucial support given by the VZVA factory were acknowledged.

The work of the symposium has been reported in the press of the Pskov region.

The IVth symposium will be held in the year 2001.