Lunar Array Mast and Power System (LAMPS) for Deployable Lunar Power Provision

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Introduction: The key challenges to sustained human presence and in situ resource utilization (ISRU) activities on the Moon are mass, dust, and power [1]. With sufficient power, surviving lunar night and working in the permanently shadowed regions are feasible. Solar power is an enabling resource anywhere at the Lunar surface, and a solar powered micro grid at the Lunar poles would be useful to mission planners, scientists, engineers, astronauts, and the Department of Defense. Lunar permanence starts with steadily available power.

Honeybee Robotics (HBR) and mPower are developing the Lunar Array Mast and Power System (LAMPS) to provide such power for the first time. This lightweight and relocatable robotic system combines key technologies for solar photovoltaic power generation, dust tolerant connection points, zero maintenance actuation, compact deployment, and autonomous operation (Figure *1*).

LAMPS is a deployable solar panel system that allows for operation 8 meters above the ground with solar panels extending another 10 meters. LAMPS, in its current architecture, is designed to provide 10 kW of electrical power, assuming various system level and solar array inefficiencies. This extended height, deployed at certain locations on the Lunar surface, will allow LAMPS to operate with a drastically reduced period in darkness, of around 5 Earth days or less.

Design: LAMPS' underlying robotic technologies from HBR have been designed for drilling hundreds of meters into lunar and Mars regolith [2] and thus are inherently robust and dust tolerant. LAMPS' solar cell technology from mPower, called DragonSCALES, is what makes LAMPS low mass and low volume. DragonSCALES-based solar arrays are half the mass per kW of traditional space solar arrays. This drives a smaller structure and overall system mass. The key LAMPS design elements include:

1. Stowable lightweight solar panels based on DragonSCALES
2. Solar panels deployment based on TRIDENT cable-pulley architecture
3. Redeployable mast based on DIABLO
4. Redeployable umbilical cable
5. HBR actuators for deployment, leveling and solar tracking
6. Dust tolerant electrical connectors
7. Thermal control system
8. Power storage and battery management
9. Avionics and communications based on TRIDENT
10. Autoleveling based on HBR robotic systems

Work Done to Date: LAMPS is made up of various HBR technologies funded over the years through numerous NASA programs including SBIR, DALI, and CLPS/PRISM. The subsystems are used in HBR drills, pneumatic excavators, and robotic actuators. LAMPS is funded through the Lunar Vertical Solar Array Technology program. Honeybee has also designed systems similar to LAMPS for single-deployment, permanent electrical power provision at large scale.

References: [1] Sanders et al. "Results from the NASA capability roadmap team for in-situ resource utilization (ISRU)." (2005).

[2] Bar-Cohen and Zacny, Advances in Extraterrestrial Drilling: Ground, Ice, and Underwater, CRC Press. (2020).

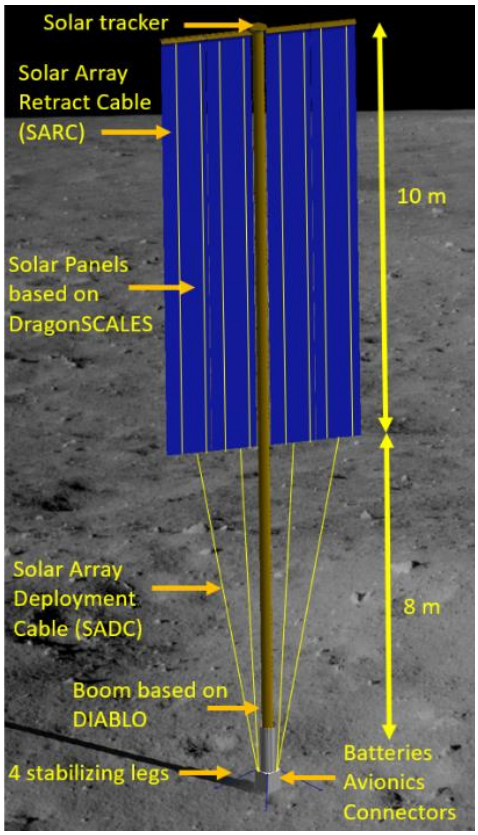

Figure 1:LAMPS and major subsystems.