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ATILIUS - ADDITIVE TECHNOLOGIES FOR INNOVATIVE LOW-THRUST IODINE SPACE UNIT FROM SCRAP

Abstract

ATILIUS is an innovative fluidic space propulsion subsystem, created to reduce the consumption of material on Earth and to mitigate the generation of debris in space. The project aimed to design, simulate, optimise, fabricate, test and validate a highly efficient solid-propellant fluidic subsystem for a space-propulsion system of small satellites, made by metal 3D printing using recycled material as raw material. With the New Space Economy, the number of satellites orbiting the Earth is increasing considerably, with a growing risk of exacerbating the problem of space debris. The best solution to mitigate this environmental threat is to ensure safe and controlled re-entry of satellites at the end of their operational life using electric propulsion systems. Mass constraints, especially in CubeSats, often prevent the addition of the propellant needed for end-of-life maneuvers. REGULUS-50-I2 is an innovative low-thrust electric propulsion system developed by T4i specifically for small satellites, designed with a plug play philosophy and using solid iodine as propellant. REGULUS current fluidic subsystem design has been optimized with ATILIUS, allowing sufficient propellant to be stored for both orbital maneuvers and de-orbiting. The only viable solution to meet extreme mass and volume constraints is to adopt additive manufacturing (AM) technologies to fabricate the fluidic system. The Laser Powder Bed Fusion (LPBF) is an AM technology with low energy consumption (laser power 400W) and low waste generation; ATILIUS also used an innovative powder as raw material, i.e. a metal powder generated from scrap recycling, with a reduction in raw material consumption and a reduction in carbon footprint by 25In addition, a numerical tool and a thermal model of the system was developed using High Performing Computing to increase the efficiency of the device. Once realized, ATILIUS was subjected to complete functional tests and vibration tests, demonstrating the validity of the approach adopted, from design to finishing, in a perspective of industrialization, without forgetting the sustainability aspects, quantified with a Life Cycle Assessment. The new design of ATILIUS featured a circular inflow of 96.7ATILIUS is a joint project by the 3 Italian SMEs T4i – Technology for Innovation and Propulsion (Space), Aidro (Additive Manufacturing), Optimad (CFD Simulations) and has indirectly received funding from EU Horizon 2020 via the KYKLOS 4.0 project.