Methodology to Assess the Human Factors Associa Teleoperated Assembly Tasks

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New Era of Space Exploration

- NASA's Mission
  - Human on the moon by 2024
  - Sustainable human lunar presence by 2028

Image Credit: NASA

- Our Mission
  - Quantify various constraints of teleoperating rovers
  - Determine new ways to effectively and efficiently teleoperate rovers

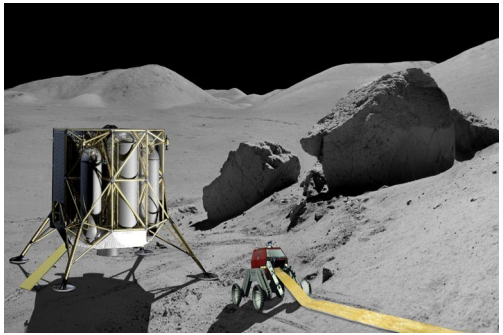
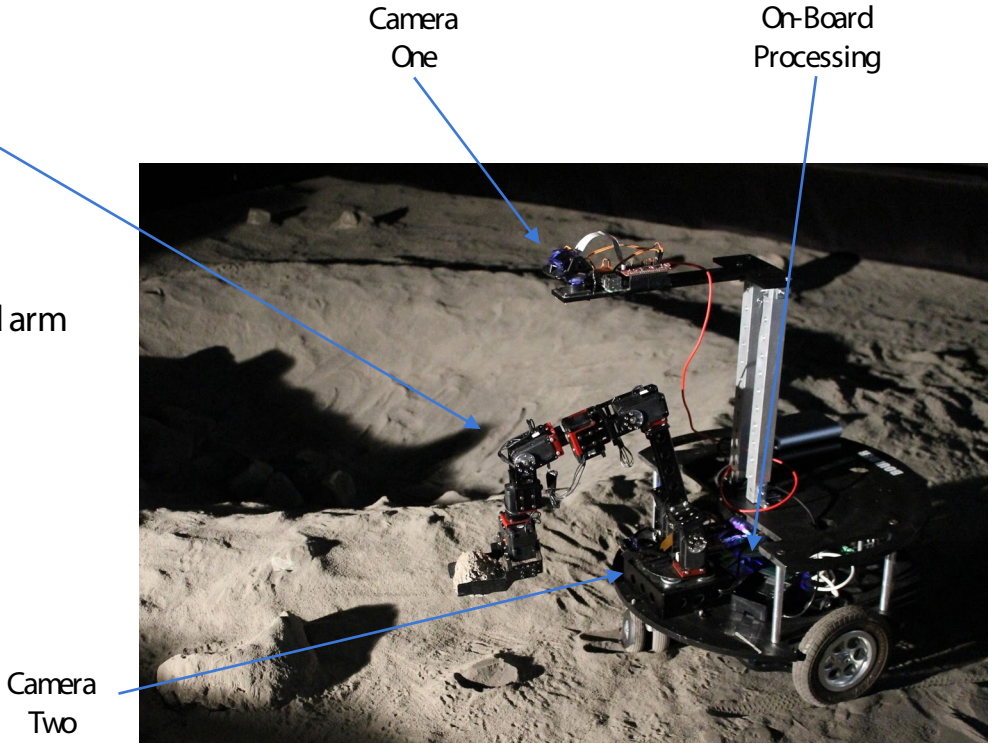


Image Credit: Jack Burns

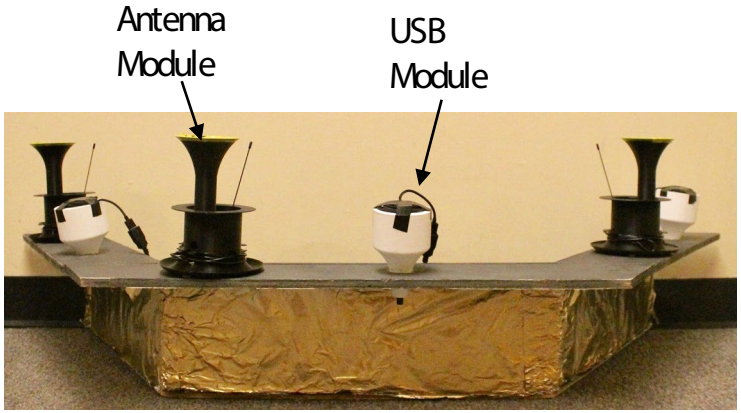
Telerobotic Simulation System (TSS)

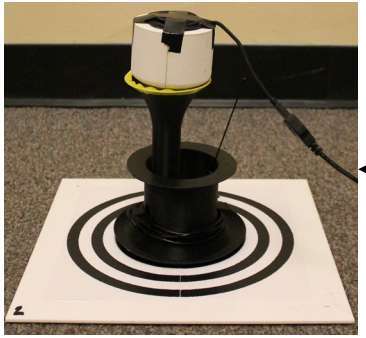
- Armstrong
  - Commercial-off-the-shelf rover
  - Crustcrawler Pro-Series Robotic Arm
    - 6 Degrees of Freedom
  - Two Raspberry Pi Cameras
  - Onboard Raspberry Pi and Arduino
    - Handles drive, camera position, and arm
- Feedback GUI for Operator support



Methodology

- 3 phases
  - Training
  - Local assembly
  - Remote assembly
- Objective Measurements
  - Number of failures
  - Time to completion
  - Antenna unit placement
- Subjective Measurements
  - Situational Awareness Rating Technique
  - NASA Task Load Index
  - System Usability Scale

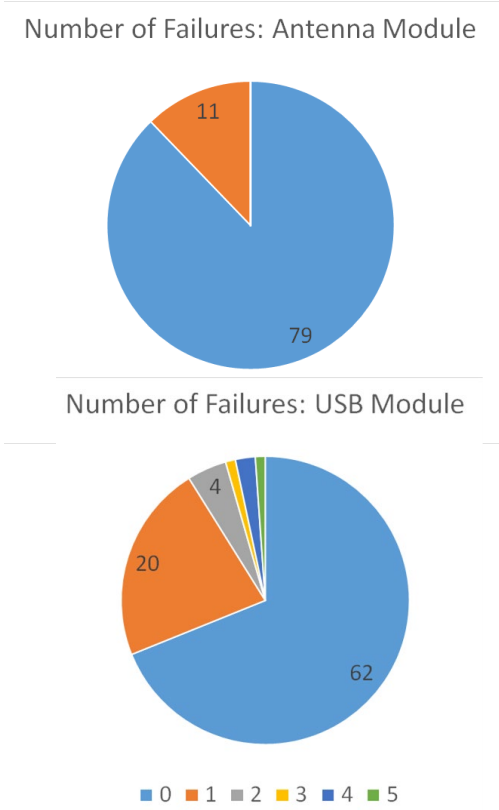




Methodology

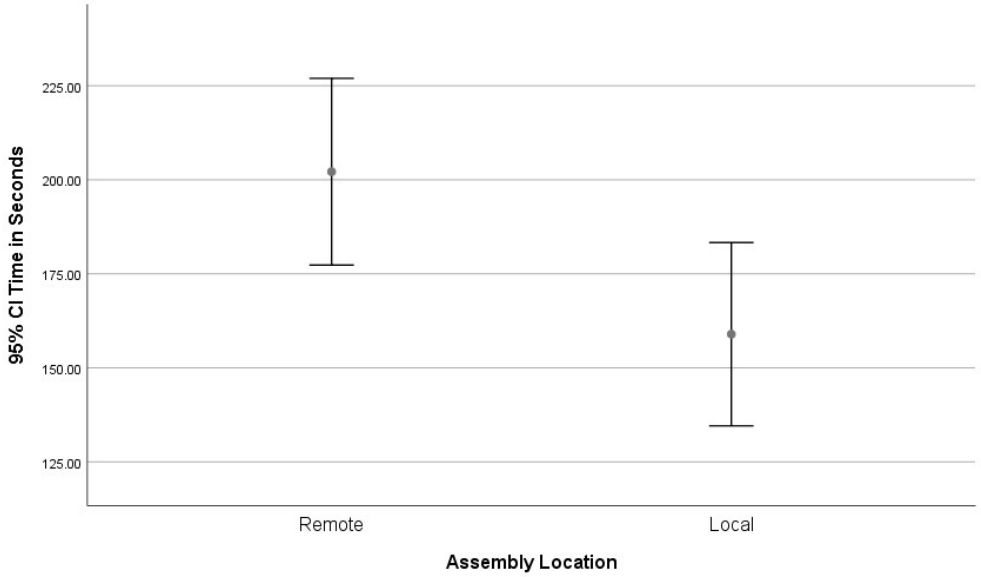
Objective Results

- Antenna Module vs. USB Module
  - More precise assembly task
  - Wire attached to USB module
  - P-value <0.001
- Antenna Unit 1 vs. Antenna Units 2 & 3
  - Operator fatigue
  - P-value =0.008
- <u>No significant difference in number of failures between remote and local assembly</u>



Objective Results

- Local assembly is significantly faster than remote assembly
  - P-value = 0.003

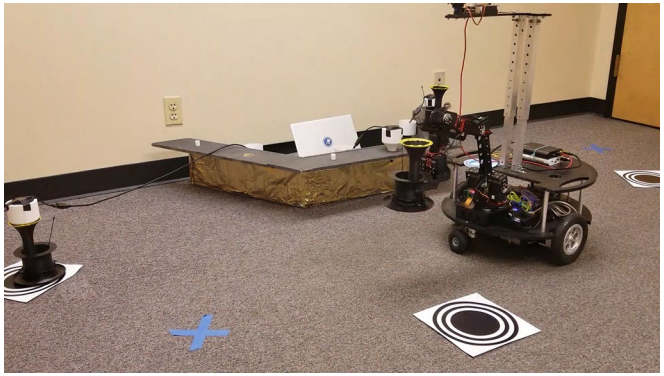


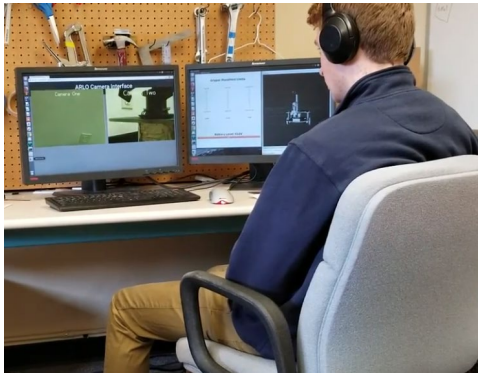
Subjective Results

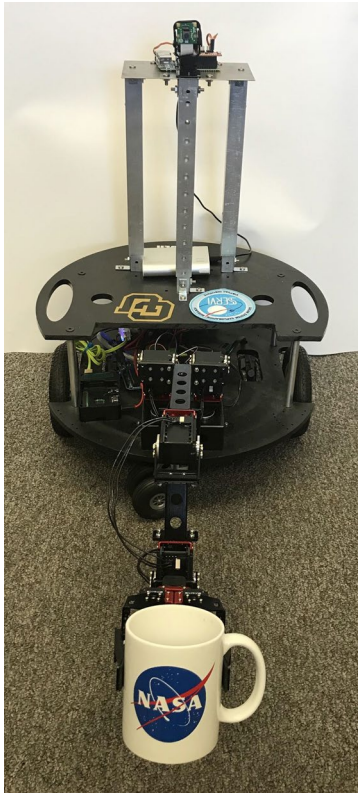
- Situational Awareness Rating Technique
  - One question showed significance
    - Wording of the questions may have been confusing for the user
- NASA Task Load Index
  - No significant results
    - Individual scale analysis may be useful
    - Again, wording may have been confusing
- System Usability Scale
  - Average SUS: 73.8
    - Users rated our system as "Just above average" (70~average)
    - Different experience levels should show different results

Next Steps

- Adjusted subjective assessment
  - Ensure validity of each test
  - Re-word confounding questions
  - Individual scale/question assessment
- Experiment Procedure
  - Guided training system
  - New variables







Thank You and Questions

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