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DYNAMIC ANALYSIS OF THIN-FILM SOLAR PANELS IN LEO

Abstract

Thin-film solar panels for space applications have been studied since the 1960s, but the important issue of degradation over time discouraged their use. In recent years many efforts have been done in order to improve this promising technology, because of its advantages in terms of lower cost and higher power density with respect to traditional bulk solar panels.

The main drawback of this technology is the extreme flexibility that implies very low first natural frequencies for the panels. Such frequencies can in some cases match with orbital frequencies or can be excited by typical manoeuvres leading to important instability conditions, in which power production and vehicle attitude are compromised.

This paper discusses the effects of the main orbital disturbances on the attitude of a small spacecraft with two large flexible appendages. Different orbital configurations and simple manoeuvres were simulated with a numerical multi-body code. The flexible components have been modelled with the lumped mass method. The panels are therefore discretized into a number of rigid bodies, connected to each other by rotational joints, while the spacecraft is thought as a single rigid body. The simulations are performed with variable panels thickness. The collected results are in terms of torques necessary for the satellite to keep a certain attitude and torques transmitted from the panels to the central body. Simulations have been performed also including a distributed control action provided by smart active films along the panel length. A comparison between the free and the controlled systems is presented and advantages/drawbacks are assessed in detail.