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REDEFINING HUMAN LUNAR HABITATION THROUGH HOPSHELL VOLUME AND SOFT MEMBRANE STRUCTURES

Abstract

Reimagining the lunar base involves introducing HopShell Volume and Soft Membrane Structure concepts, with a focus on hardware designed for humans to interact with their environment in lunar gravity. Unlike conventional lunar base designs that assume Earth-like movements, we recognize that humans can adapt their locomotion and perception to lunar conditions.

In this context, lunar base architecture can influence and modify human behavior. Under lunar gravity, where jumping and hopping become 'natural' means of locomotion due to the human body structure, we propose a shift in design to encourage and accommodate these methods for daily life on the Moon.

HopShell Volume is an approach to the use of volumetric space in the vertical direction. Under Earth's gravity, space has been interpreted as a cube with vertically connected stairs. However, physical movement and perception under lunar gravity facilitates vertical movement under its own power and does not rely on stairs. This requires volumetric space to be interpreted in a geometric form that is easier to jump and leap over.

Soft Membrane Structures advocate for the fabrication of the maximum possible amount of material, including interior materials, with soft, flexible membranes, or pneumatic tubes. On the Moon, the physical body is more prone to movement due to external forces than on Earth, membranes may be an advantage as an interior material, as they are flexible enough to catch falling objects.

Obtaining the resources necessary to demonstrate these is difficult. Human movement in a sufficiently large, pressurized space under lunar gravity has never been carried out. In addition, while knowledge of everyday human locomotion is empirical over a long period of time, and with the accumulation of a diverse sample, it is difficult to replicate in experiments with suspended or underwater walking.

The author attempts to solve this problem using Game Engine simulations rather than human equilibrium organs. Based on the internal pressure of the module and the body rig, which reproduces the structure of the human body, the behavior of the human body on the Moon was modelled. Based on this, the effectiveness of the two concepts is demonstrated and reflected in the architectural design.

This research aims to acquire challenging insights into everyday activities in lunar environments through simulations, supporting humanity's long-term stay on the moon.