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MOTION OF SPACECRAFT TETHERED TO AN ASTEROID

Abstract

It is well known that the week gravitational field of an asteroid combined with considerably large centrifugal forces makes missions to asteroids very difficult. One of possible solutions to the problem could be placing the spacecraft near the asteroid and connecting it to the surface by tethers [1,2]. To analyse dynamical properties of such system, one can use a number of simplified models, e.g., a light tether with material point at its end [3]. Besides, modelling of asteroid gravitational field represents a serious challenge since its mass distribution is usually irregular. Therefore, the choice of an adequate description for the gravitational field which would also be suitable for analytical studies is far from an obvious task. One of existent options is to model the asteroid gravitational field as a composition of three attraction centers [4]. Analysis of motion in gravity fields of triangles has been performed, e.g., in [5,6]. Using complex masses and distances to describe potentials of gravitating bodies [7], some advances have been achieved substituting the point masses in triangular model by a combination of real or complexified dumbbells [8]. We study relative equilibria of a tethered body in the non-spherical gravitational field of an asteroid; these equilibria can be used to place spacecraft in the vicinity of the asteroid surface. We consider tether oscillations and analyse the system feasibility.

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