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IAF SPACE SYSTEMS SYMPOSIUM (D1)
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Abstract

With its benefits, such as minimal wastage, reduced production time, and lightweight, highly customizable and optimized products, additive manufacturing has proven itself to be fruitful to a wide variety of Earth applications. Current initiatives are looking towards expanding additive manufacturing into the microgravity environment of space. This effective and efficient manufacturing technique can provide a solution to the limitations imposed by payload geometry and structure, significant expenses of launching, and astronaut's reliance on resupply and stockpiles of spare components. Hence, additive manufacturing is currently being researched and developed for space habitats such as the International Space Station (ISS). This paper focuses on the potential of additive manufacturing as a solution to enable a self-sustaining crewed space habitat without re-supply requirements. The paper uses the ISS as an analogue to identify numerous areas where additive manufacturing can be leveraged during crewed missions as well as to understand how other manufacturing techniques such as assembly and integration are utilized. In this paper, crewed deep space mission is defined as a space habitat with seven crew members beyond the Earth's magnetosphere for a continuous period of three years without re-supply. Since the location and duration of this mission are dissimilar to the ISS, differences in technical and crew requirements of the two space habitats are established. In-orbit additive manufacturing techniques, either developed, in-development, or not developed, are proposed for each of the requirements. The associated Technology Readiness Level, challenges and risks are also mapped for each requirement. Furthermore, the mission is perceived through an ethical, political, and legal lens which will address any issues and provide potential solutions. The paper concludes with the added value of in-orbit additive manufacturing, cost and demand considerations.