Human Robotic Partnerships for Exploration (04)
Human Robotic Exploration Partnership (1)

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USING ROBOTS BEFORE AND AFTER HUMANS TO IMPROVE SPACE EXPLORATION

Abstract

Human-robotic partnership should not be limited to side-by-side concurrent and coordinated activities. As advanced as robots have become, they are still slow compared to humans. Concurrent, interdependent operations risk creating situations where the human is waiting for the robot while it is executing or stuck. Robots that cause humans to waste time or consumables risk making human missions less productive rather than more. An alternative is to separate human and robotic activities in space and/or time. In our recent work we have investigated how to utilize robots before or after human missions, in a precursor or follow-up capacity.

Robotic recon is remotely operating a planetary rover to scout planned sorties prior to EVA activity. Robot instruments provide measurements of the surface and subsurface at resolutions and from viewpoints not achievable from orbit. This surface-level data can then be used to inform the planning process and improve situational awareness for operations. We will describe our robotic recon experiment at Black Point Lava Flow in 2009, where we operated the K10 rover remotely from the NASA Lunar Science Institute. The experiment assessed the impact recon had on planning and executing simulated EVAs by two Desert RATS crews, with a comparison of the planning and execution under conditions relevant to lunar exploration with and without recon data.

We are also studying how robotic follow-up can improve planetary exploration. We define follow-up as robotic operations subsequent to human excursions which augment the work accomplished by humans and increases overall return. To better understand the benefits, requirements, limitations and risks associated with this technique, we have conducted analog field tests with human and robot teams at Haughton Crater on Devon Island, Canada. These experiments focused on two field geology campaigns carried out

by simulated EVA crewmembers. The EVA crews prioritized the follow-up work based on measurements they did not have time to make, sites they did not have time to visit, or questions that could not be answered with information from their EVA, to plan additional measurements to be made by the robot.

In this paper, we discuss the motivation for robotic reconnaissance and robotic follow-up, describe the scientific context and system design for our work, the experimental approach and data we have collected, and present results and lessons learned from field testing.