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Ongoing and Upcoming Mission Highlights – DART Mission

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DRACO – Testing and Preparation for Impact

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Abstract

Didymos Reconnaissance and Asteroid Camera for Opnav (DRACO) was the sole instrument on the Double Asteroid Redirection Test (DART) spacecraft. DRACO was a F/12.6, 2625mm focal length Ritchey-Chretien telescope with a field-flattening lens. Images were taken with a 6.5 µm CMOS image sensor, the BAE CIS2521F and read to the spacecraft with the Focal Plane Electronics (FPE). Images were processed on board to locate blobs and centroids for use in SMARTNav and then either downlinked in real-time or recorded on the spacecraft for later playback.

DRACO served several functions aboard the DART spacecraft: 1) distant observations of the Didymos system used for ground-based optical navigation; 2) autonomous on-board guidance to Dimorphos, including processing of images for blobs and centroids; and 3) high-resolution observations of both Didymos and Dimorphos used to determine their shapes and sizes, investigate their surface properties, and locate and characterize the impact site.

Numerous types of in-flight testing were performed in addition to in-flight calibration. Optical navigation tests using stars were used to characterize the DRACO boresight and alignment to guidance, navigation, and control (GNC) sensors. Geometric and radiometric calibrations of the instrument were performed using star clusters. Dry-runs for autonomous navigation to intercept were conducted with DRACO while pointed at a bright star or at a distant Didymos to provide a target for SMARTNav. Dedicated Jovian moons tests were conducted to simulate the terminal geometry of Dimorphos (Europa) emerging from behind Didymos (Jupiter). Finally, streaming tests were conducted as close as 6 hours before impact to ensure that integration time and blobbing threshold were configured properly.

The DRACO instrument first observed the Didymos system 61 days before impact on 27 July 2022, far exceeding the 30-day requirement. DRACO performed nominally during the terminal phase, successfully sending image centroids to SMARTNav until the end of guidance. Finally, DRACO captured stunning images of Dimorphos until just before impact, which occurred at 23:14:24.183 UTC on 26 September 2022. The final full image was acquired 1.8 seconds before impact at a pixel scale of 5.5 cm.

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Comments:

Oral Presentation