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PLASTIC CUBESATS : AN INNOVATIVE AND LOW COST WAY TO PERFORM APPLIED SPACE RESEARCH AND HANDS-ON EDUCATION

Abstract

This paper describes the design and the manufacturing of a cubesat realized by students of the Space Robotics Laboratory and V-Lab of the II Faculty of Engineering of Bologna University, in collaboration with the Space System Group of the School of Aerospace Engineering of Rome University "La Sapienza".

The cubesat has a system for active attitude control, a redundant telecommunication system, a payload camera and a high efficiency power control system. The subsystems developed for this cubesat have been designed to be scaled up for larger satellites that could be used as low cost platforms to test new components in space or to perform risky missions.

The attitude subsystem is based on active magnetic system with magnetotorquers for the detumbling phase and three momentum wheels for the fine control. It is very small, with the dimensions of about 50x50x50 mm and completely realized by the Space Robotics Laboratory. The attitude control system has a microcontroller that takes data from the magnetometers, and receives commands from ground and implements the control law in the automatic flight phase.

The cubesat structure will be made in a polymeric material, obtained by rapid prototyping technique thanks to the equipment provided by the V-Lab. This technique allows the production of the mechanical parts in a very short time and at low costs and also gives the possibility to obtain complex shaped pieces, whose accuracy in many details could not be achieved using classical materials. This feature is more important when satellites become smaller and smaller, since it is very difficult to assemble miniaturized components. The structure must be able to withstand with the launch loads. For this reason, several simulations using a FEM code have been performed in the design phase.

The communication subsystem, also realized by students, has small dimensions, low power consumption and low cost. The main components of the system are the radios, the antennas (one of them is manufactured inside the ABS structure), the amplifiers and the microcontroller.

Cubesat represents an outstanding way to teach to young aerospace engineers how to face new problems, team working and practical sense in a real space project.

The paper describes the entire project of the cubesat built at the Bologna University, showing the characteristics and highlighting solutions adopted for critical issues of every subsystem and analyzing the student contribution in every step of the satellite realization.