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

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MODULARITY FOR LUNAR EXPLORATION: EUROPEAN MOON ROVER SYSTEM PRE-PHASE A DESIGN AND FIELD TEST CAMPAIGN RESULTS

Abstract

The European Moon Rover System (EMRS) Pre-Phase A activity is part of the European Exploration Envelope Programme (E3P) that seeks to develop a versatile surface mobility solution for future lunar missions. To achieve this goal, a modular approach and a comprehensive analysis of the lunar environment are crucial to designing an optimal mobile solution for different missions. The European Large Logistic Lander (EL3) is a planned multi-mission landing capability that will be used to carry out various scientific applications on the moon, including three pre-Phase A missions: the Polar Explorer (PE), In-Situ Resource Utilisation (ISRU), and Astrophysics Lunar Observatory (ALO). Therefore, designing a multipurpose rover that can serve these missions is critical. The EMRS Pre-Phase A activity is a step towards developing a mobile solution that can support different lunar exploration activities in the future. This study aims to design a modular and flexible EMRS rover that can be used in various mission configurations while achieving a balance between versatility and system optimality. The rover needs to be compatible with three different mission scenarios, each with an independent payload, making flexibility the key driver. The study focuses on modularity in the rover's locomotion solution and autonomous on-board system. The EMRS solution has been tested at an analogue facility to prove the modular mobility concept. This paper presents the modular rover solution for future lunar missions and the results of the field test campaign. The field test campaign for the EMRS rover was conducted in two phases: phase one at DLR's PEL lunar analogue facility and phase two at GMV's Mars SPoT facility. The tests involved the rover's mobility in a lunar soil simulant testbed and different locomotion modes in a rocky and uneven terrain. The tests allowed for modifications to the rover's configuration, the addition of payloads and different weights. The EMRS project has developed a multipurpose modular rover concept, with power, thermal control, insulation, and dust protection systems designed for further phases. Obstacle and excavation tests have demonstrated safe navigation and the ability to excavate in lunar regolith, essential for human life on the Moon. The modular design allows testing of locomotion and software with various scientific payloads such

as neutron spectrometers, drills, or cameras. Further work is needed on the systems designed during the project. This paper highlights the potential of the EMRS system for lunar exploration and the importance of modularity in rover design.