

SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

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ANALYSIS OF AN ASTEROID MINING ARCHITECTURE UTILIZING SMALL SPACECRAFT

Abstract

Asteroid mining offer the possibility to revolutionize supply and availability of many resources vital for human civilization. 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.

An alternative approach is presented in this paper, basing the asteroid mining process on multiple small spacecraft, i.e. a decentralized architecture. In general, this is an emerging capability trend in the space sector, which enables a higher degree of reliability, potentially lower cost of operation and smaller chances of a single-point of failure. So far, however, only limited thorough analysis of the asteroid mining capability of small spacecraft has been conducted.

This paper explores the lower limit of spacecraft size required for asteroid mining operations. Current proposed architectures and technologies are analyzed and an overview provided with focus on water extraction. From this, requirements for a minimum economically feasible approach are formulated. Subsequently, a water mining technology best suited for down scaling is selected in a trade-off analysis. This provides the foundation to establish a feasible miniaturized spacecraft design capable of extracting water from asteroids and transporting it to an appropriate orbit for further processing.