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SHAPE MODELING TESTING AND VALIDATION FOR THE DOUBLE ASTEROID REDIRECTION TEST (DART)

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ABSTRACT

In 2022, the DART spacecraft will initiate humanity's first test of asteroid deflection by kinetic impact when it collides with Didymos B. Estimating the momentum enhancement factor, beta, is a key goal of the mission. Based on numerical models and experiments, beta will be affected by the porosity of Didymos B, as well as the geologic context and local topography of impact site. As a consequence, a reasonable estimate of the volume of Didymos B is required (to determine density), along with information about, for example, whether the impact occurs on the steeply sloping face of a boulder or at approximately normal incidence into fine-grained material. In order to characterize the volume of Didymos B and the shape of the

surface near the impact site, the DART team will develop digital terrain models of Didymos B using a combination of lightcurves and stereophotoclinometry. Stereophotoclinometry (SPC) combines geometric stereo imaging techniques with photoclinometry, or surface shading from lighting conditions, to estimate the shape of a surface.

The images obtained by the DRACO camera will likely have little stereo and minimal illumination variation, which pose challenges for image-based shape modeling efforts, including SPC. We are undertaking validation efforts to assess how accurately we will be able to determine the shape of Didymos B, as well as the local topography (slopes, tilts, elevation, etc.) of the impact site. Using an appropriately sized version of the asteroid Itokawa and predicted SPICE for the DART mission, we created synthetic images that we are now using to see how precisely we can reconstruct the shape and topography of this “truth” proxy for Didymos B. We will present the results of our shape modeling effort, with an emphasis on how well we can estimate volume and local slopes.

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