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Author: Mr. Shivam Hire
College of Engineering Pune, India, hiresc17.it@coep.ac.in

Mr. Onkar Bhakare
College of Engineering, Pune, India, onkargnbhakare@gmail.com
Mr. Shubham Thorat
College of Engineering, Pune, India, shubhartho13@gmail.com
Ms. Manali Durgule
College Of Engineering , Pune, India, manali.d1115@gmail.com
Mr. Atharva Karaguppi
College Of Engineering , Pune, India, atharva011998@gmail.com
Mr. Aman Gupta
College of Engineering Pune, India, guptaa17.elec@coep.ac.in
Mr. Sushil Mahajan
College of Engineering, Pune, India, mahajansp18.comp@coep.ac.in
Mr. Bhaskar Pardeshi
College of Engineering, Pune, India, biggy.pardeshi@gmail.com
Mr. Juber Shaikh
College of Engineering, Pune, India, shaikhjf17.mech@coep.ac.in
Mr. Rahul Patil
College of Engineering Pune, India, patilrahuld16.mech@coep.ac.in
Mr. Akshay Deodhar
College of Engineering, Pune, India, akshayrdeodhar@gmail.com
Mr. Kishan Patel
College Of Engineering , Pune, India, kp768919@gmail.com
Mr. IDRIS BANDUKWALA
College Of Engineering , Pune, India, idrisas18.elec@coep.ac.in
Mr. Akash Rathod
College of Engineering, Pune, India, rathodap18.elec@coep.ac.in

LEARNINGS FROM IMPLEMENTATION OF A DETUMBLING ALGORITHM FOR A NANOSATELLITE.

Abstract

Nanosatellites, on ejection from the launch vehicle, tumble with random angular velocities and have to be stabilized before they can commence their normal working. Due to the restriction on the mass and size of the nanosatellite, the use of exhaustive massive thrusters is not feasible. Hence, nanosatellites must use alternative methods to stabilize themselves. For the COEPSAT-2 nanosatellite, the BDot algorithm will be used to damp the angular velocities along all 3 axes. BDot uses the torque generated by the interaction between the torque rods and the earth's magnetic field to stabilize the satellite. This paper presents the implementation, testing procedure, and experimental results obtained during the testing of the Bdot algorithm. The BDot algorithm requires control of magnetic dipole moment, which is achieved

by controlling the current through the magnetorquer coils. A low-power controlled current source was developed using linear regulator topology. The detailed design procedure and testing results of the current control circuit are presented in this paper. A design of an alternative switch mode topology is also discussed in the paper. For on-ground testing, an air-bearing was used for levitating the test setup, allowing it to rotate freely about one axis. This enabled us to evaluate the damping effect of BDot algorithm on angular velocity in space-like conditions. An exponential decay in angular velocity was observed in these experiments. We present the angular velocity data acquired in these experiments and the effects that various factors like magnetic field strength, maximum torquer current, gain values, initial velocity, and sensor calibration have on stabilization time. Additionally, obtained results are compared with the expected results obtained through mathematical analysis. With the help of these results, we have shown how to find the expected stabilization time and residual angular momentum of satellites in space.