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MICROVIBRATION IMPACTS ON POINTING ACCURACY OF REMOTE SENSING SATELLITES

Abstract

The scope of this paper is the structural dynamics analysis for spacecraft requiring precise pointing requirements. Structural mass, stiffness, and damping are critical characteristics in the analysis. Microvibrations degrade the performance of remote sensing satellites because they reduce the stability of the satellite pointing. Disturbance on satellite pointing stability causes an adverse effect on the optical and imaging capability of satellites' cameras. It is fundamental to derive an accurate mathematical model of the structure if microvibrations impact on the stability of pointing is to be reliably analyzed. The sources of microvibrations are reaction wheel static and dynamic unbalances, use of step motors with fixed steps, bearing noise, moving parts of the spacecraft, amid others. In this paper the model defined for the satellite includes reaction wheels and the rotation of a symmetrical pair of solar panels by using step motors. The finite element technique is used to obtain an accurate mathematical model for the on-orbit spacecraft. The system is excited by the unbalance of the reaction wheels and a step motor with fixed step size. The attitude dynamics is simulated with and without control implementation. This approach allows for the analysis of the impact of the microvibrations on the pointing stability. On the other hand the control implementation allows for the analysis of the time it takes for the control to damp microvibrations. The used control technique is the PID. A viscoelastic material to damp the vibration is used in the structure in conjunction with the PID control implementation. The computer simulation results enhances that viscoelastic materials are a good solution to quickly reduce microvibration disturbances.