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LOW-COST MANUFACTURING AND TESTING OF ATTITUDE CONTROL SYSTEMS FOR  
CUBESATS

**Abstract**

CubeSats have become one of the most popular pieces of technology used by universities and companies to get a foothold in space technology, and the Attitude Determination and Control System (ADCS) is one of the most important and challenging sub-systems for development. ADCS manufacturing and testing is both complicated and expensive; this system can be a limiting factor in mission design due to the pointing requirements required for many applications. Proper testing and calibration of the ADCS requires significant development of ground support equipment which itself can be costly. The student design teams SFU Sat and UBC Orbit have developed innovative low-cost techniques for manufacturing and testing these systems for the ALEASAT project: a 1U Earth-imaging CubeSat with strict pointing requirements and a small budget. The approaches developed for this project can help enable other groups around the world to implement their own low-cost ADCS projects to unlock new mission architectures for any group. This paper presents the requirements, design, simulation, and manufacturing of a Helmholtz cage, magnetorquers, reaction wheels, and testing techniques for each component - including the use of a portable clean box for safely testing flight hardware. To ensure that the equipment is ready for launch, a portable Helmholtz cage is used to test and calibrate the magnetorquers. Reaction wheels also require detailed testing and calibration; different techniques and test setups are shared for the testing of both actuators together.