Heavy Onboard Platform for Lunar ISRU and Terrain Excavation (HOPLITE)

Planetary Surface Technology Development Lab, Michigan Technological University, 1400 Townsend Dr., MEEM815, Houghton, MI 49931 (Contact: pjvansus@mtu.edu). Web: www.huskyworks.space

Abstract

The Heavy Onboard Platform for Lunar ISRU and Terrain Excavation (HOPLITE) is a modular robotic system built at Michigan Technological University (MTU) that enables the field testing of ISRU technologies. Many payloads are currently being designed and implemented for lunar applications where there is a need for accurate, reliable, and safe mobility during field testing. Using a large sensor array, fine tuned control, and autonomy, HOPLITE is designed to provide a solution to this need.

Data Collection

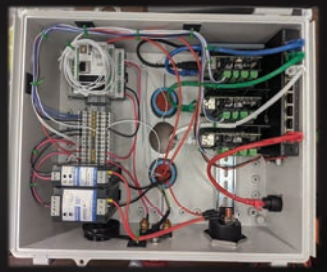
HOPLITE uses its sensors to generate data about its own orientation, movement, electronic power system, and vision system. Onboard is a 9 DoF IMU in addition to a high-accuracy GNSS. Due to its modular design, additional sensors necessary for a specific test can easily be attached and integrated into HOPLITE. The rover uses two 160 degrees FOV cameras on the front and back and supports various cameras for payload observation with differing FOVs and resolutions. Data streams collected from all onboard sensors are consolidated into a central database onboard HOPLITE. This allows engineers to query all system telemetry at any given time throughout the duration of a test.

Autonomy

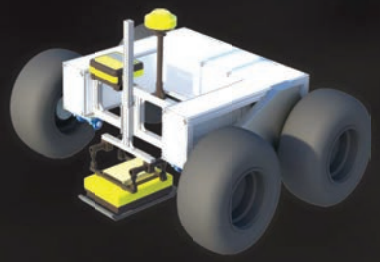
HOPLITE uses an autonomous system using its cameras, IMU, and GNSS to perform testing. This system is built from low-level commands, which can be chained into operations and actions. With these commands accurate, repetitive control is provided by allowing the operator to outline the behavior of the system without needing to actively direct it. The operator can dictate the rover's orientation, location, and operation of payloads directly or with a command sequence. This ensures the safe and effective operation of HOPLITE and its payloads.

Payloads

HOPLITE can be configured to accept a wide range of payloads from excavators to surveying equipment and any other payload up to 200 kg. HOPLITE's frame is constructed out of dual 20 mm T-slot which allows for modular mounting options that can fit a large variety of payloads. Data and power is delivered to payloads via a passthrough to HOPLITE's electronics cabinet. Payload software is compartmentalized as a ROS node and abstracted into a software library that can communicate and issue commands to HOPLITE's onboard subsystems. HOPLITE is currently configured to carry a Ground Penetrating Radar to aid in the PSTDL's 2021 LuSTR grant. HOPLITE will also be configured to carry a percussive hot cone penetrometer that will help characterize water ice distribution withing the lunar subsurface.



Electronics Cabinet



GPR Payload

Ground Control

HOPLITE is controlled via a custom open-source ground control software designed by a team at the PSTDL. Extensions can be developed for all subsystems and payloads. The ground control software provides pre-defined extensions including an integrated terminal, vision capture, sensor streaming, and more to provide system control and monitoring of HOPLITE and its payloads.

All Team Members: Dr. Paul van Susante, Collin Miller, Elijah Cobb, Hunter McGillivray, Travis Wavrunek, Austen Goddu, Ben Wiegand, Erik Van Horn, Marcello Guadagno, Ted Gronda, Chris Norton, Rocco Carlson