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POTENTIAL OF THERMAL IMAGING INSTRUMENTS IN FUTURE ROVER AND LANDER MISSIONS

Abstract

Compared to imaging instruments that operate in the visible and near infrared wavelengths (VNIR; 0.4-2.5 μm), thermal imaging instruments are less often used in planetary exploration and Earth observation missions. However, measurements in the thermal infrared wavelength range, defined here as approximately 5-50 μm, is driven by energy emitted by the surface materials themselves (as opposed to reflected sunlight in the VNIR wavelengths) and provide unique and complementary information to images taken in the VNIR. Namely, the thermal infrared is sensitive to both temperatures and composition of planetary materials, and certain orbital missions have taken advantage of these features to make notable discoveries of planetary surfaces (e.g., Mars Odyssey Thermal Emission Imaging System, Lunar Reconnaissance Orbiter Divider Radiometer, and the future Europa Thermal Emission Imaging System). Past lander, rover, and human missions have comparatively less frequently utilized the thermal infrared wavelengths, yet thermal imaging instruments possess a potential for benefiting planetary surface exploration by future missions. In fact, some programs are already planning to incorporate thermal cameras on rovers (i.e., Emirates Lunar Rover). For this reason, we review the capabilities of thermal infrared imaging instruments and provide insights that may be useful for missions planned to launch in the near future. Largely based on a planetary analog study that investigated the potential of spectral imaging instruments in future human missions, we discuss which types of thermal imaging instruments are fit to make what kinds of measurements for what purposes. Discussions included in our review are: the differences in broadband thermal cameras versus multispectral or hyperspectral imaging systems and how science output changes depending on the instrument, technical constraints of different instruments and their impact on overall mission design, and the potential of using thermal infrared imaging instruments in collaboration with other instruments.