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A SURVEY OF THE MAGNETIC DIPOLE MOMENT DETERMINATION METHODS APPLIED ON CUBESATS AND NANOSATELLITES

Abstract

Nanosatellites and specifically CubeSats are being increasingly specified and developed for demanding Earth observation and astronomical missions, where precise pointing and high stability are critical requirements. Such precision is difficult to achieve in the case of nanosatellites class, mostly because of their small moment of inertia, this means that even small disturbance torques, such as those due to a residual magnetic moment are an issue and have a significant effect on the attitude of the spacecraft. However, the other typical attitude disturbance sources for spacecraft such as the gravity gradient, aerodynamic, and solar radiation pressure torques decrease significantly when the satellites become small. The disturbances may be mitigated by applying the magnetic cleanliness program and good engineering practice, in terms of reducing the use of permeable materials and minimizing current-loop area and by characterizing and mitigating the spacecraft magnetic dipole moment to ensure that the spacecraft magnetic field stays sufficiently low. This paper presents a survey, a short description, and a comparison of the magnetic dipole moment determination methods present in the literature applied on CubeSats and Nanosatellites based on physical measurements of the dynamic nature of the residual magnetic moment of the spacecraft or by estimation methods. These methods are used to determine the strength, direction, and the center of the residual magnetic dipole moment of the spacecraft so that the dynamic dipole of the spacecraft can be compensated on the ground or in-orbit by using the in-built electromagnet.