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INTEGRATION OF AUTONOMOUS ROBOTIC SYSTEMS FOR HUMAN SPACE EXPLORATION: INSIGHTS FROM EAR ANALOG MISSION IN HADEES-C HABITAT

Abstract

Human space exploration addresses challenges such as exploring unfamiliar terrain, conducting off-station operations, and doing science in extreme conditions. The use of robotics systems enables human exploration reducing risks to humans by providing important information. The EAR (Robot Assisted Exploration) crew performed an analog mission in the HAdEES-C habitat in September 2022, to test the integration of drones and a rover in assisting exploration protocols and operations in a space simulate environment. The crew simulated emergency situations, where commercial drones such as the DJI Mavic and the owned exploration rover SARA were used. As part of the simulation, the crew lost communication during spacewalks or were injured and had to be assisted. Time was taken to compare the assistance with and without the robotic systems. Spacewalks were repeated to understand the use of these tools, and repair tasks were executed with drone observation. The integration of drones and rovers in assisting exploration protocols showed improvement in the accuracy of communication between the ground station and the crew members performing the EVA, reducing the response time in emergency situations. Through direct visualization of different operational tasks, the execution time was also reduced. The drone also served as a communication channel in case the telecommunications failed between the crew and the habitat. The experience demonstrated that the use of autonomous robotic systems is essential to assist spacewalks and exploration protocols. Human and robotic interactions provided continuous control of spacewalks, performing efficient decision making and providing situational awareness on the ground station. The integration of autonomous robotic systems with humans needs to be applied to specific objectives on planets such as Mars to enable successful exploration missions.