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VERIFICATION OF RISING-2 ATTITUDE CONTROL SYSTEM IN GENERIC HARDWARE-IN-THE-LOOP SIMULATION ENVIRONMENT

Abstract

A micro satellite called "RISING-2" was developed by Space Robotics Laboratory (SRL) of Tohoku University, targeting scientific Earth observation on Sun-synchronous orbit using 5 m resolution telescope and technical demonstrations for future constellation by micro satellites. The attitude control system of the RISING-2 gives 3-axis zero-momentum stabilization by using three reaction wheels together with three magnetic torquers for dumping of body angular velocity. The attitude determination system is equipped with two star trackers, a gyro scope, sun direction sensors, a GPS, and a geomagnetic aspect sensor. Its behavior was evaluated by means of generic Hardware-in-the-Loop Simulation (HILS) and verification environment, which is described in detail below. RISING-2 will be launched by Japanese H-IIA launch vehicle in 2014. This paper describes pre-flight evaluation results of RISING-2 in HILS environment and will also include quick reviews about the first operation in orbit and discuss the comparison between ground test data. In general, micro satellites have potentials to be rapidly developed in low cost. To achieve this, A Model-based Environment for Verification and Integration of μ-Satellite named MEVIμS was set up at SRL in parallel with the development of RISING-2. In this environment, all satellite subsystems are simulated in software based on actual components including attitude control as well as data handling and power control. MEVIμS is based on a real-time OS to realize real-time simulation of HILS environment. HILS of RISING-2 attitude control system was demonstrated by utilizing the satellite on-board computer and reaction wheels. The star tracker test system was introduced to include the failure detection and time delay. As the results, the system development became more efficient since the attitude control system verification could be carried out all of the time. After the acquisition of the RISING-2 data in real operation, the reliability of the development environment will be increased by reflecting the results. Furthermore, it will contribute to produce next micro satellite under development. This paper will put an emphasis on the configuration and capabilities of the HILS environment.