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POINTING STABILITY OF HIZ-GUNDAM SATELLITE AFTER AGILE ATTITUDE MANEUVERS UNDER THE RATE BIAS ERROR OF FIBER OPTIC GYROS

Abstract

In recent years, the importance of autonomous control is increasing due to the enhancement of the complexity of satellite missions. The HiZ-GUNDAM project aims to detect many gamma-ray burst phenomena in the ancient Universe to clarify the birth and death of the Universe's earliest stars, and the physical state of the intergalactic gas at that time. The satellite will be equipped with a wide-field X-ray detector that can capture gamma-ray burst phenomena, and an infrared telescope that will quickly observe the afterglow, to allow rapid identification of the corresponding celestial object, and measurement of its redshift. This information will be shared widely to allow telescopes around the world to carry out timely follow-up observations. The agile autonomous attitude maneuvers are required for the HiZ-GUNDAM mission to make a quick observation of the afterglow.

This paper shows an approach to the technical issues of the autonomous attitude maneuver function of the HiZ-GUNDAM satellite. The evaluation results of the mid-term pointing stability after the attitude maneuver, which is an important performance index, are presented using the actual measurement data of the actual IRU. For the mid-term pointing stability requirement in every 120 s in the HiZ-GUNDAM mission, when using an attitude determination filter based on an extended Kalman filter using a star tracker and rate gyros, the effect of the rate gyro bias estimation error on attitude drift is considered as a major cause as well as the effect of micro-vibration disturbance. On the other hand, the rate random walk, which is an evaluation index of the bias estimation error of high-precision fiber optic gyros, can be suppressed below the measurable level, so it is difficult to perform numerical simulations using a conventional gyro error mathematical model. Therefore, in this paper, we evaluate the feasibility of mid-term pointing stability required for the HiZ-GUNDAM satellite by performing attitude maneuver simulations using actual rate gyro measurement data. In addition, by comparing the evaluation results based on the conventional method, we show the validity of applying the conventional evaluation model to high-precision fiber optic gyros.

These results show two conclusions: the feasibility of the pointing performance requirements of the HiZ-GUNDAM mission and a design guideline for evaluating the pointing stability of high-precision fiber optic gyros.