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Space Resources, the Enabler of the Earth-Moon Econosphere (5)

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MISSION ANALYSIS FOR RETRIEVING NEAR-EARTH ASTEROIDS RESOURCES FROM LUNAR ORBITS

Abstract

This work focuses on the evaluation of future mission architectures and opportunities that would exploit the use of lunar-infrastructures to facilitate long-term asteroid mining missions. The near-Earth object missions from Earth have been analyzed by several studies, such as NASA's NEO Human Space Flight Accessible Targets Study (NHATS). However, these studies are not specifically designed for resource retrieval mission, and mission opportunities from vicinity of moon has not been considered before. As the moon infrastructures will be deployed in the near future, moon based deep-space missions are becoming an engineering and commercial reality. This study re-investigates the accessible NEAs from moon vicinity considering practical dynamics and examine potential mission architectures to retrieve resources in moon-based missions. First, potential mission architectures as well as cislunar logistics are constructed and compared. Second, for designated architectures, we investigate the NEA resource retrieval opportunities from moon vicinity in the timeframe of 2035 – 2065. Particularly, moon based refueling is considered, which gives more mass budget for the crew or other payloads to be launched from Earth. The lower escape delta-V and the possibility of using Earth flyby will lead to new low cost mission opportunities that would not be feasible before. Third, based on the mission opportunity search results, feasible mining targets accessible from moon vicinity will be identified. The resource type will be assumed based on the spectral type provided in JPL Small Body Database (SBDB) and LightCurve Database (LCDB). The cost of producing resources from NEA and moon under different mission architectures will be compared. Break-even analysis, sensitivity analysis and resources delivery frequency analysis, will also performed to picture the future moon-based asteroid resources shepherding missions. Finally, economically viable cases will be given.