SYMPOSIUM ON STEPPING STONES TO THE FUTURE: STRATEGIES, ARCHITECTURES, CONCEPTS AND TECHNOLOGIES (D3)
Novel Concepts and Technologies for the Exploration and Utilization of Space (2)

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ASSESSMENT ON THE FEASIBILITY OF FUTURE SHEPHERDING OF ASTEROID RESOURCES

Abstract

Asteroids have become a key research field because their importance in providing insights into the formation of the solar system. In particular, near Earth asteroids (NEA) have increased in prominence due to two important issues: they are among the easiest celestial bodies to reach from the Earth and they may represent a future threat. This paper will investigate the accessibility of the near Earth asteroid material for future exploitation. Most plausible futures for human space exploration and exploitation involve a large mass in orbit. Delivering this required mass from the Earth's surface may prove economically unfeasible due to the large energy input required to transport these resources to space, and therefore utilization of near Earth resources may become an attractive alternative. The main advantage of asteroid resources is that the gravity well from which these materials would be extracted is much weaker than that of the Earth or indeed the Moon. Thus, these resources could in principle be placed in a weakly-bound Earth orbit for a lower energy cost than material transported from the surface of the Earth or Moon. The question that arises then is how much near-Earth asteroid material is there that can be captured with a modest investment of energy. This energy investment needs to be put in an engineering context in order to understand the scale of the asteroid resource for explotation. This paper will first assess the mass of resources that are available in near Earth space by analyzing the volume of Keplerian orbital element space from which Earth can be reached under a certain energy threshold and then by mapping this analysis to the existing statistical near Earth asteroid population. For the first time, the resulting resource map provides a realistic assessment of the mass of material resources of near Earth space as a function of energy investment. It will be shown that there is a substantial mass of resources at low energy based on the statistical distribution of near Earth asteroids. With this resource map, the total change of velocity required to capture an asteroid, or transfer its resources to Earth, can be estimated as a function of size and asteroid spectral type. Thus, realistic examples of asteroid resource utilization potential will be provided.