# Breadboard model of asteroid tracking system for DESTINY$^+$ mission: concept design and initial performance test

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DESTINY$^+$ (Demonstration and Experiment of Space Technology for INterplanetary voYage, Phaethon fLyby and dUst Science) mission plans to conduct high-resolution imaging during close flyby of asteroid (3200) Phaethon, which is considered as a parent body of Geminid meteor shower. The Telescopic CAmera for Phaethon (TCAP) is planned to perform high-resolution imaging of the surface of Phaethon with an imaging rate of more than 1 frame per second and with a spatial resolution down to 3.5 m/px at closest approach. Since the relative flyby speed and closest distance to Phaethon are expected to be 30 to 40 km/s and about 500 km, it is significantly difficult to track the asteroid only by the rotation of the spacecraft itself. Therefore, an asteroid tracking system is required for TCAP to obtain unblurred high-resolution images. The tracking system is also required to operate autonomously during the high-speed flyby. We have conducted conceptual studies of the tracking mirror as well as the control algorithms to properly navigate the mirror based on feedforward and/or feedback loop. To realize the designed concept, we have developed a simple breadboard model focusing on the rotating mechanism which is the most important part of the tracking mirror. The breadboard model consists of a rotating mirror, a 2-phase stepping motor and its driver, a motor reducer, and a FPGA board to control the driver. The most important performances required for the tracking system are pointing accuracy and tracking accuracy of the mirror. We report the current development status of the breadboard model of the asteroid tracking system and show that the pointing and tracking accuracy of the breadboard model generally satisfy the required performance.

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