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**THE NEAR-EARTH OBJECT HUMAN SPACE FLIGHT ACCESSIBLE TARGETS
STUDY: AN ONGOING EFFORT TO IDENTIFY NEAR-EARTH ASTEROID
DESTINATIONS FOR HUMAN EXPLORERS**

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ABSTRACT

NASA's Near-Earth Object Human Space Flight Accessible Targets Study (NHATS) began in September of 2010 under the auspices of the NASA Headquarters Planetary Science Mission Directorate in cooperation with the Advanced Exploration Systems Division of the Human Exploration and Operations Mission Directorate. The purpose of the NHATS is to identify known near-Earth objects (NEOs), particularly near-Earth asteroids (NEAs), that may be accessible for future human space flight missions. Phase I of the NHATS was conducted during September – October 2010 and Phase II was conducted during February – March 2011. Full automation of the NHATS algorithms was completed in March 2012.

The NHATS uses an astrodynamics-based trajectory filter to determine which NEAs meet a purposely inclusive set of mission design constraints; NEAs with mission opportunities that satisfy those constraints are classified as NHATS-compliant. To be classified as NHATS-compliant, a NEA must offer at least one round-trip trajectory with total mission change in velocity ≤ 12 km/s, mission duration ≤ 450 days (with at least 8 days at the NEA), Earth departure between January 1, 2015 and December 31, 2040, Earth departure energy, $C_3, \leq 60$ km²/s², and Earth return atmospheric entry speed ≤ 12 km/s. The total mission change in velocity includes an Earth departure maneuver from a notional 400 km altitude circular parking orbit, a maneuver to match the NEA's velocity upon arrival, a maneuver to depart the NEA for Earth return, and, if necessary, a maneuver to control the atmospheric entry speed during Earth return.

The automated NHATS system performs a daily update of the list of NHATS-compliant NEAs as additional NEAs are discovered and as our knowledge of known NEA orbits improves. The current list of NHATS-compliant NEAs identified as potentially viable for future human exploration under the NHATS criteria is available to the international community via a website maintained by NASA's NEO Program Office (<http://neo.jpl.nasa.gov/nhats/>). Interested users may subscribe to an email list for daily NHATS updates at <https://lists.nasa.gov/mailman/listinfo/nhats>. In addition to mission opportunities and trajectory data, the website also provides predicted optical and radar observing opportunities for each NHATS-compliant NEA to facilitate timely acquisition of follow-up observations.

This promising list of NEAs will be useful for analyzing robotic mission targets, identifying optimal round-trip trajectories for human spaceflight missions, and highlighting potentially attractive objects of interest that require future ground-based observations for further characterization and/or orbit refinement. This paper will provide an overview of the NHATS methodology, along with current project status and NHATS-compliant NEA population statistics. Additionally, an array of particularly attractive NHATS-compliant NEAs and their associated mission opportunities will be presented and discussed.