High-capability, Low-mass Lunar Mobility at an Affordable Price. S. Dougherty, and D. Chavez Clemente, Maxar Space Robotics LLC, 1250 Lincoln Ave, Pasadena, CA 91103. (Contact: sean.dougherty@maxar.com)

Introduction: NASA's return to the Moon with the Artemis program is providing frequent delivery and support of payloads on the lunar surface through the Commercial Lunar Payload Services (CLPS) program. Initial landers are stationary. Some are delivering small rover payloads with limited capability. VIPER is a much more capable rover but pushes the limits of landed payload mass and does so at a higher price point.

Mobility will become a de facto science enabling capability on the moon, much as it has on Mars – but how do we make that happen within the mass and cost profile of CLPS? How do we enable mobility on every mission that would benefit from it, at the cadence CLPS plans to visit the lunar surface?

Maxar will leverage both its quarter century of leadership in planetary robotics and its recent technology developments to provide highly capable mobility at a sustainable price and mass. We will discuss our Lunar Under Actuated (LUnA) robotic appendage (arm or leg), NASA's electrodynamic dust shielding [1] incorporated in Maxar's SolarHub Lunar Vertical Solar Array system, and our in-house, high-value motor control electronics as they relate to new mobility capabilities. LUnA in particular, supported by the NASA Tipping Point program, represents an exciting step forward in planetary mobility.

The need to negotiate rugged terrain, reach a wide range of destinations, and extract a vehicle when stuck typically require a high degree of complexity and large number of actuators or degrees of freedom (DOF). Simple vehicles are lower cost and mass but have limited ability to traverse or survive the lunar night. LUnA drives multiple degrees of freedom (DOF) from a single actuator and motor located at the base, rather than equipping each DOF with its own actuator. This simple change has a number of beneficial effects: reducing and cost and mass while maintaining the capability of the system, and also improving the system performance in extreme environments. This allows it to work in difficult locations like Permanently Shadowed Regions (PSRs) of the Moon, and also allows it to more easily survive through the night to support long term sustainable operations.

We will apply our LUnA technology to deliver advanced suspension and walking capabilities, while minimizing the complexity of the control and actuation system. We will leverage our deep expertise and extensive heritage to produce a system that delivers high performance in an affordable package.

As a first step toward a fully integrated mobility platform, we have established a rover testbed for quick iteration of new concepts and technologies. Current status and results from this rover testbed, shown in Figure 1, will also be discussed. This system was designed, from the start, to be modular and scalable. Using our existing family of actuators from very small to very large, it can take the form of anything from a micro-rover sized vehicle to something as large as the VIPER or Perseverance rovers. The technology can be incorporated on existing landers or anything from two-wheeled trailers to six or eight-wheeled heavy equipment.

Figure 1- Maxar's Hybrid Iterative Testbed (HIT) for rover mobility technology evaluations.

[1] C. R. Buhler, M. Johansen, M. Dupuis, M. Hogue, J. Phillips, J. Malissa, J. Wang and C.I. Calle (2020) *Lunar Dust, LPI Contrib. No. 2141.*