HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
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DEMONSTRATION OF COMMUNICATIONS SYSTEMS FOR FUTURE HUMAN EXPLORATION DURING THE OPSCOM-1 TEST USING THE ISS.

Abstract

Most exploration roadmaps are calling for demonstrating operational scenarios for telerobotics from orbit around other planets. The International Space Station (ISS) is the ideal platform to test effects of microgravity on the perception of the crew on telerobotics operations and the performance of haptic devices. OPSCOM-1, a first experiment in a series of tests in operations, communications and telerobotics research for human exploration, was performed by ESA in October 2012 as a feasibility assessment of some communications aspects. During the OPSCOM-1, the crew followed a procedure to send instructions through a Graphical User Interface (GUI) on a standard laptop on the ISS to a simple rover located at the European Space Operations Centre in Darmstadt, Germany. Feedback for these instructions and the position of the rover were automatically gathered in files that were verified and transferred to the GUI on the ISS by manual ground commands of ground operators at the Belgian User Support Operations Centre, which was in charge of operations related to the ISS. Crew commands were sent to the rover using the Disruption Tolerant Network (DTN) protocol and feedback from the rover used the standard Telemetry and Telecommand path. The feedback link could not use DTN due to operational limitations on unverified automated commands sent over the uplink channel at the time of the OPSCOM-1 test. The communications concept was successfully demonstrated during OPSCOM-1. The only minor issue was the rover stalling once during way-point driving. This was traced back to packets that were lost on the space-to-ground link. Thanks to the enthusiasm of the crew on the ISS and the OPSCOM-1 team on ground, all scientific goals were achieved successfully. Time latency between commands sent by the crew through the GUI and the movement, position and picture feedback of the command to the crew was

between 3 and 5 minutes. OPSCOM-1 demonstrated that the DTN protocol can be used in telerobotics activities and the operational aspects of moving a rover from the ISS have been validated. Limitations of the uplink channel to the ISS led to long waiting times for the crew to receive feedback to their actions. These limitations should not apply any more for future tests. Issues of dropped packets will be avoided in the future by using the full functionality of "packet custodiancy" foreseen in the DTN protocol. More technologies will be used in future evolutions of telerobotics experiments by ESA.