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ANALYSIS OF ALTERNATIVES STUDY FOR NEAR EARTH OBJECT DETECTION, TRACKING AND CHARACTERIZATION

Elena Adams[(1)], Nishant Mehta[(2)], Carolyn Sawyer[(3)], Edward Hawkins[(4)], Amanda Haapala Chalk[(5)], Michael Cully[(6)]
[(1)]*JHU/APL, Laurel, USA, Elena.Adams@jhuapl.edu*
[(2)]*JHU/APL, Laurel, USA, Nishant.Mehta@jhuapl.edu*
[(3)]*JHU/APL, Laurel, USA, Carolyn.Sawyer@jhuapl.edu*
[(4)]*JHU/APL, Laurel, USA, Edward.Hawkins@jhuapl.edu*
[(5)]*JHU/APL, Laurel, USA, Amanda.Haapala.Chalk@jhuapl.edu*
[(6)]*JHU/APL, Laurel, USA, Michael.Cully@jhuapl.edu*

Keywords: *AoA study, NEO, survey system, infrared, visible*

ABSTRACT

The goal of the Planetary Defense Initiative Analysis of Alternatives (AoA) study was to trade the cost and performance of a Near Earth Object (NEO) survey system to track, detect and characterize more than 90% of NEOs 140 m diameter or larger over a 10-year lifetime. The study had to answer what system or a mix of systems provides the nation the best balance between effectiveness and affordability for addressing NEO survey gaps. It explored the space-based sensors that would best augment the existing and planned ground-based capabilities and provide the overall best solution for the survey challenges.

The study assumed a baseline Program of Record (POR) and extended it to 2033. The NEO synthetic population was modeled based on the Science Definition Team

(SDT) 2017 report. A NEO was counted as tracked and its orbit determined if it was detected with Signal to Noise (SNR) of 5 or greater, and 3 tracklets were acquired over 25 days, where a tracklet was defined as 3 detections. To maximize the odds of detecting marginal-SNR objects 3 times, 4 images of each field were taken in the 24-hour period. The alternatives had to achieve the survey goal within ~10 years, and cost less than $400M through Phases A-D (FY17), excluding Launch Vehicle. The technology needed to be at ≥ TRL 6 by mission PDR.

The main portion of the study was conducted between May and October 2017. Multiple cases were investigated that included assets in LEO, GEO and L1 orbits, as well as Earth-Moon resonance orbits. The conclusion was that separating detection, which could be done using visible telescopes, and characterization, which could be done using infrared telescopes, would allow for a more phased approach in a cost-constrained climate. More follow-on work was conducted to understand whether a solution existed for the International Space Station (ISS), to assess the rate of asteroid detections, and to understand how to better account for the Mission Operations and Ground costs. The model was rigorously evaluated by comparing the SDT (MIT Lincoln Laboratory) and NASA Goddard Space Flight Center (GSFC) models for visible telescopes. Additional work was performed in May through September 2018 to compare the AoA and SDT infrared models and resulted in a good agreement among the models.