

NASA's DOUBLE ASTEROID REDIRECTION TEST (DART) SMART NAV – PERFORMANCE IN FLIGHT (No. 142)

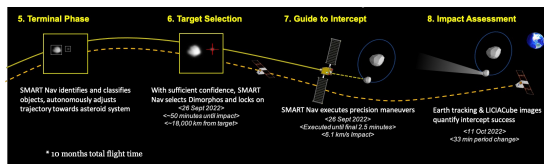
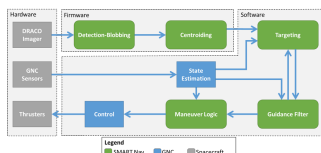
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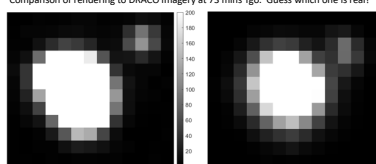
SMART Nav: the last 4 hours

The Small-body Maneuvering Autonomous Real-time Navigation system autonomously guided the DART spacecraft to a bullseye impact during the terminal phase



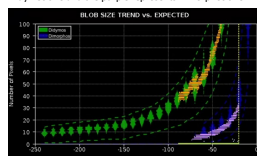
Performance during terminal: Throughout terminal, live telemetry was compared to simulation estimates, allowing the team to enjoy the autonomous ride.

Comparison of rendering to DRACO imagery at 73 mins Tgo. Guess which one is real?*

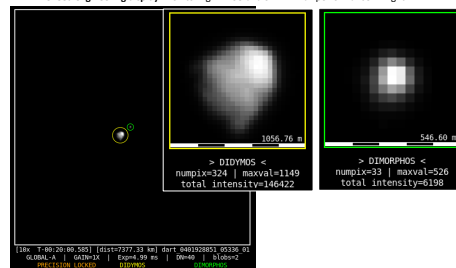


* Rendered image at 73 mins Tgo on left, real DRACO image on right

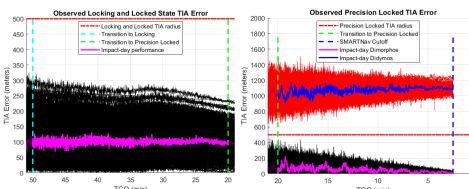
Mission Operations Display: comparing real blob size measurements to expected. The yellow represents real Dimorphos size and the purple represents Dimorphos size.



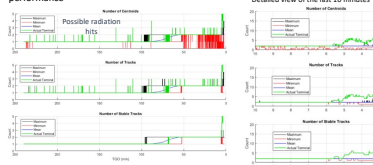
Live feed engineering display: monitoring DRACO and SMART Nav performance in flight



Targeting inclusion area (TIA): is used by targeting as a gate for assigning tracks. During locking and locked states, TIA is defined by relative ephemerides of Didymos and Dimorphos. During precision locked, TIA is defined by the guidance filter's estimate of Dimorphos. TIA performance is well bounded by Monte Carlo Simulation.



Detection & tracking performance: comparison between simulation and terminal performance

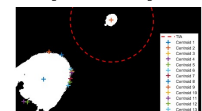


Targeting state transition during terminal as a function of time until impact

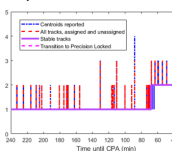


During the last minutes, asteroid topology-induced shadowing spread beyond the point spread function blur resulting in additional detections and stable tracks.

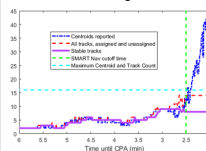
Sample image from precision locked state indicating extra centroids during those last mins



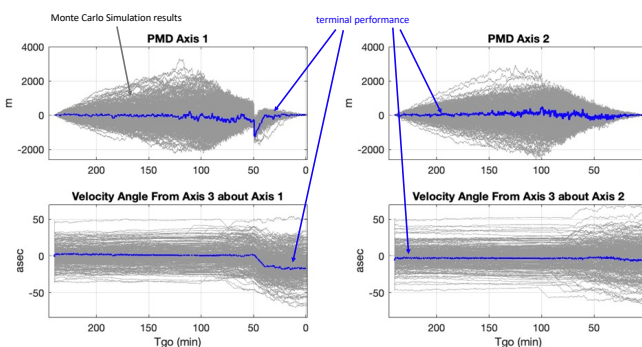
Early detections and tracks



Detections and tracks during the last 6 minutes



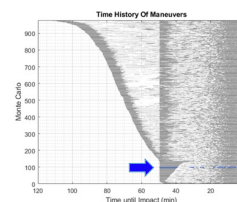
Guidance filter performance: Projected Miss Distance (PMD) in meters and Velocity angle in arcseconds as a function of time-to-go (Tgo); well-bound by Monte Carlo Simulation (gray)



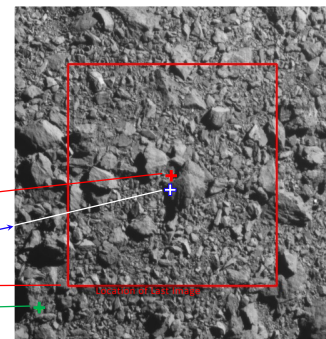
Maneuver Logic performance: The DART Spacecraft did not maneuver until after Targeting locked on to Dimorphos – which was observed in ~14% of the Monte Carlo set

The spacecraft maneuvered for a total of 28 minutes and 48 seconds

The first maneuver lasted 10 minutes 25 seconds
This was in-family with other runs in the MC set that didn't maneuver until after targeting locked on to Dimorphos



Second to last full frame image, taken at 2.781 sec before impact



Distance to Center of Illuminated Figure:** 1.73 m

**Center of Illuminated Figure determined by using a 200DN threshold on the last full image of Dimorphos and taking the centroid of the result

Distance to Center of Geometry: 25±1m

Impact Location

Center of Illuminated Figure

Last full image: 1.818 sec

Center of Geometry