SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellites Potential for Future Integrated Applications and Services (4)

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MEMS GYROSCOPES BASED ATTITUDE DETERMINATION EXPERIMENT OF ITASAT SATELLITE – PROJECT DESCRIPTION AND INITIAL RESULTS

Abstract

Commercial off the shelf (COTS) electronic components and sensors are being considered for space applications due to their low cost and availability. Combined with a careful mission definition, component characterization and radiation shielding and hardening techniques, these devices are enabling an increasing number of micro and nano satellite missions.

The ITASAT is the Instituto Tecnológico da Aeronautica (ITA)'s first academic satellite and can be classified as a micro-satellite with technological purposes. The project is inbounds of the Brazilian Space Agency (AEB)'s Small Technological Satellite Development Program and is at the beginning of its three year development schedule. The satellite's main purpose is to relay data from data collection platforms, such as environmental stations, to receiving ground stations. The current status of the project indicates the satellite will be spin stabilized and will have a polar orbit. Orientation and angular rate estimation for the attitude control system will be based on vector measurements provided by a sun sensor and a 3-axis magnetometer. The satellite will also carry a payload of scientific experiments, which includes the authors' experiment, described in this paper.

The proposed experiment is an instrument to be integrated at ITASAT that will combine data from MEMS gyrometers with the attitude information provided by this satellite's onboard computer using a Kalman filter technique as an attempt to obtain improved estimates of orientation and sensor's bias. Physically the instrument will consist of a small aluminum box which will carry three orthogonally mounted MEMS gyrometers and an embedded custom built data acquisition and processing board, based on an analog-to-digital converter and a microcontroller unit. The board will also integrate a power conditioning system to provide voltages to the instrument with acceptable noise levels. The instrument will communicate with the satellite's onboard computer through a serial communication interface. The instrument's calculated orientation data won't be employed by the satellite attitude control system. This data will only be transmitted through the satellite's telemetry to ground stations. The experiment will also receive commands and data from the onboard computer and from telecommand.

This article will present the instrument's concept and requirements to the mission. It also will describe in detail the instrument design issues, discussing its operational limits, problems found and solutions applied. It will also present the designed Kalman filter to estimate the orientation data and the gyrometers' bias, including its preliminary simulation results.