SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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HANDS-ON EDUCATION FOR INNOVATIVE RESEARCH FIELDS: A CUBESAT MANUFACTURED WITH RAPID PROTYPING TECHNIQUE

Abstract

The structure of Cubesat presented in the paper was realized within the activities of Space Robotics Laboratory and V-Lab of the II Faculty of Engineering of University of Bologna and in collaboration with the Space system Group of the School of Aerospace Engineering of University of Rome "La Sapienza".

The work team is composed by professors, researchers, PHD students, master and bachelor students.

The Space Robotics Group is involved in a number of projects aimed to the hands-on education including: an observatory for observation and monitoring of space debris, the creation of payloads for sounding rockets and stratospheric balloons, that are part of the ESA education program, the developing of a Rover for autonomous navigation and the Cubesat depicted in the paper. It is a cube-shaped nano-satellite with the side of 100 mm. Despite its small size, it has a system for active attitude control, a telecommunications system, a payload camera and the power control system. Considering the size and requirements of the various systems, the organization of interior spaces was one of the major issues in the design of the structure for which it was necessary to identify innovative solutions.

The Cubesat structure was realized by thermoplastic material (ABS) with Fused Deposition Modeling (FDM) thanks to the Dimension SST (Soluble Support Technology) equipment provided by the V-Lab.

This Rapid Prototyping technique has several advantages including the fast implementation and low cost. Moreover, concerning the construction of a small satellite, this technique is very useful thanks to the possibility to manufacture the structure as one single part and to the accuracy achievable in details, which sometimes are difficult and expensive to realize with the use of tools machine. Another important advantage is the possibility to use a material with a lower density than common aluminum; this, however, involves the deterioration of mechanical properties as analysed in the paper.

The structure must be able to withstand with the launch loads. Thus, several simulations using a FEM code have been performed in the design phase. Moreover a Test-Pod system in aluminum alloy was built to carry out the launch test campaign with Indian PLSV launcher.

After an overview of satellite mission and subsystems, the article shows the detailed design of the Cubesat with the analysis of solutions used for critical parts, the results of numerical simulations and of vibration tests campaign performed.