IAF ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (7)

Author: Prof. Vladimir S. Aslanov
Samara National Research University (Samara University), Russian Federation, aslanov_vs@mail.ru

PROSPECTS OF TETHER SYSTEM OF L1 – PHOBOS: DEPLOYMENT, DYNAMICS AND CONTROL

Abstract

In 2017, NASA has been proposed an innovative mission architecture to explore the surface of Phobos utilizing a tether system "anchored" at the L1 libration point. As a release point of the tether, it was proposed to use an orbiting spacecraft, which should hover in the vicinity of the L1 libration point Mars-Phobos system. This mission was called Phobos L1 Operational Tether Experiment (PHLOTE). Kempton, Pearson, Levin, Carroll, and Amzajerdian has performed an initial study the key technical challenges associated with implementing the PHLOTE mission at the Mars-Fobos the L1 libration point location. Nevertheless, such the complex innovative mission requires an additional theoretical substantiation and a possible multiplicity of analytical models of the system motion and control laws of the tether system. As part of the solution to this problem, the classical equations in the Nechville variables are converted into equations in polar coordinates and, for the particular case when the tether is inextensible and the primaries moving on circular paths around the barycenter of the system, these equations are integrated in quadrature, and the equilibrium positions and the oscillation period of the tether are found. In a more complete statement, in terms of the restricted elliptic three-body problem a new mission architecture is proposed, which includes three successive stages: a main deployment to the upper pulsation point (perigee) relative to the Phobos surface, an angular stabilization of the tether relative to the lower stable position, and a keeping a constant distance to the Phobos surface. If desired, this tether system can set measuring equipment directly on the Phobos surface. Numerical simulations have shown the effectiveness of the proposed control laws of the tether system at all stages of the mission for the Mars-Phobos system. The results of this study that can be used to enable many future missions throughout the solar system.