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

Author: Dr. Hendrik Kolvenbach
ETHZ, Switzerland

Dr. Anna Mittelholz
ETHZ, Switzerland
Dr. Simon Stähler
ETHZ, Switzerland
Mr. Joseph Church
ETHZ, Switzerland
Mr. Philip Arm
ETHZ, Switzerland
Dr. Valentin Bickel
Max-Planck Institute for Solar Systems Research,, Germany
Dr. Krzysztof Walas
Poznan University of Technology, Poland
Dr. Matthias Grott
DLR (German Aerospace Center), Germany
Prof. Svein-Erik Hamran
University of Oslo, Norway
Dr. Özgür Karatekin
Royal Observatory of Belgium, Belgium
Prof.Dr. Miguel Olivares-Mendez
University of Luxembourg, Luxembourg
Dr. Sofia Coloma
University of Luxembourg, Luxembourg
Mr. Marco Pagnamenta
Switzerland
Mr. Michal Gumiela
KP Labs, Poland
Prof. Jordan Aaron
ETHZ, Switzerland
Prof. Marco Hutter
ETHZ, Switzerland

LUNARLEAPER - A MISSION CONCEPT TO EXPLORE THE LUNAR SUBSURFACE WITH A SMALL-SCALE LEGGED ROBOT

Abstract

LunarLeaper is a mission proposed for the 2023 ESA call for small lunar missions. Its goal is to investigate the lunar subsurface, particularly focusing on lunar pits, also known as skylights. These collapse features on the lunar surface potentially offer access to subsurface lava tube systems that could

serve as habitats for future human explorers. Additionally, lunar pits provide a view into the geological past of the Moon, exposing valuable information about the magnitude, timing, and composition of volcanic flows along their edges. The LunarLeaper is a highly versatile, 10kg-class legged robot designed to autonomously navigate the challenging terrain around the Marius Hills pit, one of the identified skylights believed to connect to a substantial underground cave system. This pit is situated in one of the Moon's youngest and enigmatic volcanic provinces. Leveraging a combination of established geophysical and imaging methods, such as a ground penetrating radar and gravimeter, LunarLeaper can characterize the terrain along the traverse. We aim to answer questions about lunar geology, including whether volcanic rilles represent surface manifestations of extensive cave systems, the timing of lunar lava flow events, and how the composition of lunar volcanism has evolved over time. LunarLeaper's primary objectives include confirming if the Marius Hills pit is connected to the hypothesized cave system and assessing its suitability for potential human exploration and habitation.