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THE INTEGRABLE CASES AND PERIODICAL SOLUTIONS IN THE DYNAMICS OF COAXIAL VORTEX STRUCTURES

Alexey Borisov and Alexander Kilin
Institute of Computer Science, Izhevsk

The problem of dynamics of coaxial vortex rings in ideal fluid is considered. The general procedure of reduction is presented which allow to reduce the dimension of the system to one degree of freedom. For the case of two vortex rings all possible types of motion is studied depending on values of the first integrals of motion. Bifurcational complexes are constructed for different vorticities of the rings. On the base of these complexes the stability of relative equilibria of the rings is analyzed. The condition of existing of vortex rings leap-frogging is obtained. For the case of three vortex rings the stable periodical solutions for triple leap-frog are discovered.

THE DYNAMICS OF THE BALL SUSPENSION

Alexey Borisov and Ivan Mamaev
Institute of Computer Science, Izhevsk

We consider the problem of explicit integration and bifurcation analysis for two systems of nonholonomic mechanics. The first one is the Chaplygin's problem on no-slip rolling of a balanced dynamically nonsymmetrical ball on horizontal plane. The second problem is on the motion of rigid body in ball suspension. We solve these problems by generalizing the transformation which Chaplygin applied to the integration of the problem of the rolling ball at a non-zero constant of areas. We consider the geometric interpretation of this transformation from the viewpoint of a trajectory isomorphism between two systems at different levels of the energy integral. Generalization of this transformation for the case of dynamics in the ball suspension allows us to integrate the equations of motion explicitly in quadratures and, in addition, to indicate periodic solutions and analyze their stability. We also show that adding a gyrostat does not lead to the loss of integrability.