ROTATIONS OF A RIGID BODY CLOSE TO THE LAGRANGE CASE UNDER THEACTION OF NONSTATIONARY PERTURBATION TORQUE

Leshchenko D.D., D. Sc. in Physics and Maths, Professor,
Kozachenko T.O., Ph. D. in Physics and Maths, Associate Professor
(Department of Theoretical Mechanics)

The motion of a rigid body about a fixed point is one of the important problems in mechanics. In dynamics of a rigid body with a fixed point there exists vast bibliography on the perturbed motions, close to Lagrange top, and on the applications in the problems of flying vehicle entry into the atmosphere, rotating projectile motion and gyroscopy. In the theoretical aspect the problems attract the attention of specialists in the field of theoretical mechanics. They can be quite rigorously formulated within the framework of dynamic rigid body models in Lagrange's case, which is the unperturbed one. The refinement of the models under study is carried out by taking into account the perturbation torques of various physical nature, both internal and external. The mathematical description of the symmetrical top motion in the field of gravity is one of the solved problems of rigid body dynamics.

Perturbed motions of a rigid body, close to the Lagrange case, under the action of restoring and perturbation torques of forces are investigated. The following problem is formulated: investigating solutions behavior of system of equations of motion for nonzero values of small parameter on a sufficiently long time interval. The averaging method and its methodological treatment were presented and applied to the nonlinear equations of motion.The problem can be decomposed into slowly and quickly changing variables. Conditions for the possibility of averaging the equations of motion with respect to the phase of nutation angle are presented and averaging procedure for slow variables of a perturbed motion of a rigid body in the first approximation is described.We presented some new qualitative and quantitative results of fast motion of a heavy top subject to small perturbation torques. The main goal is to extend the results of previous investigations for problem of the fast motion of a dynamically symmetric rigid body under the action of perturbation torques independent or dependent on the slow time. The numerical solution was gained and plotted in some graphs taking into consideration the case of dissipative torques. The work presented a unified approach to the dynamics of rigid bodies subjected to perturbation torques of different physical nature.