THE USE OF THE HOLOLENS AS A NOVEL MEANS TO DISPLAY 3-D DATA FOR PLANETARY EXPLORATION—TARGET: ASTEROID (101955) BENNU. C. S. Dickinson[1], J. M. Zabala[1], S. Stolpner[1], L. Bloomquist[1], M. G. Daly[2] and D. S. Lauretta[3], [1]MDA, 9445 Airport Road, Brampton, Ontario, Canada L6S 0B6, cameron.dickinson@mdacorporation.com, jessa.zabala@mdacorporation.com, svetlana.stolpner@mdacorporation.com and leif.bloomquist@mdacorporation.com, [2]Centre for Research in Earth and Space Science, York University, Toronto, Ontario, M3J 1P3, Canada, dalym@yorku.ca, [3]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA, lauretta@orex.lpl.arizona.edu.

Introduction: The scanning lidar system (known as OLA [1]) onboard the OSIRIS-REx mission to asteroid (101955) Bennu has provided unprecedented three-dimensional (3-D) views of an asteroid body. During the Orbital B mission phase in summer 2019, OLA recorded approximately three billion laser shots, resulting in global surface coverage of better than 5 cm. This rich, unprecedented data set enables the interpretation of asteroid topography and has been instrumental in the selection of the mission sample sites.

The Microsoft HoloLens [2] is a unique tool for the purposes of providing "mixed reality", or virtual overlays, for a given area. The user is thus able to view the 3D surface of Bennu overlaid onto the local environment (such as an indoor space, with the floor used to anchor the overlaid data), with the projected surface changing as the user walks, moves, or turns their head. This tool has been successfully employed on tasks such as 3-D CAD design, as well as step-wise manufacturing.

In this poster and live demo, the utility of the HoloLens for the purposes of both operations and science exploration will be considered.

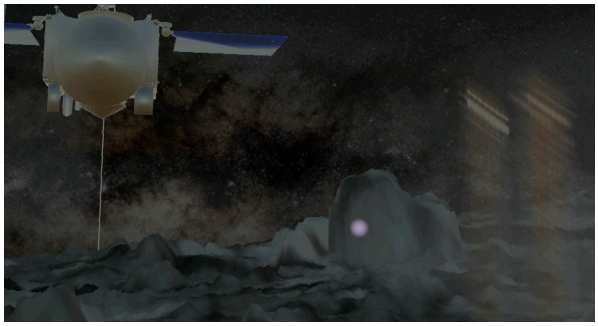

Figure 1 – Screen capture of HoloLens with the Sandpiper candidate sample site on Bennu. OSIRIS-REx spacecraft at top left; Bennu's rocky surface at lower half.

Operations: The HoloLens natively provides a toolkit that allows for the manipulation of a variety of custom objects within the 3-D environment. A full-sized replica of the OSIRIS-REx spacecraft, with the arm of its TAGSAM (Touch and Go Sample Acquisition Mechanism) fully extended (See Figure 1), has been created along with holographic 3-D representations of the Bennu surface environment. The native software allows for the six-degree-of-freedom (6-DOF) manipulation of the spacecraft, and thus, a variety of positions depicting how the TAGSAM could interact with surface sample locations can be explored.

Although the physics of surface/sample-head interactions are not captured by the tool, spacecraft geometry (including protruding elements such as solar panels) relative to nearby surface topology (such as rock outcroppings) are easily visualized, and could assist in preliminary spacecraft maneuver risk assessments, or operational visualizations.

Scientific Exploration: The HoloLens's immersive environment provides an experience very similar to that experienced by a field geologist. The user is able to "explore" the asteroid's surface simply by walking, with head movements correlating to changing view angles.

Currently, a 10 meter x 10 meter swath of asteroid Bennu's surface is able to be loaded into the HoloLens with minimal loss of spatial resolution. This provides the user with spatial scales similar to that found in the natural environment, and thus a novel method to understand the surface topology of Bennu.

Two swaths of Bennu have been created which depict a rocky area and a possible sample site, however, the tool is capable of loading any portion of the asteroid's surface.

Acknowledgments: The OLA program is funded by the Canadian Space Agency as a contributed instrument to the NASA New Frontiers OSIRIS-REx mission. This material is based upon work supported by NASA under Contract NNM10AA11C issued through the New Frontiers Program. We are grateful to the entire OSIRIS-REx Team for making the encounter with Bennu possible.

References: [1] Daly, M. G., et al. (2017) *Space Sci. Rev.*, *212*(1), 899–924. [2] https://www.microsoft.com/en-us/hololens.