IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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PAVING THE ROAD - CONTEXTUALIZING LASER SINTERING WITHIN A LUNAR TECHNOLOGY ROADMAP

Abstract

The Global Exploration Strategy of the International Space Exploration Coordination Group (ISECG) describes a timeframe of 2020 and beyond with the ultimate aim to establish a human presence on Mars towards the 2040ies. The next steps lie on the Moon with a focus on the coming 10 years. Early lunar surface missions will establish a capability in support of lunar science and prepare and test mission operations for subsequent human exploration of Mars and long-duration human activities on the Moon.

Given the extreme costs involved in the shipping of material from Earth, a prerequisite for future human exploration is the manufacturing of elements directly on the Moon's surface. Unlike the equipment, which at the beginning will have to be brought from Earth, raw materials and energy could be available following the concept of In-Situ Resource Utilization. The ESA OSIP PAVING THE ROAD study investigates the use of a laser to sinter regolith into paving elements for use as roadways and launch pads thus mitigating dust issues for transport and exploration vehicles. The ESA funded study examines the potential of using a laser (12 kW CO2 laser with spot beam up to 100 mm) for layer sintering of lunar and Martian regolith powders to manufacture larger 3D elements and provide know-how for the automatic manufacture of paving elements in the lunar environment. The project contributes to the first step toward the establishment of a lunar base and will lead to the construction of equipment capable of paving areas and manufacturing 3D structures.

PAVING THE ROAD project sets the starting point for an examination into the larger context of lunar exploration. Mission scenarios will look at different phases of lunar exploration: Robotic Lunar Exploration, Survivability, Sustainability, and Operational Phase. A proposed Technology Roadmap investigates the mission scenario and analyzes how, and to which extent, laser melting/sintering will play a role in the various phases of exploration. The paper contextualizes laser sintering within the selected mission scenarios and discusses the different kinds of infrastructure that can be produced at each phase of the mission. The outcome of the study includes the detailing of the TRL steps in the project and an outline of a timeline for the different elements. Covered aspects include terrain modeling such as operation pads, roadways, or towers, non-pressurized building structures to protect machinery, and habitat envelopes, to protect and shield humans against dust, micrometeoroids, and radiation.