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INITIAL CHECKOUT RESULTS OF THE ATTITUDE AND ORBIT CONTROL SUBSYSTEM OF GREENHOUSE GASES OBSERVING SATELLITE (GOSAT)

Abstract

In this paper, we present results of the initial checkout operation of the attitude and orbit control subsystem (AOCS) of Greenhouse Gases Observing Satellite (GOSAT) launched on 23rd Jan. 2009. GOSAT is developed by Japan Aerospace Exploration Agency (JAXA) and manufactured by Mitsubishi Electric Corporation (MELCO). The objective of GOSAT is to capture precise and global distribution of greenhouse gases in the atmosphere. The greenhouse gas observation sensors equipped on GOSAT measure the altitude distribution of carbon dioxide and methane from 56,000 locations on the Earth's atmosphere.

The AOCS of GOSAT consists of earth sensors, sun sensors, star trackers, an inertial reference unit, a GPS receiver, reaction wheels, thrusters, magnetic torquers and their associated electrical circuits. The AOCS has many features such as a fine attitude estimator which utilizes the star trackers, an autonomous orbit control using the GPS receiver, a pointing algorithm which meets various observation demands, a robust reconfiguration, an attitude control with four thrusters and a moon pointing mode.

The autonomous orbit control determines the timing and the duration of the firing of the orbit control thrusters. It utilizes orbit parameters which are estimated by the GPS receiver. The AOCS controls the attitude of GOSAT using four thrusters during the initial acquisition and the orbit control thruster firings. It is the first time for us to use four thrusters for the low earth orbit satellite.

The moon pointing mode is also a new function for our AOCS. When the AOCS configures GOSAT to the moon pointing attitude, the greenhouse observation sensors see the moon for their calibration. The calibration is performed once a year.

One of the important features of the GOSAT AOCS is its robustness. Sensors and actuators have redundancy, and we also implemented sophisticated software algorithms to enhance the robustness in case of sever failures such as the breakdown of all the inertial reference units fail. When all the inertial reference units fail, the algorithms automatically reconfigure the angular rate estimator to use the differentials of the angle data from the star trackers.

The initial acquisition was successfully completed. The orbit control firings are also successful. The attitude control with four thrusters works correctly during the initial acquisition and the orbit control firings. Sensors and actuators of the AOCS operate normally and the nominal attitude is kept as designed. We will soon perform a checkout of the moon pointing mode.