EXPLORATION OF THE MOON AT THE MICROSCALE USING THE ADVANCED MULTISPECTRAL INFRARED MICROIMAGER (AMIM).
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Introduction: To maximize scientific return, future robotic and human missions to the Moon will need to have *in situ* capabilities to characterize the geology near the landing site, prospect for lunar resources, and enable the selection of the highest value samples for analysis with other instruments and "high-grading" for potential return to Earth.

We have developed a prototype of the Advanced Multispectral Infrared Microimager (AMIM), a compact microscopic imager, for future robotic and human missions to provide *in situ* spatially-correlated mineralogical and microtextural information of rocks and soils at the microscale to characterize the geology of planetary surfaces, support traverse characterization, and facilitate the selection of samples for onboard analysis with other instruments and potential return to Earth (Figure 1) [1-3].

Instrument: AMIM consists of compact, low-power multispectral LED arrays coated with narrow-bandpass filters (> 30 wavelengths with FWHM ≤ 50 nm), an adjustable focus mechanism capable of focusing from a distance of few cms (spatial resolution ≤ 30 µm/pixel) to infinity with z-stacking and high depth of field, and an infrared camera capable of imaging from the visible/near-infrared to the midwave-infrared (VNIR/MWIR, currently 0.45 - 3.6 µm) [1-3]. This wavelength coverage has wide applicability for the detection of minerals and ices.

Capabilities: AMIM advances beyond the capabilities of current microscopic imagers [4-7], which image in the VNIR and are limited to detecting Fe-bearing minerals. The expanded coverage in the SWIR and narrow bandpasses (FWHM ≤ 50 nm) enable AMIM to discriminate both iron and non-iron bearing mineralogies with greater fidelity compared to these instruments.

AMIM is particularly well-suited for investigating the composition of rocks and soils *in situ* at the grain scale, especially Fe-bearing igneous (ex. olivine or pyroxene) and oxide minerals (ex. hematite), OH/H_2O-bearing minerals (ex. altered minerals), glasses, agglutinates, and ices (ex. H_2O and CO_2) as well as effects of space weathering. These materials are of cross-cutting importance for understanding the geology of the lunar surface and prospecting for resources [e.g., 8-10].

AMIM's compact design eliminates the need for complex optics or scanning mechanisms, and provides flexibility by allowing data to be collected at a variety of distances under different illumination conditions. This enables AMIM to be deployed at the end of a robotic arm or belly on a compact rover, lander, or hopper. In addition, deployed in the field or in a lunar glovebox, AMIM could play a critical role as a tool in characterizing rocks and regolith near the lander/rover enabling astronauts to quickly characterize collected samples during EVAs and carefully select the most valuable samples (i.e. "high-grade") for potential return to Earth [11].

Thus, AMIM would provide many of the capabilities that are commonly associated with orbital instruments such as CRISM on the Mars Reconnaissance Orbiter (MRO) [12] or M3 on Chandrayaan-1 [13], but at a size and mass comparable to current microscopic imagers for landed science while also requiring little to no sample preparation - a powerful tool for future surface exploration of the Moon and other planetary surfaces.

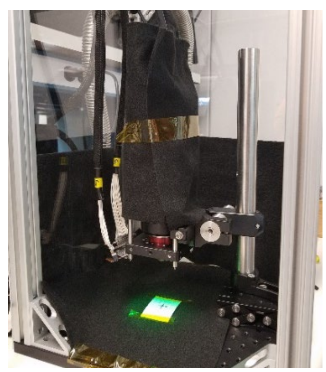

Figure 1. Image of prototype of AMIM instrument shown with green (525 nm) LEDs turned on. For scale, holes on optical base plate are ~1 inch apart.

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