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DESIGN AND DEVELOPMENT OF A THREE-AXIS CONTROLLED HELMHOLTZ CAGE AS AN IN-HOUSE MAGNETIC FIELD SIMULATOR FOR CUBESATS.

Abstract

Team Anant is the University Student Satellite Team of Birla Institute of Technology and Science, Pilani, India. The paper presents the details of the design and in-house development of a Three-axis Controlled Helmholtz Cage prepared by the members of the Team as an Attitude Determination and Control test bed for CubeSat type nano-satellites. The testbed has been designed to provide a testing volume of approximately 60 dm^3 with uniform magnetic field, which is sufficient to test nanosatellites of up to 3U Size (CalPoly Standard). The maximum designed magnetic field intensity for each coil is 120 μT. The cage has been designed so as to simulate the magnetic field over the entire range of Low Earth Orbits.

The papers starts from the very basic coil design requirements with detailed analysis of the dimensional requirements and materials to be used. The analysis is complemented with a budget optimization model for a cost effective setup. The cage has an unconventional but improvised Square-Coil design. The methodology applied for the structure design and assembly of the cage has been presented in a thorough manner. Comprehensive information about the internal and external, software and hardware connections have been provided. All other relevant information has been presented to provide a step by step guide for the development of the cage.

Aluminum Square Pipes and Aluminum Flats were used to prepare the structure of the Cage supplemented by Copper Wire for the production of the field. MATLAB and STK are used to determine the Magnetic Field Intensities along the orbit which are then translated in real time to current intensities on the three pair of Coils. A brief analysis of the circuitry used for producing the required currents is also presented. The system is able to perform as expected in common configurations and is able to produce the desirable field in all three axis. The paper concludes with the experimental data obtained during the testing of the structure and the software of the cage.