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STUDY OF ISOKINETIC STRUCTURES AND APPLICATIONS FOR EXPANDABLE AND ADAPTIVE HABITATS USING IN-SITU LUNAR RESOURCES FOR FUTURE MOON SURFACE MISSIONS

Abstract

Numerous concepts for permanent lunar base structures have been proposed. Among these designs, some of them highlight expandability anticipating future growth at the expense of a detailed study of the lunar surface environment and the effects it may have on the structure and materials. Others concepts have the advantage of being structurally sound however, they do not consider the availability of lunar construction materials.

In this paper, we present a modular architecture for a lunar habitat taking into account the properties of isokinetic structures and the possibility of in-situ resources utilization. The overall concept would allow a mission crew of four to live and work on the Moon's surface, in collaboration with robots.

The proposed solution presents the idea of an isokinetic expandable geodesic dome as the main and internal structure. This structure is completed by a particular layer design, made from a pattern of empty triangular-based pyramids to be filled by regolith and/or lunarcrete enabling at the same time a future growth of the habitat. This layer increase the strength of the structure as well as provide a protection shield against outer environment.

At this stage of the work, the overall dimensions of the maximum expansion of the dome are 6 m diameter with 3 m height. However, we contemplate the possibility to have a bigger dome with an expansion up to 10 m diameter. Further expansions are yet to be studied. A similar scale prototype has been created to verify the actual effectiveness of the sole deployment mechanism. We have taken into consideration the lunar environment, construction methods and materials, structural systems and design loads among other parameters in the designing of the habitat. We also understand the role of human and robots, their performances and their interactions during the development and completion of the mission. Other aspects such as life-support systems, interior design, regolith processing and transportation will be studied within the next steps of the work.

This habitat requires achieved and available technology therefore, the lunar base idea may become a reality within the next decade, expanding our frontiers and open new opportunities for research.