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TETHERED SPACECRAFT IN AN ASTEROID GRAVITATIONAL ENVIRONMENT

Abstract

We examine dynamics of spacecraft tethered to the surface of an asteroid in the framework of a quite simple analytical model. The problem of existence and stability of equilibria for an inverted pendulum suspended at a point of a uniformly rotating asteroid with an arbitrary mass distribution is considered. Conditions of existence and stability are expressed as functions of pendulum's length. The results are compared with those obtained for terrestrial and lunar gravitational conditions. The feasibility of the asteroid elevator with a massless inextensible tether is also discussed.

It is known that in vicinity of natural bodies an inverted pendulum exhibits instability due to the combination of gravitational and centrifugal forces; this instability relates to the local maximum of the augmented potential. As is also known, a very long inverted penulum is stable due to the local minimum of the augmented potential provided by the centrifugal force. Naturally, it is expected that the interval between the maximum and minimum of the augmented potential should contain bifurcations and intermediate relative equilibria related to a saddlepoint of the augmented potential. This effect has been detected in [1,2] for a lunar pendulum anchored in a plane of the lunar orbit (see also [3,4]). For a pendulum suspended at a point in the Earth equator, similar properties have been detected in [5].

The results are compared with those obtained for terrestrial and lunar gravitational conditions. The feasibility of the asteroid elevator with a massless inextensible tether is also discussed (cf. [6,7]).

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