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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialised Technologies, Including Nanotechnology (8)

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MULTIDISCIPLINARY DESIGN AND SIMULATION OF A 3D PRINTED LATTICE COLD PLATE

Abstract

Designing space systems and components is a complex engineering process: contrasting requirements and harsh environment conditions major affect their operational life and performances. To address the upcoming major challenges resulting from higher scientific objectives, future space missions should account for complex objects, which progressively integrate more functions into a single element. Those multi-purpose components have to be optimized with respect to the final configuration and the discipline involved in the conceiving phase. Novel manufacturing techniques, such as 3D printing, are enabling new design paradigms also for the historically-conservative space field. A complete new branch of project methodology is emerging, where the technical feasibility is considered together with production costs and traditional simulation techniques. The purpose of the present research work is to analyse the multidisciplinary design approach for the next generation of space components. The case study considered is the optimization of a cold plate that is currently flying on-board the International Space Station (ISS) Columbus module. Additive manufacturing technologies are adopted to create a sandwich structure with a lattice core. Different trabecular topologies have been analysed using structural and fluid dynamics tools for performances prediction: specifically, the Finite Element Method (FEM) for mechanical evaluations and Computational Fluid Dynamics (CFD) for thermo-fluid dynamics investigations. The loads level ranges from the launch, which is the most critical mission phase to withstand for structural stress, to the nominal operative phases. Thermal loads have been set accordingly to the ISS standards, where this multifunctional panel is interfaced with other components of the fluidic system for temperature control. The different solutions are then compared to optimize the final product, depending on the boundary design parameters imposed. Weight has been set as the variable to minimize, also considering the primary function of heat rejection related to thermal efficiency.