Paper ID: 32993
oral

ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (1) (8)

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

Prof. Arun Misra
Mc Gill Institute for Aerospace Engineering (MIAE), Canada
Dr. Vadim V. Yudintsev
Samara National Research University (Samara University), Russian Federation

CHAOTIC MOTIONS OF TETHERED SATELLITES WITH LOW THRUST

Abstract

One of the interesting applications of tethered satellite systems is the active debris removal problem. Although there have been several recent investigations, many aspects of this problem remain unexplored. One of them is the possibility of chaotic behaviour of the system, which includes a space tug, a tether, and space debris. Understanding the dynamical behaviour of such systems is essential for the success of any tether-assisted active debris removal mission. The chaotic motions of the system appear during the passive orbital motion of the system in an elliptical orbit or can be caused by the out-of-plane librations of the tether. On the active (post-burn) phase the chaotic motions of the system also possible in the presence of low-thrust applied to the space tug.

We consider the chaotic motion of the system caused by the combined effects of the eccentricity of the orbit of the centre of mass, the thrust on the tug and the out-of-plane roll oscillations of the tether. Stable and unstable stationary solutions are presented for the in-plane motion of the system in a circular orbit, which depend on the value of the tug's thrust. The unstable solutions give rise to the chaotic motion of the system in the presence of additional disturbances. Poincare sections and Lyapunov exponents are used to investigate the motion of the system for different initial conditions and parameters.

It is shown that the chaotic motions of the system depend on the value of the tug's thrust, so that using the tug with low thrust and starting the active phase of the active debris removal from unsuitable initial conditions (for the pitch and roll angles of the tether) can lead to chaotic motion of the system. The results obtained in the paper will be useful for selecting the system parameters of the space tug and the tether for a space debris removal system.