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MULTIPURPOSE LOCOMOTION SYSTEM FOR CREW AND CARGO TRANSPORTATION ON THE LUNAR SURFACE

Abstract

The roadmap for future human exploration sees the Moon as a critical step for developing new explorative technologies. Soon we will witness, for the first time after the Apollo missions, a crew landing on the Moon. The new generation of lunar explorers will have to deal with a dual challenge: widening the horizons of scientific research, while setting the basic infrastructures for the satellite future colonization. In this context, the development of a new type of vehicle for the transportation of both astronauts and cargo payloads is crucial. The intent of this paper is to provide a preliminary study for a multi-scenario locomotion system, optimized for the issues future lunar missions will face. The flexibility of this new technology will result in an extended and faster surface crossing that could be exploited for future manned missions on Mars. To achieve scalability, two main configurations of the vehicle are foreseen: a smaller unit, providing agile mobility for the crew and autonomous deploying of scientific instruments, and a second configuration designed to displace large payloads. This could include habitation blocks to prolong the crew's permanence on the surface for longer-term exploration, thus acting as a moving shelter. The study focuses on the choice of the locomotion system, considering both legged and wheeled vehicles. The main drivers of the trade-off analysis include the capability to provide efficient mobility in low gravity with

maximized speed and minimum power consumption to ease extended surface exploration. The analysis also takes into account the asperity of the regolith soil and the irregular terrain: specifically, the vehicle's capability to travel large distances requires a design able to adapt to the diverse lunar morphology. Motion in the polar scenarios is prioritized, since potential sites of interest have been identified by the International Space Exploration Coordination Group (ISECG). Finally, the integrability of the system is studied to answer most of the potential missions requesting the system employment, including an in-depth evaluation to define the possibility of merging autonomous driving algorithms already tested in exploration rovers with manual driving performed by the crew when onboard the vehicle. The SEEDS program relies on the collaboration of Politecnico di Torino (Italy), ISAE-Supaero (France), and University of Leicester (UK). The project has been developed by an international group of students in partnership with Thales Alenia Space, the Italian Space Agency, and the European Space Agency.