Data Science Summit 2022 Abstract

Finalized presentation title:

LIPA: Lunar Ice Perception Algorithm

Brief abstract:

The highest concentration of Lunar water-ice stores exists within the Permanently Shadowed Regions (PSRs) of the Lunar South Pole. As such, the ability to locate *in situ* water-ice stores in an accurate, systematic, and safe manner will prove vital for future Lunar activities which rely on hydrogen-based resources. Here we show how the strong absorptive properties of ice can be exploited (by coupling robotics, infrared imaging techniques, and machine learning) so that surface frost located in PSRs can be easily differentiated from the surrounding frozen regolith.

Testbeds which simulate an icy lunar landscape were created and then imaged using a mid-wave infrared (MWIR) camera system mounted to a robotic arm (UR5e). Testbeds were imaged under two filter modes (1) wide band mode: whereby imagery captured filled a spectral range of 3.0 - 5.0 μm and (2) narrow band mode: whereby imagery captured were confined to a single central wavelength (CWL) of 3.15 ± 0.03 μm. A CWL of 3.15 μm was chosen due to the highly absorptive nature of ice at that specific wavelength.

Images produced under both camera modes were processed in MATLAB. Narrow band images (NB) were subtracted from their wide band (WB) counterparts to produce differenced images (DI) which clearly demonstrated the spatial extent of ice (e.g., WB – NB = DI). Differenced images were used to train a Microsoft Azure model to discriminate between frozen regolith which did and did not contain ice.

These works prove promising for future *in situ* resource utilization (ISRU) missions which employ robotics in combination with camera systems to advance science objectives (e.g., locate water-ice in frozen regolith) on the lunar surface.