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

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BUILDING A PIECE OF THE MOON: CONSTRUCTION OF TWO INDOOR LUNAR ANALOGUE ENVIRONMENTS.

Abstract

Fifty years after the first moon landing, agencies and companies have set their sights back to revisiting the lunar surface. However, this time, they aim to return permanently. To facilitate this, autonomous robotic systems will be a crucial element in making it a reality. During an initial exploration phase, they will play an essential role in mapping the surface and searching for resources. They will also be an important factor in building up supply chains to ensure astronauts can surface in this harsh environment. Lastly, in order to set up efficient mining operations, this task has to be taken over by autonomous robotic systems.

Developing and testing these autonomous systems to ensure that they work reliably on the moon is a difficult task, as testing on location is not an option. Instead, engineers rely on simulations, testing facilities and outdoor lunar analogues. Due to the lack of lunar analogue testing facilities in Europe, ispace Europe and the University of Luxembourg have teamed up to build two of these facilities with the goal of designing new vision-based navigation systems. These systems will enable autonomous long range traverses for lunar rovers. The two new facilities have a surface area of 81 and 77 square meters respectively.

With regards to the type of testing needed for vision based systems, the optical fidelity of the environment was considered to be the most important factor. Different types of Basalt have been used for the two facilities to create a larger number of possible landscapes, such as craters, hills, rocky areas and smooth planar surfaces. Regolith simulant was also considered but, due to the health restrictions and the cost factor, basalt was selected instead. As a result, this has also allowed for larger testing areas. The illumination setup has been designed to simulate the polar regions of the Moon, with a single light source positioned low above the horizon, casting long shadows over the entire area. To mitigate problems with feature detection algorithms picking up features at the edge of the facility, the walls have been painted black. This also produces high contrast shadows, which is exactly what makes vision-based navigation challenging in the polar regions.

The outcome of this research is a set of lessons learned which will enable other researchers to replicate similar facilities and to reproduce the same fidelity in indoor testing for future vision based navigation systems.