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DETERMINATION AND MITIGATION OF THE RESIDUAL MAGNETIC DIPOLE MOMENT OF CUBESATS FOR IMPROVED ATTITUDE STABILITY

Abstract

Precise pointing, agility, and stability are increasingly being critical requirements for CubeSat missions. Such precision is difficult to achieve in nano-satellites class, mostly because of their small moment of inertia, as small disturbance torques due to a residual magnetic moment have a significant effect on the attitude of spacecraft. The problem of high tumbling rates observed on several CubeSat missions is often due to un-modelled magnetic moments, mainly caused by the current flowing in the spacecraft, and the fact that CubeSats are often not designed with magnetic cleanliness in mind. This paper presents a new technique using a network of magnetometers to characterise and then mitigate the residual magnetic moment of CubeSats. A software model and a hardware prototype have been developed and successfully tested with the engineering model of the boom payload of Alsat-1N CubeSat, which represents a 1-unit CubeSats in a Helmholtz coils test facility in the Surrey Space Centre. This method is performed by implementing a network of eight miniature 3-axis magnetometers on the spacecraft and controlled by a Raspberry-Pi computer. These magnetometers are used to determine the strength, the direction and the centre of the magnetic dipole of the spacecraft and then compensate their dipole moment using the magnetorquers. This technique will contribute to reduce the effect of magnetic disturbances and improve the stability of CubeSats.