Paper ID: 30662
oral
student

22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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ACTUATION SYSTEM FOR ATTITUDE CONTROL OF TWIN-NANO-SATELLITE STUDSAT-2

Abstract

Project STUDSAT-2 (STUDent SATellite) is India's first Twin Nano-satellite mission which aims to demonstrate Inter-satellite Communication between two Nano-satellites having a combined mass of less than 10 Kgs approximately. The mission objective is to demonstrate In-Orbit separation, implementation of Drag Sail Technology to de-orbit the slave satellite and capture images of Earth with a CMOS multispectral Camera. The Attitude Determination and Control System (ADCS) for STUDSAT-2 helps to maintain the desired orientation required for the successful implementation of the objectives. The mission requirement dictates that the satellite should maintain a sun-synchronous polar orbit with nadir pointing within 1°. In order to ensure the same STUDSAT-2 use Sun-Sensors, Magnetometers and Gyros for data acquisition and has Magnetic Torquer coils and Nano Reaction Wheel as actuators to get a 3-axis stabilized configuration.

This paper describes the design and development of the actuation system for STUDSAT-2. ADCS uses 3 magnetic torquer coils in orthogonal fashion to provide coarse pointing during the tumbling period. Coils generate a magnetic moment depending upon the amount of current passed through it. The magnetic moment in the presence of any external magnetic field gives the required torque for the orientation of the satellite. The magnetic torquer coils are controlled using magnetometer using B-Dot Law. The paper provides detailed design and control approach for the coils developed for the mission. After the satellite

is detumbled there is a requirement to further improve the pointing so that image could be taken. 3 axis-stabilized nano reaction wheels were developed in tetrahedral fashion indigenously by the team to meet the required pointing. Electronically Commuted Flat Brushless DC maxon motors are used to drive the flywheels. The paper describes the detailed designing, motion and frequency analysis, motor modeling and brief control approach of the nano reaction wheels used for fine pointing.

The actuation system developed for the project could be extended as a modular architecture for other nano-satellite missions. The same configuration of actuators can also be used for micro-satellite by appropriate scaling of design parameters.