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THE MISSION ACCESSIBILITY OF NEAR-EARTH ASTEROIDS

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ABSTRACT

Near-Earth asteroids (NEAs), those asteroids with perihelia <1.3 AU, offer opportunities for science, commerce, and exploration while also posing a threat to our planet. The threat of Earth impacts by NEAs arises from how closely their orbits resemble Earth's, and it is this same characteristic that makes some of them unusually accessible for robotic and/or human spacecraft missions.

In this paper we place accessible NEAs, as defined by NASA's Near-Earth Object Human Space Flight Accessible Targets Study (NHATS), into context with other possible solar system destinations. The NHATS criteria and data are provided at http://neo.jpl.nasa.gov/nhats/. At the time of this writing, 1321 NEAs (11% of the 11,882 currently known NEAs) satisfy the NHATS accessibility criteria. All of these NEAs are more astrodynamically accessible than Mars or its moons (round-trip missions to Mars or its moons will require more Δv, flight time, or both). Furthermore, 558 of the NHATS-compliant NEAs can be visited (round-trip) for less Δv than the lunar surface, and 49 of them can be visited for less Δv than low lunar orbit.

We describe NASA's automated NHATS system for monitoring the mission accessibility of the NEA population, and we describe the orbital characteristics and dynamics of the NHATS-compliant subpopulation of NEAs. Additionally, we present example future NEA mission opportunities identified by the NHATS system, along with analysis of past mission opportunities to two NEAs that are among the most accessible yet discovered: 2006 RH_{120}, and 2009 BD. Our analysis of optimal mission opportunities to those two NEAs during the time frame surrounding their discovery illustrates how useful it would be to have the capability to discover accessible NEAs before they are in close proximity to Earth (the time when they are most accessible) and instead discover and track them them several years or more before their peak accessibility seasons begin.

Finally, we describe ongoing efforts in which the NEA observing community receives notifications from the NHATS system and other sources regarding NEAs that are of particular interest. Rapid notification is motivated by the fact that NEAs are often most easily observed during the time frame surrounding the time when they are discovered. Specific examples will be discussed wherein timely observations of NEAs were attempted, with the goal of improving our knowledge of their orbits and/or physical characteristics.

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