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# THE FEASIBILITY OF CONDUCTING COMMERCIAL ASTEROID EXPLORATION

**Abstract**

Asteroid Mining is gaining significant attention as a potential solution to meet the growing demand for natural resources on Earth and to support future space exploration. Near-Earth Asteroids (NEA) are primary candidates for this purpose due to their proximity to Earth during a specific period of time. However, existing scientific literature proposes missions which involve sending mining equipment to an asteroid, extracting the minerals and returning the resources back to Earth without promoting any commercial infrastructure. NEAs come with a short proximity window in years and thus, require a lot of time to complete a single mission. This paper introduces a commercial infrastructure framework for asteroid mining that involves continuous resource extraction. The paper suggests the use of Sun-Earth (S-E) L5 Lagrange point for asteroid collection, where near earth asteroids are transported when they are closest to Earth. NASA has already proposed a Near-Earth Asteroid Retrieval Mission (ARM) study in collaboration with JPL for transporting asteroids. In addition, Earth-Moon (E-M) L2 Lagrange Point is used as a deep-space gateway for mining and other space transportation technology. The entire model uses 2-body and 3-body dynamics along with low thrust acceleration to provide transportation of asteroids, equipment, and mined resources with minimal delta V.

The paper addresses the key aspects of this concept and creates comprehensive mission specifications for a commercial asteroid mission by analyzing various components and suggesting new solutions based on existing technology. Included are evaluations of various resources that can be mined and how the resources can be utilized. For instance, water can be used (ISRU) to act as fuel for electrodeless Lorentz force thrusters, which can be used as propulsion technology for transportation of asteroids to L5 and resource and equipment back and forth S-E L5 and E-M L2 Lagrange points. Metals like Aluminium can be used for 3D printing and construction of space infrastructure while rare earth minerals like Platinum group are being transported. Additionally, the paper discusses the progress of development of mining and processing technologies and investigates the use of spider-claw robotic systems for anchoring, which is versatile to the shape of the asteroid. The study concludes with a case study of designing a complete mission sequence for mining Ryugu (sampled by JAXA's Hayabusa 2 mission) which can be executed by 2040 with mission risk assessment.