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Conceptualizing Space Elevators and Tethered Satellites (3)

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DISASSEMBLY OF NEAR EARTH ASTEROIDS BY LEVERAGING ROTATIONAL SELF-ENERGY

Abstract

One of the key challenges for future space exploration is to envisage efficient ways to exploit the material resources available in the family of Near Earth Asteroids. These resources have been recognised as a potentially lower cost alternative source of material to those launched to Earth escape (such as water, metals, and liquid propellants). Several studies have investigated the accessibility of these resources, as those asteroids are among the easiest celestial bodies to reach from the Earth [1]. These scenarios require, in particular, the design of efficient methods to lift material from the surface of these objects, for direct exploitation or for partial disassembly. In the latter case this is to increase the exposed surface area of the material, for example to harvest water using solar concentrator technologies [2]. In this paper, an interesting concept is presented to raise material from the surface of a rotating body. Building on the orbital siphon concept it is shown that, by connecting multiple payloads from the surface of an ideal spherical asteroid as an N-body tethered system, the centrifugal pull due to the body's spin can overcome the gravitational force on the payloads, eventually allowing the resource payloads to escape [3]. A stream of such payloads can therefore be envisaged to provide a continuous mass flow from the surface of the asteroid into orbit without the need for external work to be done. Using simple assumptions, it is shown that an analytical approach can be developed for a vertical chain of resource payloads, taking into account the angular velocity decrease of the asteroid due to mass removal and the consequent decrease in centrifugal lift. The paper will use this initial analysis of the mechanics of the problem to investigate the engineering requirements for such a resource extraction system including: tether length and tension requirements for candidate objects, achievable mass flow rates and disassembly timescales, tether system deployment and operation

References

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[3] McInnes, C. and Davis, C. (2006), The orbital siphon: a new space elevator concept. *JBIS, Journal of the British Interplanetary Society*, 59(10):368-374