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Space Architecture: Habitats, Habitability, and Bases (1)

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AUTOMATIC DEPLOYMENT MECHANISM OF ORIGAMI HOUSE

Abstract

The Space business has recently expanded significantly, and economic development and resource exploration is going to begin targeting the moon, Mars, and asteroids. There is a need to consider residential facilities on the moon and Mars. NASA's "Artemis Project" is going to conduct manned exploration on the lunar surface around 2024, and aims to build a permanent lunar base in 2028. The lunar surface is considered as a relay point for heading to Mars, as described in the 2018 The Global Exploration Roadmap. Therefore, we believe there is a strong demand for the lunar base which serves as habitat and warehouse. In this paper, we focus on the automatic deployment mechanism of ORIGAMI HOUSE. ORIGAMI HOUSE can be folded small during transportation and expanded on the moon, so reducing transportation volume and lowering transportation costs. Origami technology has a great advantage in the operation in space because the mathematically defined form provides stability and the use of thick and rigid material results in structural strength. Easy and quick Origami deployment can shorten the construction time of the facility, helping boost various businesses on the Moon in an earlier development stage. In this research, we first designed our unique and patented ORIGAMI HOUSE, and then performed mechanical and FEM analyses to find out how much force and power are required to fold and unfold the structure. Based on these analytical results, we designed an optimal and low-power actuator system that can automatically deploy the ORIGAMI structure. Finally, we built a ORIGAMI HOUSE model equipped with the actuators to verify the feasibility of technology and the analytical results. As a conclusion, we could successfully create a unique, low-power, low-cost, easily-manageable, and automatically-deployable base technology of ORIGAMI HOUSE. This project was conducted as a joint research of Obayashi Corporation, OUTSENSE, and Shonan Institute of Technology.