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A CONCURRENT BALANCING MECHANISM FOR CUBESAT ATTITUDE HARDWARE-IN-THE-LOOP DESIGN AND SIMULATION

Abstract

The Onboard Space Systems at Luleå University of Technology has developed an integrated design and simulation environment for the hardware-in-the-loop verification and validation of nanosatellites under orbital conditions. One of the systems included in such a platform is a three-degree-of-freedom spherical air-bearing stand for emulating the cubesat attitude behavior in orbit. For this purpose, the disturbance torque from various sources acting on the air-bearing stand must be eliminated. The sources of perturbations include the gravity, elastic compliance distortions, gyroscopic and Coriolis effects, and aerodynamics. The existing solutions for compensating the torque disturbances deal with each source separately. The paper details design and development of a concurrent balancing mechanism that can remove torque perturbations of various sources concurrently. The mechanism consists of four masses mounted on mutually perpendicular linear servomotors, hence capable of changing the position of the center of mass of the spherical air-bearing stand through a model-based control scheme to compensate for the imbalance torque. The performance of the proposed mechanism is investigated in different scenarios.