Development of telescopic camera (TENGOO) performance evaluation device in MMX

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Mars has two satellites, Phobos and Deimos, and there are currently two hypotheses for the origin of these satellites. The first of these hypotheses is that the moons are captured primitive asteroids, and the second is that they formed because of a giant impact event on Mars. The Japan Aerospace Exploration Agency (JAXA) is planning the Martian Moon eXploration (MMX) mission, which is a sample-return mission for Phobos, to determine which hypothesis is correct and reveal the origin of these two satellites.

The TElescopic Nadir imager for GeOmOrphology (TENGOO), which will be installed in MMX, has the purpose of measuring the geographical features of Phobos to locate a suitable landing site less influenced by space weathering. The design of TENGOO was optimized for achieving this goal. In the optical design, the instantaneous Field of View (iFoV) is 5.8 μrad/pix and the Modulation Transfer Function (MTF) is 0.3 at the Nyquist frequency.The design performance of the manufactured TENGOO needs to be confirmed. We evaluate the performance of TENGOO by measuring the Point Spread Function (PSF). Therefore, a low divergence collimated light is needed for a ground experiment to obtain the PSF with sufficient accuracy. We succeeded at making a collimated light source with divergence less than 11.6 μrad.

The Full Width of Half Maximum (FWHM) of PSF obtained with this collimated light is approximately 2x2 pixels in TENGOO. Therefore, the sampling interval becomes wider than FWHM of PSF, and the error of PSF estimation due to Gaussian fitting increases. To solve this problem, we measured the Line Spread Function (LSF) with diagonal lines and complemented the measuring points by obtaining multiple PSFs.

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