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Author: Ms. Juliette Lacasse
Université de Sherbrooke, Canada, juliette.lacasse15@gmail.com

DESIGNING THE FIRST THREE-SECTION ARM ON A CUBESAT

Abstract

As part of the Canadian CubeSat Project, a team of undergraduate students from Université de Sherbrooke are designing QMSat, a 2U CubeSat. QMSat's mission is to test the technology of a quantum magnetometer, to gather vectorial data of the Earth's magnetic field. Being sensitive to electronic noise, it has been calculated that the payload must be at least 60 centimeters away from the electronic components of the satellite. However, being a 2U CubeSat, QMSat is approximately 20x10x10 centimeters when stowed and the payload must initially be inside the CubeSat, meaning that a deployable arm must be used to distance the payload form the electronics. The only way for the quantum magnetometer to be far enough from the rest of the CubeSat to collect valuable data and still have QMSat respect the height limits of a 2U CubeSat, is by using a three-section arm, which is a first on a CubeSat. A three-section arm involves increased safety hazard, so to ensure a safe launch the team has designed a custom locking mechanism comprising two burn wires that will prevent a premature deployment of the arm. The deployment will be done in two different sequences, to prevent the payload from hitting the antennas on top of the CubeSat, hence compromising the satellite's operations. To reduce the acceleration on the quantum magnetometer during the first deployment sequence, a damping structure will be absorbing a part of the energy. The structure of the arm itself involves four tape springs, which attach the three sections of the arm together. Tape springs are highly useful for a deployable arm and their behavior compares to the one of a measuring tape since they are easily bendable but when unfolded they become stiff enough to keep the arm form moving around in space, while being flexible enough not to create a substantial impact on the payload during the deployment. It is also key to test the deployment sequence before the launch to study the dynamic of such an arm. However, since the mechanism is meant to work in a low-gravity environment, the test must account for the offset the gravity creates. The solution of a three-section arm on a CubeSat brings multiple possibilities for missions with payloads that are sensitive to electromagnetic fields. The use of a three-section arm can also be adapted to different satellite format to broaden its use and further liberalize the access to space.