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Author: Mr. Scott Dorrington
UNSW Australia, Australia

Dr. John Olsen
UNSW Australia, Australia

LOGISTICS PROBLEMS IN THE DESIGN OF AN ASTEROID MINING INDUSTRY

Abstract

In recent years, there has been an increasing interest in the commercial exploitation of resources present in near-Earth asteroids. Numerous commercial companies have expressed interest in the exploration, extraction, processing, delivery, and purchasing of asteroid resources. Together, these companies and operations will lead to the development of an asteroid mining industry that has the potential to become a significant component of a larger, developing cislunar economy.

There are a number of logistical decisions to be made in the design of the architecture of this industry. This paper discusses how methods used in operations research, graph theory, and combinatorial optimization can be applied to study the various logistical components of an asteroid mining industry. A number of optimization problems are formulated to model logistical decisions to be made in asteroid target selection, mineral exploration approach, flight itinerary and trajectory design, and the design of a space supply chain network. Solution methods are presented for each of these problems, determining the optimal decisions from a set of candidate approaches. These problems and solution methods can assist in the design of the architecture and operating procedure of a future asteroid mining industry.