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A COMPREHENSIVE STUDY ON MAGNETIC ACTUATOR DESIGN FOR CUBESAT MISSIONS.

Abstract

Almost every CubeSat mission uses magnetic actuators for detumbling, for wheel momentum desaturation, or for coarse attitude control. Three types of coils are established in the CubeSat community: torque rods, air coils, and printed air coils. Torque rods consist of wire wound around an iron core. Air coils are produced from adhesive wire that keeps its shape after baking. And printed air coils are created on internal layers of printed circuit boards that form a set of multiple helical, overlapping coils.

This article explains the dependency of the coil characteristics magnetic dipole, electric power consumption, mass, and volume on the design parameters of the different coil types. Design parameters are parameters like the core length and diameter, the wire diameter, the number of layers, or the number of windings. Additionally to the three established coil types, a fourth coil type named printed torque rod is presented. This coil type is an anology to the torque rod but based on printed circuit board technology.

Based on the explanation described above a simple way of finding the optimal coil type and design parameters for a particular CubeSat mission is shown. This optimization takes all of the coil characteristics into account. Specifically highlighted is the search of optimized coil types and design parameters in the environment of highly integrated CubeSat side panels that support fluid-dynamic actuators.

The work presented will allow CubeSat developers to easily design magnetic actuators that optimally fulfill the mission requirements and constraints.