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MODELING INDIVIDUAL AND MULTI-AGENT TEAM PROBLEM-SOLVING SKILLS FOR LUNAR BASE CONSTRUCTION

Abstract

Future human lunar exploration will necessitate that astronaut crews work autonomously to solve unexpected and time-critical problems, and will demand increased cooperation between humans and robotic and autonomous aides. The ability of these individuals and multi-agent teams to perform at a high level, and to maintain resilience in their functioning in the face of unpredictable contingencies will, therefore, be integral to mission success and safety. In order to mitigate mission disruptions and to reduce the risks for crew/autonomous-system teams, research is needed to identify relevant standards and guidelines for individual and multi-agent team problem solving, as well as for training related to human-systems interface during autonomous missions. We aim to undertake a spaceflight task relevant assessment of team problem-solving skills in the context of future long duration mission construction tasks, specifically Lunar base building scenarios. The ultimate goal of this work is to contribute towards the establishment of future standards and guidelines for training and operations, and the development of validated measures and metrics for determining training effectiveness through a model of dynamic individual and team problem-solving in response to change. This work will provide a cross-cutting, integrative assessment of individual and multi-agent team problem-solving skills, focusing specifically on team coherence, adaptability, and trust, and will contribute to the development of future decision- and execution-support systems. We will determine, through contextual inquiry conducted in military and civilian-run complex construction site operations as Earth-bound analogs for in-situ Lunar base construction, how problem-solving skills are developed and used across a variety of operational tasks and situations relevant to future long duration spaceflight exploration, and aim to identify which individual, team, and human/robotic collaboration skills are most important to performing tasks in both normal and emergency conditions. We will be presenting the challenges and research questions motivating this work, from the perspective of existing and future Lunar base construction concepts of operation, as well as our novel methodological paradigm and preliminary insights gained in the early phases of our investigation.