SEVENTH CONFERENCE ON NONLINEAR VIBRATIONS, STABILITY, AND DYNAMICS OF STRUCTURES

July 26-30, 1998

Program

Sponsored by

The United States Army Research Office
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Virginia Polytechnic Institute and State University

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Perturbed rotations of a rigid body, close to the Lagrange case

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The authors investigated some new problems of the motion of a rigid body about a fixed point under the action of perturbing torque of forces of different physical nature. The motion with the moment of external forces in Lagrange's case is considered as a nonperturbed motion. The influence of the perturbations is determined by the averaging method for the Lagrange-Poisson motion.

We have established the conditions of the feasibility to average (with respect to the nutation angle) the equations of the rigid body motion related to the Lagrange case. The averaged system of equations is obtained and qualitative analysis of motion is conducted. In the case of the rotational motion of the body in the linear-dissipative medium, the numerical integration of the averaged system of equations is conducted.

The authors investigated perturbed rotational motions of a rigid body that are close to regular precession in the Lagrange case. The averaged systems of equations of motion is obtained in the first and second approximations. We considered mechanical models of perturbations related to the rigid body motion in the following cases: a) the linear-dissipative medium; b) under the action of a torque that is constant in the attached axes; c) with the cavity containing viscous fluid; d) with the distribution of mass that is close to Lagrange's case. The qualitative distinctions of the motion in these cases are noted.

The authors investigated perturbed rotational motions of a rigid body that are close to regular precession in the Lagrange case when the restoring torque depends on the nutation angle. Analogously to the case of constant restoring torque, the averaged systems of equations of motion is obtained and investigated in the first and second approximations. For the motion under the action of the resistance torque, applied by the medium, and the torque that is constant in the body-connected axes, we have found out the evolution of the precession and nutation angles.