Paper ID: 44660
oral
student

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

Author: Mr. Valerio Cardini
Sapienza University of Rome, Italy, valerio.cardini@uniroma1.it

Prof. Paolo Gaudenzi
Sapienza University of Rome, Italy, paolo.gaudenzi@uniroma1.it
Prof. Alberto Boschetto
Sapienza University of Rome, Italy, alberto.boschetto@uniroma1.it
Dr. Luana Bottini
Sapienza University of Rome, Italy, luana.bottini@uniroma1.it
Dr. Marco Eugeni
Sapienza University of Rome, Italy, marco.eugeni@uniroma1.it
Mr. Gabriel Graterol Nisi
Sapienza University of Rome, Italy, gabrielgrateroln@gmail.com
Prof. Francesco Veniali
University of Rome "La Sapienza", Italy, francesco.veniali@uniroma1.it

SELECTIVE LASER MELTING OF A 1U CUBESAT STRUCTURE. DESIGN FOR ADDITIVE MANUFACTURING AND ASSEMBLY.

Abstract

The aerospace industry has used Additive Manufacturing (AM) since its beginnings in the '80s. In the last decade, new advancements in these technologies have led applications to proliferate moving from the prototyping to the direct part manufacturing, rapid tooling, and repairing. In fact, AM is a completely new manufacturing process if compared to the conventional subtracting methods and it has deeply influenced product design and assembly in the aerospace becoming strategic technologies throughout the entire supply chain. Moreover, AM enables easy integration of design change, has the capability to build virtually any shape, and at least as importantly it allows complex feature integration and part count reduction, greatly simplifying product assembly. As a result, also the functionality and the verification through the FEM simulation could benefit. For example, stress singularities, which tends to occur in the proximity of interface points, are reduced and tuning of the FEM model with the experimental results would be much more efficient, since interface-related modeling issues would be avoided. These advantages can be addressed to the production of small satellites constellations, made by up to some hundreds of satellites, finding an optimum compromise between customization and modularization needs. In view of the above points, the present work shows a re-design of the structural sub-system of a small satellite of CubeSat class. Specifically, a 1U CubeSat design has been developed taking into account the consolidation of parts, integrating the features into more complex elements, reducing and/or avoiding the assembly issues, ignoring the constraints imposed by conventional processes, considering AM built related factors. As a result, a new 1U CubeSat composed of two parts already assembled has been fabricated by the Selective Laser Melting (SLM) technology. Particular care has been made to new features, e.g. the clearance and the shape of the hinge and the snap joint matching SLM specific constraints: support structures design and removal planning, part orientation, hollowing out for powder removal. The obtained results point out AM as a key technology allowing for drastic reduction of part count in a complex mechanical system, as a small satellite structure. The paper results show how the AM allows complex and customized

shape components fabrication leading to a mass customization instead of mass production; nevertheless, the technology built related factors must be taken into account in a Design for Additive Manufacturing approach thus affecting the final design.