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PORTABLE ON ORBIT PRINTER 3D: 1ST EUROPEAN ADDITIVE MANUFACTURING MACHINE ON INTERNATIONAL SPACE STATION

Abstract

Additive Manufacturing (AM) technologies represent a solution for enabling astronauts to manufacture parts in situ, as needed, starting from feedstock material. The importance of these capabilities are particularly evident in manned space exploration missions, e.g. on human Mars missions, where a paramount cargo capability would be necessary to supply the astronauts with everything they may need during the mission. Also, item obtained by 3D printing process may have a lighter structure than if manufactured out of conventional process, thus helping in reducing overall mass at launch. The capability to make parts in space, during the mission, would dramatically reduce the mass sent to the destination site and also help astronauts in solving some of the problems that can occur during a space mission: if the Apollo had been equipped with a 3d printer, the filter housing with a suitable interface could have been easily manufactured by astronauts using Additive Manufacturing technology.

The Portable on-Orbit Printer 3D represents the first European additive manufacturing experiment in space. The Printer implements the Fused Deposition Modelling (FDM) process for the fabrication of parts using the PLA thermoplastic polymer. The objective of the experiment is to validate the 3D printing technology in microgravity and to pave the way for an Italian and European development of the additive manufacturing technology on board the ISS and, more in general, in space. Portable on-Orbit Printer 3D is a 3D printer developed by TAS-I together with ALTRAN and IIT. The project has been managed and funded by ASI in the frame of 2012 AO "Bando Volo Umano Spaziale". The Printer has been launched to ISS within the Cygnus module with OA-4 resupply mission (Atlas 5) on December 6th, 2015. The astronaut on-orbit operations are limited to activate the Built-In Test and the "printing" process that lasts about 50 minutes. At the end the printer is returned to Earth were the "printed" part is removed and analyzed. Scientific goal of the experiment is mainly to prove that FDM fabrication with a representative type of polymeric material is not significantly influenced by the gravity acceleration field.

This paper will present the results of the demonstration activities performed on orbit and the results of the analysis performed on the on orbit "printed" part in comparison with the same part "printed" on ground.