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UNFOLDING SEQUENCE OF INTERIOR STRUCTURES FOR A DEPLOYABLE LUNAR HABITAT

Abstract

In the past decade, there has been renewed momentum towards sending humans back to the lunar surface, with the intent to turn visitation into lunar habitation. NASA's 2018 Strategic Plan marked an effort for "sustainable long-term exploration and utilization [of the Moon]," and the European Exploration Envelope Programme resolves to "[develop] new concepts for international exploration activities," including long term exploration of the lunar surface. One promising technology to help this goal are deployable habitats. These habitats can be packed into the rocket payload and then configured and occupied by users once on the lunar surface. Inflatable or transformable habitats have become some of the leading technologies, especially since NASA TransHab. Similarly, modular interior configuration schemes have been utilized in case studies like the International Space Station to standardize utilities and interior configurations. Furniture "modules" can be outfitted with a diverse range of services including operations technology, storage, recreational spaces, and agriculture. Problems have arisen, however, when the circular nature of inflatables intersect with the rectangular-grid patterns of modular racks. Precedents like the ISS EXPRESS Racks opted to fill out curved space with malleable amenities like air supply and electricity. This study aims to optimize interior space more purposefully, utilizing the curved space to decrease wasted volume.

Since 2018 the design and engineering firm Skidmore, Owings Merrill has been investigating together with the European Space Agency and faculty from the Massachusetts Institute of Technology concepts for the first permanent human settlement on the lunar surface. The project aims to provide a holistic design for a self-sustaining Moon Village in the southern polar region. This paper develops in detail the packing and unfolding sequence of the Moon Village Habitats. Specifically proposing how to pack the floor and interior furnishings into the stowed configuration in the rocket and then the sequence of unfolding into the deployed configuration. It focuses on analyzing and optimizing geometries to formulate floor plates that can both unfold from the payload interior and house modular furniture blocks. Optimization was also concerned with minimizing material whilst maintaining functionality. The model was tested by developing both a digital and physical model, the latter to fine tune the limitations of the inflatable design and create proof of concept.

An understanding of deployment logistics contributes plausibility to making Lunar Habitation a reality. From here, stakeholders of the Moon Village Project can envision it evolving from a mere idea, to tomorrow's future.