Paper ID: 53342
student

26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Missions Global Technical Session (9-GTS.5)

Author: Mr. Vishnu Katkoori
Birla Institute of Technology and Science(BITS), India

Ms. Jivat Neet Kaur
Birla Institute of Technology and Science(BITS), India
Mr. Tushar Goyal
Birla Institute of Technology and Science(BITS), India

SIMULATION AND SELECTION OF DETUMBLING ALGORITHMS FOR A 3U CUBESAT

Abstract

As a satellite is deployed from the launch vehicle, it is subjected to high angular rates which need to be dampened in order for the satellite to perform its functions as expected. Simple and robust algorithms, such as BDot, are generally used to provide the required control torque for detumbling the satellite. This paper elucidates the design process for the detumbling algorithm to be implemented on a nanosatellite currently being developed by Team Anant, the Student Satellite Team of BITS Pilani. The process commenced with the selection of hardware to be used onboard the satellite. Magnetometers and Gyroscopes were finalized to be used as sensors. Various commercially available sensor models were then compared based on power and operating conditions. For actuation, a magnetorquer system was designed specifically to the requirements of the team. The system comprised of two magnetorquer rods and a magnetorquer coil aligned in orthogonal directions. The sensors and actuators were then accurately modeled in MATLAB for further testing. The modeling involved some interesting challenges due to the magnetic moment retained by the ferromagnetic core. These challenges, and the ways to overcome them have been also been briefly discussed in the paper. After finalizing the hardware, the team proceeded with implementing various popular control algorithms for detumbling the satellite. The algorithms were first theoretically analysed, and then modeled on MATLAB. The simulations took the space environment around the satellite into consideration for higher accuracy. The algorithms were tested for different initial conditions, using different time-steps and under different power constraints. The algorithms considered and the conclusions derived from these simulations have also been discussed elaborately in this paper. The paper concluded by presenting the finalized detumbling algorithm(s) to be used by Team Anant, and the various conditions devised to ensure efficient use of electrical power. The paper also presents viable alternatives to the finalized algorithm(s), using other hardware components. These alternatives and conditions have also been documented in the paper for a better understanding.