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- ☐ **Planetary Defense – Recent Progress & Plans**
- ☐ **NEO Discovery**
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INSIGHTS FOR NEO DEFLECTION

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ABSTRACT

The Aerospace Corporation has developed a Near Earth Object (NEO) Deflection Simulator for NASA HQ under guidance and in collaboration with NASA's Jet Propulsion Laboratory (JPL). NEOs are asteroids and comets whose orbits bring them close to Earth's orbit and pose a collision possibility. The simulator was developed in response to findings and recommendations from studies, conferences, exercises and workshops on the NEO impact threat and defending the planet from such impacts. Hypothetical impact scenarios with simulated NEOs were created by JPL and feasible deflection mission options and factors influencing mission decisions were identified and incorporated into the deflection simulator. The tool uses astrodynamic data to determine possible launch windows with current and forthcoming launch vehicle capabilities. Furthermore, the tool approximates two means of deflection modeling - kinetic impact and standoff detonation of a nuclear explosive – and establishes Earth-miss criteria that inform decisions as to what option is preferred over another for a given scenario. The tool helps to understand and gain insight on deflection requirements, possibilities and limitations in the following categories: NEO discovery time, early vs. late decision to build and launch the deflection device; NEO orbit, size, composition and the associated uncertainties; NEO intercept direction and velocity; single vs. binary objects; U.S and international lift capability; and the number of launches required in a deflection campaign. This paper studies several simulated NEOs with different orbital characteristics using the NEO Deflection Simulator and reports the insights and recommendations derived from this work. Objects in Earth similar, high inclination, and long period orbits are studied for their varying effects on mission parameters such as frequency of launch windows, attainable relative velocities, mass delivery, and deflection susceptibility. It was found that the problem of NEO deflection is highly non-linear and is heavily dependent on the NEO's orbital characteristics. Moreover, it is demonstrated that early NEO discovery increases mission options and deflection effectivity, that

forthcoming heavy lift has better capability to deflect bigger NEOs and counter the effects of uncertainties associated with smaller NEOs, and that nuclear detonation remains the only viable option in most short warning situations.

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