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SCIENCE AND EXPLORATION OF THE MOON ENABLED BY SURFACE TELEROBOTICS

Abstract

Teleoperated rovers have been a feature of space exploration for decades. Ground control teams that operate these rovers generally consist of a robot operations team supported by science and robot engineering groups. In these teams, the sharing of information and the flow of control is aligned with team size, organization, and hierarchy. But, in the future, astronauts will also remotely operate rovers. But integrating tele-operated rovers into human space exploration raises important questions. What system configurations are effective? Which modes of operation and control are most appropriate? When is it appropriate to rely (or not) on tele-operated rovers? To answer these questions three mission phases were simulated in a derived lunar terrain model in which participants drove a Turtle rover through the following task sequences : pre-mission planning, site survey, and surface asset deployment. The study employed located in the Lunares hab facility.

Data analysis indicated that interactive monitoring is an effective strategy for crew-centric surface telerobotics. Safeguarded driving using this mode of operation enabled the participants to perform each task successfully. Participants maintained good situation awareness with low effort using interactive visualization of the rover state and its activity. In addition, it was observed that crew workload as measured using the TLX was consistently low, which suggests that multi-tasking can be integrated into telerobotic operations.

From post-test debriefs it was determined that all participants were able to maintain a high level of SA during operations and that the activity employed in the operator interface was a key contributing factor to achieving these high levels.