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INFLUENCE OF SPATIAL ORIENTATION ON PROPERTIES OF 3D PRINTED PEEK PARTS AND THEIR DESIGN ADAPTATION

Abstract

Human exploration and permanent settlement on another planet's surface is the one of the most attractive and challenging next steps in space. In this frame, the Additive Layer Manufacturing (ALM) is one of the key technologies that have been demonstrated to provide a significant added value for space missions. In particular, the Fused Deposition Modelling (FDM) technology has proved its working capability under microgravity conditions on the ISS. However, currently, the technology is limited to consumer grade plastic with very low mechanical and thermal performance.

The ESA MELT project aims to build and test a 3D printer breadboard capable of processing engineering thermoplastic and printing both functional and structural parts. Within the project, the influence of the orientation and the gravity vector on mechanical properties was studied on standard ASTM samples and functional parts were printed to test performance. Different gravity vector orientation was simulated by printer position. Differences in mechanical properties of tensile, compression and flexure samples printed with different orientation in the printed volume and gravity vector orientation are discussed. Functional parts have been selected in the perspective on implementation on the International Space Station (ISS) and future planet outpost directly after printing phase, without any postprocessing steps.

The samples were then printed and checked for form, fit and function. The results of functional tests are presented and discussed, as well as recommendations on the design adaptation for the additive manufacturing process to enable the development of in-space manufacturing capabilities.