Geometric and Radiometric Calibration of the Thermal Infrared Imager onboard the Hayabusa2 Spacecraft by the Earth Observation

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The TIR is an infrared thermal imager onboard the Hayabusa2 spacecraft, which will perform thermography of C-type asteroid 162173 Ryugu through in situ observations during the rendezvous phase in 2018 and 2019. The Hayabusa2 spacecraft carried out an Earth swing-by on December 3, 2015, and the TIR observed the Earth and the Moon for its performance checks. The detector of the TIR is an uncooled microbolometer array (320A, NEC Inc.), and the optical system has a germanium triplet lens. The observation wavelength is an integrated wavelength range of 8 to 12 micrometers. The field of view is 16 x 12 degrees, and the number of image pixels is 328 x 248 (Okada et al., 2016). The performance of the TIR was evaluated in the pre-launch test, and the conversion table from the detected radiation intensity to a brightness temperature was constructed for every pixel. The focal length was evaluated by using a large aperture collimator, as well as the image distortion and the ratio of pixel aperture. Otherwise, the performance check is necessary after launch because the observed temperature depends on surrounding changes, such as radiation and heat flow from the spacecraft and the TIR itself in space. The detector alignment correction and the observed temperature evaluation were performed by the Earth and the Moon observations in the Earth swing-by phase. The alignment was corrected to determine the Earth center position within a sub-pixel accuracy for the observed image pixel by fitting to the observed limb positions using the ellipse function for the flatness shape (6356.75 km / 6378.14 km) calculated by SPICE kernels (NAIF/NASA). The observed temperature evaluation was performed to compare the Earth sea data regarded as a blackbody with observed data with the Earth observation satellites, such as MODIS onboard Aqua and Terra. In this study, the results of the calibrations by the Earth and the Moon observations for the performance checks of the TIR are introduced.

Keywords: Hayabusa2, Thermal Infrared Imager, Earth, Calibration