Observing scenario for the Multi-Band Camera onboard SLIM

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Smart Lander for Investigating Moon (SLIM) is being planned by Japan Aerospace Exploration Agency (JAXA). SLIM aims to research and demonstrate the engineering key issues related to the smart landing on the gravitational planets. They are precise guidance algorithm, vision based navigation, smart landing gear. By doing SLIM mission, we expect to achieve the paradigm shift in the field of celestial body landing from 'landing where easy to land' to 'landing where desire to land'. We proposed Multi-Band Camera (MBC) for SLIM lander. MBC is a compact VIS-NIR camera composed of an imaging sensor (InGaAs), a filter-wheel with 10 band-pass filters, and a movable mirror for panning and tilting. Scientific objectives of MBC are the identification of rocks and rock-forming minerals around the lander and the estimation of Mg#(=Mg/(Mg+Fe)) of olivines that might have come from lunar mantle.

MBC has a telescopic optical system and is a camera with a new concept of spectroscopic observation of rock rather than powder called regolith, so various innovative methods are required for its operation. Among them, we will introduce the methodology of scan operation, on-site calibration, autofocus system, spectroscopic observation of rocks, and Mg # estimation.

Since it is dangerous to land on a place covered with rocks, SLIM landing site was carefully selected. The landing site should be the site where the rock distribution does not become an obstacle to landing and the distribution is as much as rocks can be observed. Since MBC is a telephoto optical system in which the horizontal viewing angle is 4 degrees, rocks would not be observed in random shots. Therefore, it has a function to create a map with a combined low resolution scanned images of around 300 shots that can cover the all observable field of view. After specifying the location of the rock to be observed, we will perform spectroscopic observations efficiently. SLIM, a small unmanned spacecraft, arrives at the moon after a much longer period of time than a manned rocket, so it will be attacked much higher levels of radiation. Because there is a possibility that the background signal of the imaging device increases or the transmittance of the filter changes, we plan to calibrate on the moon. Specifically, MBC has a function to acquire deep space images as dark background data and subtract it from observed image. We also plan to carry out luminance calibration by installing a standard diffuse reflection plate. Since MBC is a telephoto optical system, a focus adjustment mechanism is also indispensable. We realized an automatic focus adjustment function using the fact that the file-size compression rate of the acquired image decreases when approaching the best focus. Although spectroscopic observation of rocks in the near infrared range is thought to be inherently difficult, we are planning to make use of the observable conditions obtained by observation experiments of natural rocks and rock-analogs. In addition, we are planning to spline-fit the data of each band intensity and detect subtle change in wavelength of the absorption peak of Fe^{2+} to estimate Mg # of olivine.

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