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MODULAR ROBOTICS FOR LUNAR SAMPLE ACQUISITION, AGGREGATION AND RETURN TO ISS

Abstract

NASA's continuing efforts to explore the Moon in the Artemis program will offer unique opportunities to augment the science capabilities of the program hardware with autonomous and tele-operated technologies. In response to the agency's interest in developing the architectures to accumulate samples from the multiple lunar surface surfaces and returning them to the ISS, this project introduces a conceptual idea of a self-reconfigurable modular rover inspired by modular robotic technique and an architectural concept for sample return to ISS. A self-reconfigurable modular rover is composed of multiple modules and has the capabilities to configure in different configurations using uniform docking interfaces. By applying a proposed algorithm, the rover will split into multiple modules and finish the task of collecting samples at multiple lunar locations. Once the samples are collected, the modules will reconfigure it into one system and then further perform the sample aggregation procedures. The challenges involved in using such fully autonomous rovers in hazardous environments for sample acquisition from multiple locations and its aggregation before sending to ISS are identified and corresponding mitigation actions are recommended in this paper. The paper also illustrates the feasible ConOps options and sample collection techniques in and around the lunar lava tubes through its modularity options. This technology will help in deducing the possibility of human habitability in lava tubes at the South Pole location on the lunar surface. A mission architectural approach outlined in this paper, discusses the possible concepts of landing the self-reconfigurable modular rover on lunar surface, sample acquisition and aggregation, its on-surface analysis, and return to the ISS.