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IAF SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

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DIRECT ROBOTIC EXTRUSION OF PHOTOPOLYMERS FOR IN-SPACE APPLICATIONS

Abstract

Structural masses of space systems are generally oversized due to the high structural requirements of a launch vehicle, reducing a mission's potential. First in-space manufacturing methods have been demonstrated in the past with the aim of reducing the structural mass and thereby the transportation costs. A method utilizing the *Direct Robotic Extrusion of Photopolymers* is presented, enabling generative in-space manufacturing of customised space system components in a cost-effective way. The viscous photoreactive resin is hereby extruded through a robotically directed nozzle and simultaneously cured by UV-light. While conventional 3D-printers operate layer-by-layer, the presented method directly creates three-dimensional structural elements in one continuous movement. Emphasis is placed on possible application scenarios and their feasibility. These scenarios include antennas, structural components and space tethers. Further, the newly gained design possibilities through the combination of three-dimensional movement of a robotic extruder and the possibilities of manufacturing in microgravity are evaluated. To verify the versatile manufacturing processes necessary to create these highly efficient customised spacecraft structures, basic printing operations are derived. These will be tested during a parabolic flight campaign in November 2020. The experiments include the printing of rods straight sods, the printing of arbitrarily shaped rods as well as the connection of existing elements. These experiments shall demonstrate the feasibility of this technology.