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A NOVEL DESIGN APPROACH FOR SPACE COMPONENTS: APPLICATION TO A MULTIFUNCTIONAL PANEL

Abstract

One of the most challenging problem that engineers must face during the design phase of any single component of space systems is weight. The more is reduced, the less the launch will cost. Another critical aspect to consider is the overall dimensions of any object together with the coupling and compatibility with the surrounding parts. Moreover, the harsh operative conditions, like cosmic radiations and thermal gradients, pone major challenges for the operational life. Via progressively integrating more functions into a single element, is it possible to optimize the final configuration of a complex object, addressing the multi-purpose role required for future applications. Although in the past this integration was not always possible, nowadays the emerging additive techniques are enhancing the design freedom with novel solutions. In fact, the present trend in all industrial sectors is to introduce additive manufacturing, not only for rapid prototyping, but also for producing components to be used for real applications. Due to safety reason, the usage of this production technique for space application is very limited, but several increasing test campaigns are rapidly rising its Technology Readiness Level (TRL). A novel concurrent design approach that integrates not only the thermal and structural performances, but also the technical feasibility and the cost effectiveness of the part itself, could be a great turning point for the project methodology. The purpose of this work is to cast some lights into the multidisciplinary design of the next generation of space components introducing these novel aspects. Inasmuch as 3D printing is the future production trend, Selective Laser Melting (SLM) technology has been adopted for the analysis presented. The case study presented in this paper outline a new design method applied for a multifunctional panel to be used as cold plate as well as structural panel, able to cope with the hostile ambient conditions of space missions. The primary function of the proposed part is to withstand the loads, from the launch to the operative phases and, instead of having a dedicated and separated loop for thermal regulation, the panel is designed to internally incorporate the working fluid. The flow rate has been minimized imposing reference boundary conditions taken from the International Space Station (ISS) standards.