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Human Exploration of the Moon and Cislunar Space (1)

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LADE: A MOBILE HABITAT PAVING THE WAY FOR SUSTAINED LUNAR EXPLORATION

Abstract

Since Apollo missions, robotic exploration of deep space has seen decades of technological advancement and scientific discoveries. Today, NASA's Artemis Program is envisioning a plan to drive humanity to

live on the Moon. Indeed, the possibility of building a permanent settlement on the Moon is still a major challenge. In this framework, Alta Scuola Politecnica and Thales Alenia Space partnered to design a novel agile habitat through an holistic multi-disciplinary approach to allow crewed surface exploration missions. Lunar Architecture Design Exploration (LADE) project's output is a mobile space architecture system that enables human presence on the Moon, allowing medium to long term missions. This module is the key movable part to build a more complex system of hybrid class II and class III shelters that aims at the construction of a lunar village.

The goal of the design effort is to allow the permanence of four astronauts for 30 days on the South Pole of the Moon, next to Shackleton crater. The location is strategical for surface exploration goals and provides favourable environmental conditions for a future permanent settlement. To achieve this, a combination between a mobile habitat and a network of robotically constructed shelters will be necessary. The design of both systems aims at satisfying all habitability and mobility requirements in the harsh and extreme lunar environment, while exploiting ISRU, through the demonstration of 3D printing capabilities for micrometeoroids and radiation shielding purposes.

The presence of a sheltering system will concur with a series of minimum infrastructure requirements, which will be reached through a first robotic mission. The aim will be defining the first mission elements necessary to sustain a human settlement, including the construction of solid foundations, roads and landing pads, stabilising the soil, providing an energy production and storage sub-systems.

The iterative process of functions allocation within the module and its overall architecture have been guided by the principle of human-centered design. The different mission constraints led to the development of an adaptive system, able to change according to the astronauts' needs and provided with a combination of rigid pre-integrated elements and reconfigurable spaces.

The implementation of LADE's functionality into the Artemis mission architecture enables the shift from early exploration phases to a continuous human presence on the lunar surface.