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DEVELOPMENT OF AN INNOVATIVE UHF-BAND ANTENNA FOR 6S POLISPACE CUBESAT 1U

Abstract

The interest in nanosatellites and CubeSats is growing thanks to their reduced cost compared to their traditional full-size counterparts. That is associated with the lower resources required to lift them to orbit. Much effort has been focused on developing innovative antennas for CubeSats that respect the imposed constraints, such as reduced dimensions, high-efficiency requirements, and wide impedance bandwidth. In the last years, several studies have been published comparing and categorizing the different antenna designs for CubeSats based on their operating frequency bands and mission objectives.

Focusing on the design of antennas for UHF band LEO CubeSats for telemetry and telecommand purposes, the current state of the art sees the emergence of new solutions such as dual-frequency antennas, deployable antennas, meander line antennas, and patch antennas array. In this paper, an innovative antenna design for the 6S PoliSpace CubeSat antenna is presented.

PoliSpace is the first Space association of Politecnico di Milano, and it is currently designing a 1U CubeSat set to fly at the beginning of 2023, which will be the first satellite entirely designed and built by students in this university. The mission objectives consist in testing a type of structural battery and perovskite solar cells and sending to the ground station all the obtained data for analysis.

In the international framework for collaboration between Politecnico di Milano and Universidad Politécnica de Valencia, an innovative design of a 435MHz-438MHz UHF band high gain antenna for PoliSpace nanosatellite is currently being studied.

Using the Theory of Characteristic Modes, firstly developed by Harrington and then updated by further studies, an antenna with circular polarization and a gain of approximately 6 dB has been designed. The considerations over the reduced size of the structure, the analysis of the mode diagrams, and the inclusion of eight radial monopoles elements of different lengths at the CubeSat structure vertices, led to an improvement of the initial radiation pattern and to an increment in the directivity of the antenna. A feature that made it an excellent candidate for the future PoliSpace mission.