24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Spacecraft for Deep-Space Exploration (8)

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LOW-COST ASTEROID MINING USING SMALL SPACECRAFT

Abstract

Recent studies suggest that Near-Earth Asteroids (NEA) contain sufficient volatile and high value minerals to make their extraction economically feasible with a specific sub-domain being the extraction and supply of water, not only for refueling purposes for spacecraft but also for life support on human missions in outer space, and radiation shielding.

The majority of asteroid mining missions proposed to date, however, involve single spacecraft that are traditionally large and expensive. Recent examples of such concepts, which rely on the capturing capacity of the spacecraft are the Asteroid Retrieval Mission (ARM) and the Asteroid Provided in-situ Supplies (APIS) project.

An alternative approach to asteroid mining could be based on multiple small spacecraft, another emerging capability in the space sector, which could enable a higher degree in reliability and a potentially lower cost of operation and a smaller chance of single point failures. However, limited analysis on the asteroid mining capability of small spacecraft has been conducted so far.

This paper explores the possibility to perform asteroid mining operation with small spacecraft. An overview of the different approaches is provided, analyzing the current architectures and technologies, with a focus on water extracting techniques. Subsequently, a trade-off analysis to select the best suited water mining technology is presented. This analysis provides the foundation to establish a feasible design for a spacecraft capable of extracting water from asteroids and transport it to an appropriate orbit for further processing.