ASSESSING VIRTUAL REALITY FOR REMOTE LUNAR GEOLOGICAL FIELDWORK C. Paige[1], F. Ward[2], D. D. Haddad[3], J. Todd[4] and D. Newman[5]. [1]Massachussetts Institute of Technology (MIT) Aeronautics and Astronautics, Ph.D. Candidate, cpaige@mit.edu, [2]MIT Aeronautics and Astronautics, Ph.D. Candidate, [3]MIT Media Lab, Ph.D. student, [4]MIT Woods Hole Oceanographic Institute Joint Program, Ph.D. student, and [5]MIT Aeronautics and Astronautics, Apollo Professor of Astronautics and Media Lab, Director

Introduction: The Resource Exploration and Science of our Cosmic Environment (RESOURCE) team, funded by NASA's SSERVI (Solar System Exploration Research Virtual Institute), informs future in situ resource utilization (ISRU) through the scientific investigation of potential resources on SSERVI Target Bodies, and the development of operations and hardware associated with ISRU prospecting. The MIT branch of the RESOURCE team focuses on operations and associated technologies for optimizing human interaction with robotic explorers.

To ensure we are achieving the most science possible within these ISRU missions, human-computer interaction needs to take a front-seat in mission planning [1]. By treating machines as collaboration tools, we stand to improve cross-discipline communication, improve real-time decision-making processes, reduce task loads and provide flexibility in both temporal and spatial planning. Volatiles prospecting missions will stand to benefit given the specificity of the knowledge required to make decisions around geological data. Providing naturalistic visualization tools that multiple team members can use to analyse, discuss, and interpret data, has the potential to dramatically improve the scientific return on both rover prospecting missions, and later human exploration missions.

Critical to this development is understanding if virtual reality can be leveraged to improve analysis for increasing science return. Virtual reality is an exciting technology which has gained traction as a tool for space applications in recent years. The Mars Curiosity Rover team used VR to explore geological sites on Mars [2]; NASA uses VR for both astronaut training [3] and as an outreach tool; the entertainment industry has developed immersive games such as Mission ISS for the Oculus Quest. Additionally, there are numerous analogue missions developing VR tools for mission operations, be it human or robotic [4]. Lacking in all of this, however, is the defined demonstration of why such a tool is beneficial. And if it is, for what mission operations does it provide the most return. These questions should be answered before investing in the development of VR as an operational tool.

We will be testing both the scientific and operational usefulness of a virtual reality platform for local, small-scale (< 5 m) geological analysis for Lunar rover exploration missions using a Lunar south pole analog site in Longyearbyen, Svalbard in October of 2022. Specifically, we will be testing the use of a commercial off-the-shelf LiDAR camera combined with RGB imagery displayed in a VR platform developed for the Oculus Quest 2. Additionally, we will incorporate local environmental data such as temperature, luminosity, humidity, and multi-spectral data. We will collect data from a minimum of three distinct locations, render the data in VR and, using specialized tools developed in the platform, have mission scientists answer questions about the relevant local geology. Having a geologist on-site we will be able to provide ground-truth and will compare the VR assessments to a screen-based platform and traditional geological field methods to better understand the relevance of VR for science in remote analysis.

A major benefit of using time-of-flight is that it is a single camera with no position calibration dependency. An additional benefit of time-of-flight cameras is their increasing use in commercial industry [5]. Commercial-off-the-shelf (COTS) components are now readily available, and with relatively minimal modification could be made flight ready for lunar applications.

We will perform a pilot study of the mission in Marblehead, MA July-August 2022 to assess hardware, VR rendering pipeline and testing metrics.

Acknowledgments: We acknowledge our funding agency SSERVI for the support in developing the analog mission and associated pilot studies as well as MIT's Space Exploration Initiative who are funding the Svalbard analog mission.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

[1] NASA (2020) NASA's Plan for Sustained Lunar Exploration and Development. [2] Caravaca, G. et al. (2019). *Planet. Space Sci.* 182. [3] Garcia, A. D., et al. (2020) *AIAA SciTech, Forum 1, Part F* 1–13. [4] Lim, D. S. S. et al. (2019) *Astrobiology* 19, 245–259. [5] Berg, L. P. & Vance, J. M. *Virtual Real.* 21, 1–17 (2017).