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# ATTITUDE CONTROL OF A RIGID FLEXIBLE SATELLITE BY USING REACTION WHEEL AND PIEZOELECTRIC MATERIAL FOR PASSIVE CONTROL OF THE ELASTIC VIBRATION

**Abstract**

The interactions between flexible components of satellites with the attitude and orbit control actuation has been studied for years and still are included in the dynamics analysis to help decision taking in project and implementation of the attitude and orbit control subsystem (AOCS). Many theoretical studies of the problem are based on mathematical modeling approach by using discretization methods. There is no consensus about the efficiency of controlling the elastic vibration actively for such discretized mathematical models. Despite the large amount of papers published in the area, by knowledge of the author there is no application in any space mission so that use the results of those papers. Instead space missions use absorbers or passive damping vibration to overcome the problem of elastic vibration disturbances on the attitude motion. Based on these ideas this paper implements passive control of vibration by using piezoelectric material which has mechatronic properties in that the material has the inherent capability to convert mechanical action into electric energy, and vice versa. If thin film of such material is covering part of the surface of a satellite flexible appendage and it is under an electrical voltage then it counteracts the elastic vibration of the flexible appendage, damping it. Passive vibration damping is a method, where the vibration is converted into electrical energy through the piezo effect and then stored or dissipated into heat, for example by means of resistors. The satellite physical model is defined as rigid platform containing two symmetric flexible solar arrays. The modeling approach is based on the Lagrangian formulation combined with Finite Element Method (FEM). The control law to implement the attitude control is the PID. The state equations of motion are solved numerically by using the Matlab software. The results show that the approach of using piezoelectric material works fine and may be one option for real space mission application whose spacecraft includes flexible appendages.