Paper ID: 27685
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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human and Robotic Partnerships in Exploration - Joint session of the Human Spaceflight and Exploration Symposia (3-B3.6)

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REDUCING EARTH DEPENDENCY FOR HUMAN SPACEFLIGHT THROUGH ROBOTIC SPACE MANUFACTURING

Abstract

Human space exploration is currently hampered by extreme supply chain challenges. Current missions to Low Earth Orbit (LEO) requires constant resupply and is completely dependent on Earth resources. If future missions expand exploration into the solar system, new strategies must be created in order to rely not just on ground based supply chains to ensure safe and affordable programs. Additive manufacturing enables the restrictions placed on Earth supply chains to be lifted and new exploration architectures to be explored. Starting in 2014, the International Space Station had the capability to not entirely rely on launches to receive mission items on orbit when Made In Space launched the 3D Printing in ZeroG Experiment (3D Print) in partnership with NASA. This technology demonstration proved the vitality of additive manufacturing in space and analyzed the effects of long duration microgravity on the hardware and manufacturing process. The 3D Print mission was a stepping stone for the future Additive Manufacturing Facility (AMF) that will be installed on ISS in 2015. The AMF is a commercially available manufacturing facility on ISS. This same technology can support future manned exploration by suppling astronauts with the ability to make critical and non-critical fixes to ensure missions success. Future additive manufacturing technology that is being developed will supply all necessary spares and upgrades for missions as well as create infrastructure, such as habitats on Mars, that can be robotically created before crew arrives. This is one of many examples of the applications that can be used with the technology. This paper explores the possibility that additive manufacturing provides to the future of both manned and robotic space exploration as well as the anticipated technology development roadmap and associated disruptive aspects it brings to space exploration.