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Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

Author: Ms. Bhavyashree Janardhana
Technische Universität Berlin, Germany

Ms. Tanishqa Jain
Technical University Berlin, India

MINING IN ASTEROID BELT AND UTILIZATION OF IN-SITU RESOURCES FOR EXPLORATION OF OUTER PLANETS

Abstract

With deep space travel being fuel consuming, extracting resources from the main asteroid belt can help bring down the fuel requirement used for deep space and interstellar travel. Here we propose a mission to Asteroids in the Main Belt, that serve as mining stations to mine followed by processing fuel and thus assist in travel beyond the main belt. A simplistic approach, through patched conics method, is used to first take gravity assist from Mars and then touch down potential propellant-bearing asteroids (C or S type asteroid). The envisioned resources are in the form of silicate mass that is further processed to obtain the required propellant. Finally, we simulate a mission to Neptune using Mars gravity assist and mining at an asteroid mining station in the asteroid belt and compare the delta-V requirements, time required, and cost with existing missions to Neptune. The optical mining method is used for mining carbonaceous chondrites and silicate surfaces on an asteroid to extract water and other volatiles from the mined mass. The optical mining method uses a system of reflective and non-imaging optics to concentrate sunlight on the surface of the asteroid. We also discuss the utilization of the Ambipolar Thruster, an ion thruster technology which is capable of using several types of propellants that can be gaseous at low pressure. This flexibility in the type of propellant is required for the utilization and storage of various propellants like iodine or water according to their availability and also reducing the overall mass of the mission. The propellant used for the thruster depends on the phase of the mission, while the initial lap i.e. till reaching the asteroid uses iodine or similar rare gasses, the second lap i.e. travel to outer planet uses the propellant(water) extracted from the in-situ resources on the asteroid surface. Thus we check the feasibility of the aforementioned deep space mission in the near future.

Keywords : Asteroid Mining, In-situ resources, Propellants, Gravity-assist, Neptune fly-by