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MISSION ARCHITECTURE FOR ROBOTIC, LOW-COST, HIGH-FIDELITY MAPPING OF MISSION AREAS

Abstract

Informed mission planning is a crucial step for successful manned missions both in space and on other bodies. Precursor missions have frequently been used as both technological testbeds and implementers of prerequisite infrastructure to support future missions as part of an incremental space exploration strategy. While Mars presents a new opportunity for human exploration and long-term missions, it also presents new logistical challenges in mission planning and execution. This is due to environmental, communications, and resource availability challenges not experienced with manned missions within the Earth system. Consequently, missions designed for exploration and scouting of areas of interest before the arrival of humans become a necessity.

This paper presents a vehicle design and mission architecture for a rapid, cost-efficient, and redundant scout system for high-fidelity mapping and exploration of mission areas. A swarm robotics approach utilizing highly modular, simplified rover platforms and existing commercially available equipment are able to autonomously build 3D maps of large swaths of terrain that include information on topology, mineral concentrations, ambient conditions, and additional data pertinent to mission planning and in-situ resource utilization. Standardized buses with plug-and-play payload racks allow for use of variable payloads to suit mission needs without changes to overall design or logistics. This modular, redundant design represents a considerably valuable mechanism for increasing cost-efficiency and chance of mission-success of interplanetary operations from early-planning to end of mission life.