Paper ID: 7794
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

Author: Mr. Takanori Toraya
Tokyo Metropolitan University, Japan

Prof. Hironori Sahara
Tokyo Metropolitan University, Japan

A TECHNIQUE OF REACTION WHEEL CONTROL FOR PRECISE TORQUE TRANSMISSION IN SUPPRESSING ITS OWN DISTURBANCE

Abstract

Development of microsatellites by universities and organizations advances so increasingly and widely that the higher techniques such as highly precise attitude control of pointing accuracy and stability is getting required for even the microsatellites engaged in their complicated space missions. In general, reaction wheel is often used as an actuator for attitude stabilization of the conventional satellites accomplishing telecommunication or remote sensing missions. Whereas it is expected that most of the microsatellites control their attitude with reaction wheel to achieve their attitude controls, reaction wheel can frequently cause serious disturbance to reduce their attitude control accuracy. It indicates that reaction wheel ought to actualize suppression of disturbance generation as well as transmission of control torque for highly precise attitude control. In this paper, **we propose a revolutionary technique for reaction wheel to achieve both the disturbance suppression and the control torque transmission**. First, we designed and fabricated a reaction wheel with a thin flywheel to be installable onto small volume in a microsatellite. Since the flywheel with large diameter compared to its thickness is wobbling, we measured a magnitude and its frequency of the reaction wheel disturbance with a laser displacement sensor under the condition of constant-speed rotation. In addition, we conducted a simulation of the reaction wheel with disturbance model paying attention to an weight-unbalanced flywheel and rattling bearings, where we determined parameters in the model by comparison between the experimental and the simulation results. Thus, **we constructed a detailed analytical model of realistic reaction wheel in consideration of disturbance**. Subsequently, we started a simulation to suppress the disturbance of reaction wheel. We found an effective control rule, and confirmed the suppression of serious disturbance. It is very important to suppress the natural vibration because the first mode of disturbance derives from its radial rocking and often adversely affects not only satellite attitude control but also satellite structure. Consequently, we succeeded in both the disturbance suppression and the torque transmission in the reaction wheel. It will contribute to the higher accuracy of attitude control for microsatellite.