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EQUILIBRIUM CONFIGURATIONS FOR ATTITUDE AND ORBITAL CONTROL BY TETHER SYSTEM.

Abstract

The use of spacecraft's shape change and mass re-distribution for attitude and orbital control has been proposed in several studies. For example, much research on tether systems suggests controlling system position and/or orientation by changing the tether length. Recently, we have examined dynamics of a two-body tethered system in an elliptic orbit and proved the possibility to keep the tether orientation with respect to the Earth using tether length control. There exist also a possibility to implement a uniform, with respect to the true anomaly ν, rotation of such tether system; periodic control of the tether length for uniform rotations have been found and their stability studied.

In more general case of a spatial spacecraft, it can be shown that if the spacecraft inertia tensor I changes with true anomaly ν so as $(1+ecos\nu)^2 I = const$, there exist 24 relative equilibria of the spacecraft. In these equilibria configurations, one of the spacecraft's principal axes of inertia is aligned with the local vertical and another is orthogonal to the orbit plane.

The objective of the current study is to analyze the behavior of a 3D spacecraft in a central keplerian force field and possibility to cause spacecraft rotation via mass distribution control. We develop a model for dynamics of body whose tensor of inertia can be changed according to a prescribed control law and study control of its attitude motion when its center of mass moves along an elliptic orbit. We show that there exists periodic control for such motion and analyze its stability.