MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (9)

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FUSED DEPOSITION MODELING TECHNIQUES FOR MANUFACTURING OF CUBESAT BASED ON MODULAR DESIGN CONCEPT

Abstract

Cubesat is getting one of the most used platform for the development of nanosatellites. For this reason it is important the introduction of new production techniques in order to reduce costs and manufacturing time. The structure is a key element in a cubesat: it has to respect standardized geometrical constraints both in terms of shape and dimensions. In the past few years the researching groups of Space Robotics of the University of Bologna and Space Systems of the University of Rome have been studying the use of rapid prototyping techniques for the manufacturing of cubesat structures. The particular process is called FDM, fused deposition modeling: the part is created layer by layer by the deposition of a thin wire. The technique has several advantages with respect to traditional manufacturing processes, including the quick implementation and low costs. Moreover it allows the creation of shapes and details difficult or even impossible to achieve with the use of machine tools. This translates in the possibility of a complete adaptation to every payload configuration and customization of inner volume with "ad hoc" requirements. A number of models of cubesat structure have been designed and manufactured in order to analyse the advantages of the FDM technology. One of the concepts is a 2U modular cubesat, in which two single cubesats are assembled separately and then joined together to guarantee easy access to the inner volume during the mounting phase (this concept could be extended also to 3U cubesats). The used material is ABS, a polymer with a lower density than aluminum so that the resulting structure is lighter. Many simulations using a FEM code have been performed to verify the mechanical properties of a plastic made structure and its capability to resist to stress due to the launch, moreover vibration tests were also performed on 1U cubesat. Results by FEM analysis and shaker vibration testing sessions are depicted in the paper.