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Author: Prof. Alexander Burov
A.A.Dorodnicyn Computing Centre, FRC Computer Science and Control, Russian Academy of Sciences & Higner School of Economics, Russian Federation

Prof. Ivan Kosenko
A.A.Dorodnicyn Computing Centre, FRC Computer Science and Control, Russian Academy of Sciences, Russian Federation
Prof. Anna Guerman
Centre for Mechanical and Aerospace Science and Technologies (C-MAST), Portugal
Dr. Ekateryna Shalimova
Lomonosov Moscow State University, Russian Federation
Mr. Vasily Nikonov
FRC Computer science and control, Russian Academy of Sciences, Russian Federation

RELATIVE EQUILIBRIA OF A SPACE PROBE ON THE SURFACE OF ROTATING ASTEROID

Abstract

According to the recent research, for small celestial bodies, the centrifugal force produced due to the rotation of the body may exceed its own gravitational field, which sometimes leads to the fact that loose objects can not be collocated in certain regions on the surface of such bodies. Another effect, namely, a sliding of objects from certain areas of the surfaces can occur, when the friction force is too small to maintain the objects in place. Meanwhile, in some point of the asteroid the dry friction can prevent sliding effects. Due to the properties of dry friction and the respective hysteresis effects, the resulting equilibrium positions are not isolated and form equilibrium domains on the body surface. The present paper is devoted to the study of such domains, in particular, their dependence on the parameters of the problem.

The motion of space probe modelled as a point mass over the surface of a uniformly rotating gravitating asteroid is considered. It is assumed that the force of dry friction acts between the point mass and the surface of the asteroid. The sets of non-isolated positions of the relative equilibrium of a point mass on an asteroid are described, and their dependence on the parameters of the problem is investigated. An asteroid that consists of two spherical parts is considered as an example. Some special cases, e.g., the case of fast asteroid rotation and the case of strong gravitational fields of the asteroid parts, are studied analytically. The general case is examined numerically. The results are presented in the form of bifurcation diagrams.