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ALCIDES: A NOVEL LUNAR MISSION CONCEPT STUDY FOR THE DEMONSTRATION OF ENABLING TECHNOLOGIES IN DEEP-SPACE EXPLORATION AND HUMAN-ROBOTS INTERACTION

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Abstract

Returning to the Moon has kept gaining interest lately in the scientific community as a mandatory step for answering a cohort of key scientific questions.

This paper presents a novel Lunar mission design to demonstrate enabling technologies for deep-space exploration, in accordance with the Global Exploration Roadmap and the National Research Council. This mission, named ALCIDES, takes advantage of some of the systems that are currently under development as a part of the HERACLES exploration architecture: these include the Orion module, the Space Exploration Vehicle, the Boeing Reusable Lander, the Ariane 6, the Falcon Heavy, the Space Launch System, as well as the Evolvable Deep-Space Habitat placed in EML2.

A consistent part of the efforts in designing the ALCIDES mission accounts for innovative exploration scenarios: by analysing state of the art in robotics and planetary exploration, we introduce a mission architecture in which robots and humans collaborate to achieve several tasks, both autonomously and through cooperation.

During this mission, high-performance mobility, extravehicular activity and habitation capabilities would be carried out and implemented. This project aims to demonstrate the human capability to live and work in the Lunar environment through the development of a long-term platform.

We selected the Amundsen-Ganswindt basin as the landing site for multiple reasons: the possible presence of permanently shadowed regions, its position within the South Pole and its proximity to the Schrödinger basin. The main objectives of the ALCIDES mission are to study the Lunar cold trap volatiles, to gain understanding of the Lunar highlands geology through sampling and in-situ measurements and to study Human-Robotic interactions. In addition, factors such as psychology, legal issues and outreach regarding this mission were also considered.

In particular, four traverses connecting the Amundsen crater with the Schrödinger basin were proposed, three of which to be performed by a tele-operated rover, and the remaining one to be carried out by a human crew with rover assistance. During these traverses, the rover will collect samples from several points of interest as well as perform in-situ measurements with a suite of instruments on board, helping to locate a convenient place for future human habitation.

The ALCIDES mission results will help the scientific community to better understand the Moon and to take advantage of its resources for future space exploration. Gaining this knowledge will allow us to move forward in the development of systems and capabilities for manned missions to Mars and beyond.

Keywords: Global Exploration Roadmap, HERACLES, Lunar Space Mission, Human-Robot Interaction

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