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Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems (2A)

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PRELIMINARY PROPOSAL OF A STRUCTURAL FRAMEWORK FOR THE CONSTRUCTION OF AN EXTRATERRESTRIAL INFRASTRUCTURE: AN ATTEMPT TO RESPOND TO THE LOW UP-MASS AND VOLUME REQUIREMENTS IN SPACE MISSIONS THROUGH OPTIMIZED DESIGN

Abstract

Structural materials, sufficient radiation protection, and robotic operations - required for the construction of the extraterrestrial infrastructure - entail huge energy and economic costs, caused by the up-mass and volume of the payload. That is why space exploration calls for solutions that are relatively lightweight and have a small volume. At the same time, they need to be sufficiently durable and respond to flexibility and reliability concerns. This paper presents an idea for the construction of a structural framework system, based on the multi-resolution hexagonal grid geometry. The following project is a result of multidisciplinary, digital fabrication and parametric design workshop in Gdynia (Poland). The primary objective was to optimize the material's mass, volume, and assembly method. Part of the repetitive structure was manufactured by laser cutting and assembled on a small scale in workshop space. The developed system could be used to construct elements of extraterrestrial infrastructures, such as support for reflectors, telescopes, and antenna or shielding and protective structures for hangars, storages, and greenhouses. The components for the construction of this framework system would be transported in a very compact form and assembled in-situ using robotic operations. After the assembly process, the structural framework would be covered with a durable membrane, enhancing the structural integrity and

contriving environmental protection. The assembly process would be relatively easy and enable reusability due to the reconfigurability of the elements. The structure is based only on one type of element, connected by two types of repetitive joints. By varying the positioning of the elements, the structure can morph into diverse forms, therefore enabling plenty of architectural solutions and various applications.