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ASTEROID MINING ARCHITECTURES: A ROBUST OPTIMIZATION APPROACH

**Abstract**

Asteroid mining is considered as an enabler of an in-space economy by supplying resources such as volatiles and metals to customers in space and to Earth. For analyzing the viability of asteroid mining, several parametric models have been proposed, taking various technical and economic factors into consideration. However, these techno-economic analyses face two challenges: the technological alternatives are limited to point designs and the large uncertainties associated with the parameters is not appreciated. In this paper, we apply a robust optimization approach to asteroid mining parametric models, taking uncertainties into account and exploring a larger number of technological alternatives. We apply this approach to two prominent use cases for asteroid mining: water delivery to cis-lunar space and returning platinum to Earth. We demonstrate that given the uncertainties in the parameters, developing technologies such as fast propellantless propulsion systems and rapid in-situ bootstrapping of mining capacities at the asteroid could significantly improve the feasibility of asteroid mining ventures.