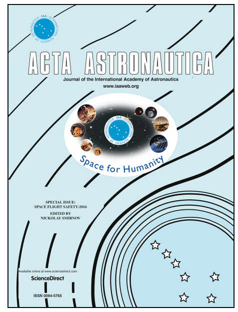

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PII: S0094-5765(17)30400-9

DOI: 10.1016/j.actaastro.2018.06.014

Reference: AA 6932

To appear in: *Acta Astronautica*

Received Date: 14 March 2017

Revised Date: 30 May 2018

Accepted Date: 5 June 2018

Integrated vibration isolation and attitude control for spacecraft with uncertain or unknown payload inertia parameters

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Abstract: To meet the spacecraft attitude control requirements with high accuracy and stability, all vibrations in the spacecraft should be reduced in appropriate ways. This paper presents an integrated control method for attitude and the vibrations in both high frequency and low frequency in the spacecraft. The integrated control method includes a vibration isolation platform and a modified adaptive attitude control method. The paper presents a vibration isolation platform with magnetic suspension to reduce high frequency vibrations and a parameter design method for the platform. An adaptive control method is presented to reduce low frequency vibrations while accounting for the bandwidth constraint due to the vibration isolation platform. Firstly, a parameter design method is proposed for the vibration isolation platform, and an entire 6×12 dimensional transformation matrix is derived for the case that the inertia of the payload is of the same order of magnitude as that of spacecraft bus. Then, an adaptive attitude controller is presented that accounts for the coupling characteristics of the spacecraft, the vibration isolation platform and the uncertain or unknown payload inertia parameters. To ensure the robustness of the attitude control system and the performance of the vibration isolation system, a method of estimating the initial value of the payload inertia is presented using classical control theory. Finally, numerical simulations demonstrate that the integrated control method presented in this paper can achieve the attitude control task for spacecraft with high accuracy and stability.

Keywords: vibration isolation platform, magnetic suspension, attitude control, adaptive control, transformation matrix

1. Introduction

Earth observation and deep space observation satellites with high resolution such as the Hubble Space

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