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TRAJECTORY DESIGN FOR OBSERVING NEA WITH DIFFERENT MINERALOGIES

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ABSTRACT

Near-Earth Asteroids (NEAs) are considered as a unique component of the solar system and provide key information about the origin and the evolution of the solar system. Many of them may constitute a serious risk for the Earth because of the not-so-remote distance. Therefore, a good knowledge about the chemical and physical compositions of the target object is essential. NEAs can be classified according to orbital characteristics, geometric characteristics and compositions, etc. Dunn et al. [1] used Infrared Telescope Facility (IRTF) to determine the mineralogies and source regions of NEAs. Based on the observed spectral parameters of the 47 NEAs, 15% of these have H chondrite mineralogies, 10% have L chondrite mineralogies, 60% have LL chondrite mineralogies, and 15% have mineralogies that are either the L or LL chondrites. In order to get more detailed and accurate information about potential hazard of NEAs, close-up observations via asteroid rendezvous to all these types of NEAs are necessary and beneficial. In Ref. [2], the

change in velocity needed for transferring a spacecraft from low-Earth orbit to NEAs with different mineralogies is studied.

Compared with a single-rendezvous mission, a multiple NEA rendezvous mission has great advantage in fuel consumption. Trajectory design for multiple asteroid missions has been investigated in great details. In the last IAA Planetary Defense Conference Peloni et al. [3] presented solar-sailing trajectory design for close-up NEA multiple-rendezvous mission. Yang et al. [4] studied low-thrust trajectory between asteroids with distant orbits. However, little literature has been published about multiple asteroid mission which has constraint of visiting NEAs with different mineralogies.

In this paper, the NEAs are firstly categorized based on their compositions. Then, optimization problems with or without gravity assists to different NEAs are formulated. The particle swarm optimization (PSO) method is employed to solve the formulated problems. The optimized results will be presented in the final paper.

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[4] Yang, H., Li, J., Baoyin, H., 2015. Low-cost transfer between asteroids with distant orbits using multiple gravity assists. ASR 56 (5), 837–847.

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