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INFLATABLE ANTENNA FOR CUBESAT: MOTIVATION FOR DEVELOPMENT AND ANTENNA DESIGN

Abstract

CubeSat and small satellites are becoming a way to explore space and to perform science in a more affordable way. As the goals for these spacecraft become more ambitious in space exploration, moving from Low Earth Orbit (LEO) to Geostationary Earth Orbit (GEO) or farther, the communication systems currently implemented will not be able to support those missions. One of the bottlenecks in small spacecraft communication systems is represented by antennas, since the gain is a function of the antenna dimensions. Current antennas for CubeSat are mostly dipole or patch antennas with limited gain (generally not more than 6dB). Deployable (not inflatable) antennas for CubeSat are currently being investigated, but these solutions are affected by the challenge of packaging the whole deployable structure in a small spacecraft.

The work that we propose represents the first attempt to develop an inflatable antenna for a CubeSat. Inflatable antennas can be packaged efficiently occupying a small amount of space, and they can provide, once deployed, large dish dimension and correspondent gain. Inflatable antennas have been previously tested in space (Inflatable Antenna Experiment, STS-77). However they have never been developed for small spacecraft such as CubeSat, where the packaging efficiency, the deployment, and the inflation represent a challenge.

Our study explores for the first time the possibility of developing such antenna in a way compatible with CubeSat dimensions. The research provides answers on possible dimensions for an inflatable antenna for small satellites, gain and resolution that can be achieved, deployment and inflation mechanism compatible with CubeSat, and the impact of the technology on future CubeSat missions and other small satellites. Future work will include the test of the antenna in flight during a specific technical demonstration mission.

The article is structured as follow: context and motivation for Cubesat inflatable antenna are described; then a study to design the antenna which achieves the required performance metrics, while respecting the constraints imposed by CubeSat structure is presented. Finally, the design of the antenna is presented and the testing campaign is discussed.