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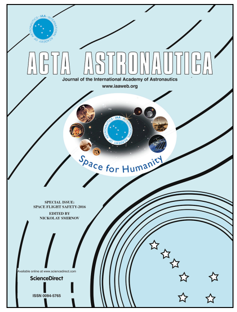

Boundary control of anti-symmetric vibration of satellite with flexible appendages in planar motion with exponential stability

Hossein Kaviani Rad, Hassan Salarieh, Aria Alasty, Ramin Vatankhah

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Boundary control of anti-symmetric vibration of satellite with flexible appendages in planar motion with exponential stability

Hossein Kaviani Rad[1], Hassan Salarieh[1*], Aria Alasty[1], Ramin Vatankhah[2]

1. Department of Mechanical Engineering, Sharif University of Technology, P.O. Box 11155-9567, Tehran, Iran
2. Department of Mechanical Engineering, Shiraz University, Shiraz, Iran

Abstract

In this research, we have investigated the planar maneuver of a flexible satellite with appendages anti-symmetric vibration. The hybrid governing equations are comprised of coupled partial and ordinary differential equations which are derived by employing Hamilton's principle. In this paper, control goals are the tracking desired pitch angle along with the flexible appendages vibration suppression simultaneously by using only one control torque which is applied to the central hub. The boundary control is proposed to fulfill these control aims; furthermore, this boundary control ensures that spillover instability phenomenon is eliminated, and in-domain sensors and actuators implement are excluded. Indeed, the proposed boundary control is able to stabilize an infinite number of vibration modes, which is one of the important benefits of the proposed control when it is considered that different factors including external disturbances and even the satellite maneuver can excite the various vibration modes of the flexible appendages and consequently the excitement of the high order vibration modes will be possible. Lyapunov's direct method is used to prove the exponential stability; moreover, this proof is achieved in absence of any damping effect in modeling the vibrations of flexible appendages. In addition, the procedure for finding the boundary control coefficients which ensures the exponential stability is provided. Eventually, numerical simulations are presented to illustrate the effectiveness of the proposed boundary control.

Keywords: Flexible satellite; Boundary control; Partial differential equation; Exponential stability; Vibration control; Hybrid system control

List of symbols

[*] Corresponding Author:

Hassan Salarieh, Sharif University of Technology, P.O. Box 11155-9567, Tehran, Iran

Email: Salarieh@sharif.edu