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FUNDAMENTIALS OF IN-SPACE ADDITIVE MANUFACTURING

Abstract

In-space additive manufacturing (ISAM) is progressively developing and under intense attention. On one hand, additive technologies may significantly impact future human spaceflight programs. On the other hand, the average maturity level of additive manufacturing is not high enough to radically change space industry. The purpose of this paper is to review additive technologies and to analyze their applicability for space. The review provides basics for most of all existing technologies, recent developments and novel concepts of additive manufacturing systems. The analysis also includes determination of major manufacturing parameters and issues. Systematic approach was used to carry out the analysis. Although additive manufacturing is increasingly developing, Fused Deposition Modeling (FDM) is the only technology successfully demonstrated in space. In 2014 the company Made In Space, Inc. has delivered the first FDM extrusion-based 3D-printer to the International Space Station (ISS). Therefore a detailed analysis of FDM and similar methods was carried out to more accurately estimate limits and range of space applications for extrusion-based systems.