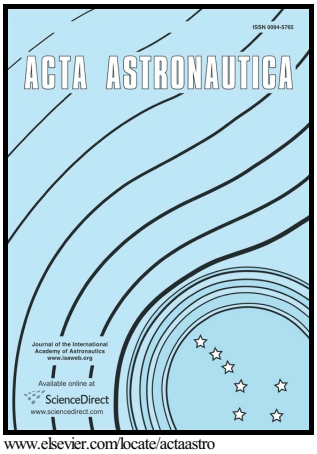

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Evaluation of Transient Response of Spinning Solar Sail with Flexible Membrane by Eigenfunction Analysis and Continuum Analysis[☆]

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Abstract

This study evaluates the transient response of large spinning membrane structures in space —especially spinning solar sails —by two different methods. A flexible sail membrane is easily deformed when a spacecraft changes its attitude, such as when using thrusters, and the control response including membrane vibration must be estimated in advance of operation. In order to estimate the motion of the membrane, numerical simulations using a Multi-Particle Model (MPM) are conducted, where the membrane is modeled with masses, spring, and dampers. Usually, force propagation is calculated directly in this model and the position and velocity of each particle represent the membrane motion, which is referred to as a continuum analysis in this study. This method is useful for the analysis of membrane vibration because it replaces the complex dynamics with simple equations of motion. However, the computational cost is high and the calculations require a considerable amount of time. This study introduces an eigenfunction analysis to solve this problem. In this method, natural vibration

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