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NEO COLLISION RISK REDUCTION UNDER B-PLANE UNCERTAINTY

Abstract

Near Earth Objects, or NEOs, are asteroids and comets whose heliocentric orbits could intersect with Earth's orbit and pose a collision risk with our planet. Once detected, the NEO's orbit is determined and the probability of collision in the future is estimated. How well the orbit is known affects collision probability and gauges the deflection effort required to reduce the collision risk to an acceptable level. It is therefore desired to include orbital uncertainty in simulation tools that are used for education and training of NEO deflection mission design. One such a tool is an online interactive NEO deflection app that was developed at The Aerospace Corporation for NASA and can be found here: http://neo.jpl.nasa.gov/nda. The tool enables a user to deflect simulated, realistic NEOs on Earth-impacting trajectories with high-energy kinetic impactors, but it does not account for orbital uncertainty in its current implementation. Therefore, the size of the kinetic impactor carried by a launch vehicle to deflect the NEO is underestimated. This paper describes modifications to the NEO deflection app to include NEO orbital uncertainty. The technique employed estimates the orbital uncertainty at the cutoff time (time of last orbital measurement), accounts for deflection impulse uncertainty, validates uncertainty propagation with high fidelity simulation tools, and refines the overall impact probability estimate. The approach employs the B-plane technique to assess attainable Earth miss distance more realistically than is currently done. The enhanced NEO deflection app provides the user with new insights on the realities of planetary defense and NEO deflection mission design.