Paper ID: 29770
student

13th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Space Elevator Tether and Space Mineral Resources (3)

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# TRAJECTORY OPPORTUNITIES TO ARJUNA TYPE ASTEROIDS FOR ASTEROID MINING MISSIONS

**Abstract**

Asteroid mining has been proposed as a means of reducing the cost of space exploration by creating a space-based infrastructure in Earth orbit. Asteroids have an abundance of mineral resources that could potentially be used to facilitate the refueling and construction of spacecraft in Earth orbit. Several approaches to asteroid mining have been proposed including bringing back a whole asteroid, processing ore at the asteroid, and even the in situ production of propellant for the return trajectory. In order to be viable, an asteroid mining mission would be required to return usable asteroid resources to Earth orbit at a lower cost than launching the same resources from Earth. Accessible asteroids with short duration and low $\Delta$V trajectories are ideal targets for asteroid mining missions. This paper calculates the $\Delta$V, stay-time and mission duration of trajectories to accessible asteroids, and uses them to compare the various asteroid mining approaches. The paper focuses on Arjuna type asteroids, a class of near-Earth asteroids with very Earth-like orbits. Arjuna type asteroids are inaccessible during most of their long synodic periods, however offer many low $\Delta$V launch opportunities over several years around times of opposition. Optimal launch dates and times of flight for the Earth-Asteroid and Asteroid-Earth trajectories are used to identify several classes of trajectory combinations with 1, 1.5, and 2 year durations. The Net Present Value method is used as a figure of merit to assess the economic viability of each trajectory combination and mining approach over the duration of accessibility.