Integration of a COTS Robotic Arm and Rover for Future Low-Latency Telerobotic Assembly Experiments.
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NASA has set a goal to return to cis-lunar space to conduct lunar science and space science, and to prepare for future human missions to Mars. NASA will send astronauts to cis-lunar space using Orion and the SLS, where they will dock with a lunar-orbiting habitation and science module known as the Lunar Orbiting Platform-Gateway (LOP-G). The LOP-G's proximity to the lunar surface allows for real-time communication with surface assets, therefore enabling the use of low-latency surface telerobotics. Low-latency telerobotics can be used for many remote tasks on the lunar surface, including geological exploration and assembly tasks.

The Telerobotics lab at the University of Colorado-Boulder has integrated a CrustCrawler robotic arm with a Parallax ARLO rover forming the Arm-Rover Manipulator (ARM) system. The ARM system has been developed in preparation for low-latency telerobotic assembly experiments. We are simulating the telerobotic assembly of a radio array while varying the conditions of the video feedback. This experiment plans to quantify the operational video constraints on telerobotic assembly tasks. There are several aspects of the ARM system we developed and tested prior to conducting the telerobotic assembly experiment. The underlying system used to control the ARM system is the robotic operating system (ROS). We utilized a software package called MoveIt! that runs on top of ROS to solve the inverse-kinematics and plan movement between different positions and orientations. This setup allows operators to use a GUI to control the arm's movement, location, and orientation with ease and accuracy. Video feedback is provided to the operator by cameras strategically placed on the robotic arm and rover to maximize situational awareness. We also developed an antenna and antenna housing that will be used for our assembly experiment. The experiment will have the ARM system remotely place the antennas in designated locations and make the necessary electrical connections to create a simple radio interferometer (Figure 1).

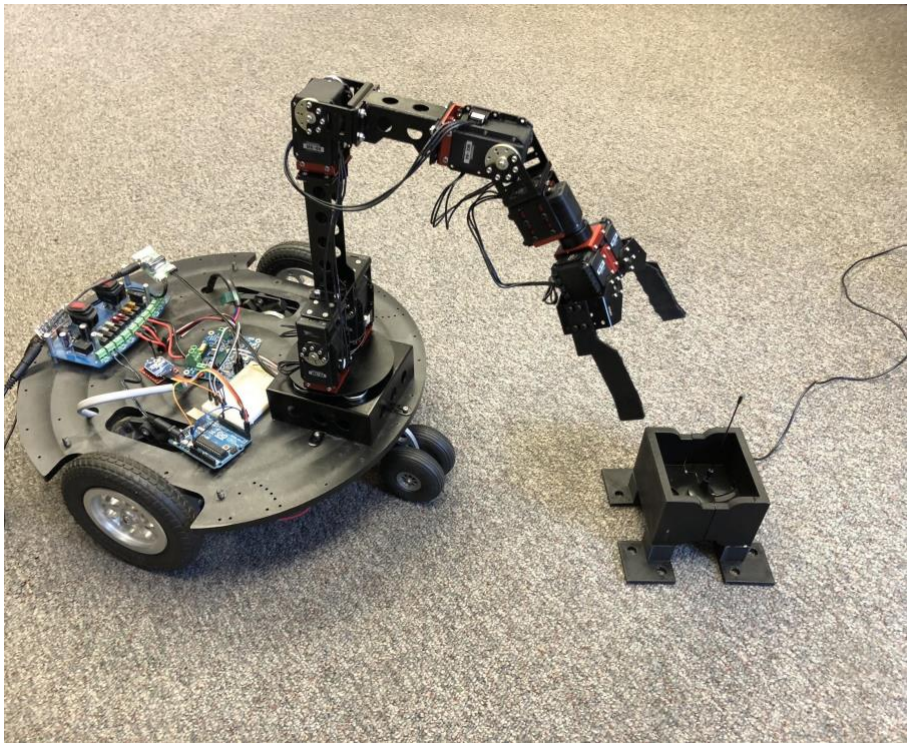

Figure 1: The ARM system with its open claw reaching for an antenna assembly.