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GENERATIVE IN-SPACE MANUFACTURING OF LARGE STRUCTURES BY EXTRUSION OF UV-CURABLE POLYMER RESIN

Abstract

In-Space manufacturing of lightweight structures is a key technology for enabling the cost-effective fabrication of large orbital and planetary systems. We present a method for generative in-space fabrication by extrusion and cure of photoreactive polymers, first ground test results and a sounding rocket experiment for in-space verification, which is foreseen to be launched in March 2020. Latest advances in generative manufacturing indicate the potentials of these technologies for in-space manufacturing. While first experiments with 3D-printing have been performed under controlled, pressurized conditions on the International Space Station, a technology for generative fabrication of space structures in open space environment is not yet available. Studies based on reinforced thermoplastic filament structures suffer from extensive power requirements, high complexity and difficult thermal control. The AIMIS project at Munich University of Applied Sciences developed a method for fast and power effective manufacturing of large space structures by extrusion and transient UV-curing of polymer resins. The resin is continuously cured during extrusion by a UV-induced cationic polymerization process, forming single polymer rods and allowing the generative fabrication of three-dimensional truss structures. The experimental verification of this method will be performed on a sounding rocket, where cylindrical polymer rods of 4 mm diameter will be created under microgravity and vacuum conditions. Further, concepts for large structure fabrication and assembly, based on the proposed manufacturing method, are presented and discussed.