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The DART Terminal Guidance Phase

Dr. Brian L. Kantsiper[(1)]
[(1)]The Johns Hopkins University Applied Physics Laboratory
11101 Johns Hopkins Rd, Laurel, MD 20723
240-228-4739
brian.kantsiper@jhuapl.edu

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ABSTRACT

Mitigation of a hazardous NEO can be accomplished by deflecting it so that it misses the Earth. Strategies to deflect an asteroid include impacting it with a spacecraft (a kinetic impactor), pulling it with the gravity of the mass of a spacecraft (a gravity tractor), using the blast of a nearby nuclear explosion, and modifying the surface or causing ablation by various means including lasers or particle beams. None of these approaches has been tested on a NEO. The Double Asteroid Redirection Test (DART) mission is a proposed demonstration of kinetic deflection, the most mature technique for mitigating the impact hazard of a Near Earth Object (NEO).

The main objective of the DART mission is to deflect the secondary member of the binary asteroid 65803 Didymos, with the impact scheduled to occur in September 2022. The DART impact on the secondary member of the Didymos binary at ~7 km/s will alter the binary orbit period by at least 4 minutes, assuming a simple transfer of momentum to the target, and the orbit perturbation can be measured using a series of ground-based observations. The DART mission held its System Requirements Review and Mission Design review 30 Aug 2016.

The Didymos secondary is ~160 m in diameter, making it a smaller target than previously attempted in deep space. This paper provides an overview of the DART terminal guidance phase and the design decisions made to support it. It begins with the basic cruise phase operations and the accommodations to improve ground-based radiometric tracking. Thirty days prior to impact, Didymos is detectable, and the focus transitions to ground-processed optical navigation and a series of maneuvers to improve the B-plane target. Finally, hours before impact, there is a

transition to autonomous tracking and on-board targeting. The paper discusses the design decisions made, within the confines of a highly cost-constrained mission, in order to enable successful impact on the small secondary.