OPTIMIZING LUNAR SURFACE ACTIVITIES: LIDAR AND mSM AS SCIENTIFIC TOOLS? G. R. Osinski[1], T. Barfoot[2], N. Ghafoor[3], P. Jasiobedzki[3], J. Tripp[4], R. Richards[4], T. Haltigin[5], N. Banerjee[1], M. Izawa[1], S. Auclair[1], [1]Depts. of Earth Sciences/Physics and Astronomy, University of Western Ontario, London, ON, N6A 5B7 (gosinski@uwo.ca), [2]University of Toronto Institute for Aerospace Studies (UTIAS), Toronto, ON, M3H 5T6, [3]MDA Space Missions, 9445 Airport Road, Brampton, ON, L6S 4J3, [4]Optech Incorporated, 300 Interchange Way, Vaughan, ON, L4K 5Z8, [5]Dept. of Geography, McGill University, Montreal, QC

Introduction: LiDAR (LIght Detection And Ranging) has been used extensively during the past few years for on-orbit space shuttle inspection [1] and, more recently, for autonomous satellite rendezvous [2]. The use of LiDAR as a vision system for long-range rover navigation has also received considerable attention [3, 4] as it provides the capability to operate at night and within permanently shadowed regions [5]. Space-based LiDAR has many terrestrial applications (e.g., [6, 7]). LiDAR has been used extensively for atmospheric studies on Earth [8] and, now, with the Phoenix mission, for Mars [9]. This research is driven by the question: can LiDAR be used as a scientific tool for the rover-based geological exploration of planetary surfaces? Very few studies have addressed this question [10]. A complementary vision system in development for planetary exploration – suitable for both rover and astronaut mounted scenarios – is the Mobile Scene Modeler (mSM) developed by MDA, based on a stereo camera system. mSM autonomously generates rapid 3D models from sequences of stereo images obtained from a mobile stereo camera pair [11].

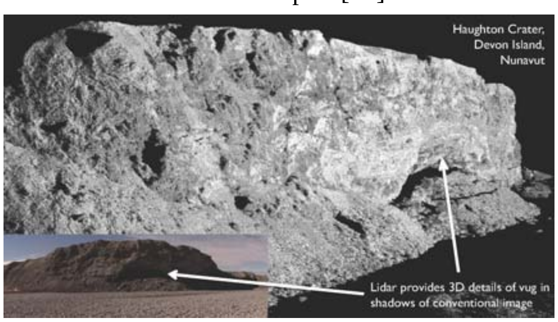

Figure 1. LiDAR scan and panoramic image (inset) of a site of impact-associated hydrothermal mineralization.

Hardware: We used an ILRIS3$_6$D-ER (Intelligent Laser Ranging and Imaging System on pan-tilt unit) LiDAR developed by Optech Inc. [12] with a range of up to 1 km. Two stereo camera systems were used – one in a rover-mounted configuration and another simulating astronaut handheld or robotic arm deployment. The former was a Bumblebee 2, manufactured by Canadian company Point Grey Research (PGR). This was an integrated fixed-baseline stereo camera with a motorized base to allow for panning and tilting.

Field tests: We conducted a series of field tests at the Haughton impact structure, Canadian High Arctic, in July 2008. Haughton is a well-preserved, well-exposed 23 km diameter, 39 Myr old meteorite impact structure [13]. This site represents an ideal space analogue environment with an unusually wide variety of geological features and microbiological attributes [14].

Results and Discussion: Several sites of geological interest within Haughton impact structure were imaged. This work shows that a key strength of LiDAR and mSM is in the 3-D record of a site(s), providing the ability for a geologist to virtually revisit sites, perform measurements, and view from multiple directions and angles; the latter is something that is not always possible in the field. A particular strength of LiDAR is the independence from ambient lighting conditions. Many of the outcrops surveyed during the field tests had shadowed zones; with conventional camera systems little or no useful data could be obtained without supplementary active illumination, which was not the case with the LiDAR, and implicitly active system. This is particularly relevant for the Moon because many high-priority scientific targets lie within the permanently shadowed zones of lunar impact craters [15]. Further applications will be discussed. Future work will address the specific scientific information that can be gleaned by LiDAR and mSM in a variety of lunar and Martian analogue environments.

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