

ASTRODYNAMICS SYMPOSIUM (C1)  
Attitude Dynamics - Part 1 (5)

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FEM-BASED EVALUATION OF SOLAR RADIATION PRESSURE EFFECT FOR SPINNING  
SPACECRAFT**Abstract**

This paper discusses about attitude dynamics for spinning spacecraft under influence of solar radiation pressure(SRP). Generally spinning objects maintain its spin axis with reference to inertial frame. But if disturbance torque like SRP affects this object, the spinning motion indicates a unique behavior due to dynamical coupling between the SRP torque and the spin motion. IKAROS and HAYABUSA launched by Japan Aerospace Exploration Agency (JAXA) positively utilize this phenomenon in actual operation. For example, HAYABUSA was kept sun-oriented during spin stabilized phases without fuel utilizing this effect. In the IKAROS mission a method has been developed which controls both attitude and orbital trajectory by SRP. These two are the remarkable examples of how SRP is utilized for fuel-saving and efficient operation. To enable to this technique, it is essential to understand attitude dynamics including SRP influence correctly. In past papers, simplified attitude models including SRP effect are derived both for HAYABUSA and IKAROS missions. These models are cable of explain wide range attitude motions. But in the flight data of HAYABUSA and IKAROS, there are remarkable motions that these simplified models cannot explain. In past papers, these motions called wind mill effect and spiral behavior. There are two purpose in this paper. The one is alignment of microscopic theory and macroscopic theory. The another one is considering these remarkable motions theoretically. For the this purpose, we construct FEM-model including SRP effects and simulate attitude dynamics numerically. In the results of simulations, two causes were found. The one is surface optical property distribution of spacecraft. The another one is non-flat surface effect of spacecraft. In this paper, we indicate the background of constructing SRP model and the evaluation including flight data of HAYABUSA and IKAROS. Then we discuss about the relationship between simplified attitude models and microscopic models.