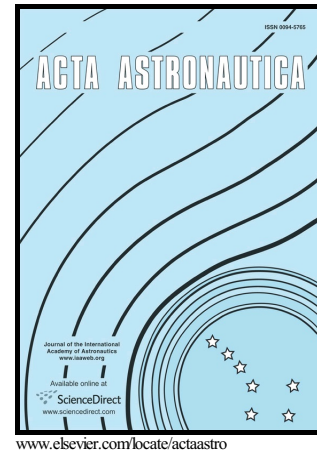


Author's Accepted Manuscript

Nonlinear model and attitude dynamics of flexible spacecraft with large amplitude slosh

Mingle Deng, Baozeng Yue



PII: S0094-5765(16)30496-9
DOI: <http://dx.doi.org/10.1016/j.actaastro.2017.01.003>
Reference: AA6153

To appear in: *Acta Astronautica*

Received date: 24 May 2016
Accepted date: 5 January 2017

Cite this article as: Mingle Deng and Baozeng Yue, Nonlinear model and attitude dynamics of flexible spacecraft with large amplitude slosh, *Acta Astronautica* <http://dx.doi.org/10.1016/j.actaastro.2017.01.003>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Nonlinear model and attitude dynamics of flexible spacecraft with large amplitude slosh

Mingle Deng, Baozeng Yue*

^aDepartment of Mechanics, School of Aerospace Engineering, Beijing Institute of Technology, Beijing 100081, China

Corresponding author. bzyue@bit.edu.cn

Abstract

This paper is focused on the nonlinearly modelling and attitude dynamics of spacecraft coupled with large amplitude liquid sloshing dynamics and flexible appendage vibration. The large amplitude fuel slosh dynamics is included by using an improved moving pulsating ball model. The moving pulsating ball model is an equivalent mechanical model that is capable of imitating the whole liquid reorientation process. A modification is introduced in the capillary force computation in order to more precisely estimate the settling location of liquid in microgravity or zero-g environment. The flexible appendage is modelled as a three dimensional Bernoulli-Euler beam and the assumed modal method is employed to derive the nonlinear mechanical model for the overall coupled system of liquid filled spacecraft with appendage. The attitude maneuver is implemented by the momentum transfer technique, and a feedback controller is designed. The simulation results show that the liquid sloshing can always result in nutation behavior, but the effect of flexible deformation of appendage depends on the amplitude and direction of attitude maneuver performed by spacecraft. Moreover, it is found that the liquid sloshing and the vibration of flexible appendage are coupled with each other, and the coupling becomes more significant with more rapid motion of spacecraft. This study reveals that the appendage's flexibility has influence on the liquid's location and settling time in microgravity. The presented nonlinear

Download English Version:

<https://daneshyari.com/en/article/5472481>

Download Persian Version:

<https://daneshyari.com/article/5472481>

[Daneshyari.com](https://daneshyari.com)