DEVELOPMENT OF A ATTITUDE CONTROL SYSTEM FOR A GRAVITY GRADIENT BOOM STABILIZED SMALL SATELLITE

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ABSTRACT

Verification of the software for an attitude control system (ACS) of a small satellite is usually done by modeling and simulation of the attitude equations, sensors, actuators and the controller together with some propagators. Therefore the models and the software which integrates these models should be subjected to rigorous tests to ensure successful utilization of the satellite.

In this article, development of models and simulation software for a gravity gradient stabilized small satellite called MESBAH will be explained. Design and manufacture of the engineering and flight model of the satellite is an on-going program in ITRC/IROST. The simulator is used as a design and implementation aid for the ACS software. The model presented in this paper is used for a store and forward free satellite with fixed and mobile user terminals. The orbit is LEO type and its ACS is responsible for providing a pointing accuracy of +/−10 degrees for the satellite antenna.

The formulations used for attitude determination of the satellite have been reviewed. A model for a variable moment of inertia matrix is presented next. Block diagrams representing mathematical models of: Euler’s equations, kinematics of motion, orbit propagator, sensors, actuators, disturbing torques, and the controller have been given. Determination of safe boom deployment conditions including: maximum allowable deviation from nadir, maximum allowable angular velocity of the satellite prior to boom deployment and the proper boom deployment velocity are presented. Also based on different initial angular velocities before deployment of the boom, the stable zones have been calculated.