Abstract #840

English

Resource Definition and Delineation of Near Earth Asteroids Using Automated Probes

There is a growing segment in the mining industry targeting the collection of subsurface resources found on asteroids, moons and planets in our solar system. There are over 9000 NEAs (Near Earth Asteroids) that have been catalogued so far and more telescopes are planned to be launched within the next decade for the purpose of finding more (Going Platinum, 2012). Of these, 700 to 800 of these asteroids are considered to be easier to reach and land on than Earth's moon (Kaufman, 2013). It is entirely possible that a targeted asteroid could have inaccessible or low quality ore, which would make mining it uneconomical (Endsor, 2014). Due to the high risk of asteroid mining, we propose that the first step in any operation needs to be the effective definition and delineation of the available resources on the mass before any mining operation begins. To accomplish this task a series of probes can be used to take subsurface readings and relay that information back to the control team through the primary spacecraft carrying the mining equipment. The probes themselves are meant to be no larger than 0.5 m3 and will be attached to the outside of the spacecraft so they can be released toward the surface of the asteroid at appropriate points to get the most complete picture of the interior of the asteroid as possible. The small volume and mass of the probes is critical to the value of them as the cost of launching the additional mass into space must have a worthwhile return on investment. These units are also expected to be one-time use and therefore must be as cost effective as possible. Each unit contains a staged drilling apparatus, mass spectrometer assembly, and short range transmitter to relay collected data back to its nearby carrier vessel for transmission back to mission control. Enclosed titanium construction provides protection, shielding from electromagnetic interference and allows for economical packing of the units. Symmetrically mounted harpoons are propelled by a solid fuel and oxidizer mixture towards the surface near the end of descent to create an anchor point as well as dissipate most of the robot's momentum without the use of thrusters or reaction wheels, which would require additional mass and control system complexity. Deployment of the units will be a bit of a sensitive matter as the only means of kinetic energy dissipation will be the firing of the harpoons. Required approach speed at this point is given by : vreq=v$h$arpm$h$arpmtot Accounting for nearby gravitational fields and relative velocity of deployment vehicle to the surface, the optimal deployment vector is: v⃗=vreqr̂−velŷ−∫G(r)⃗dr0⃗H Where G(r)⃗ is a numerically determined vector field describing gravitational acceleration that is unique to the asteroid. The approach angle tolerance is determined by how much clamping force will be needed to keep the unit fixed during drilling, we'll call this parameter freqr⃗. The goal of this probe system is to increase the success rate and efficiency of space mining operations in a highly cost effective manner, allowing the emerging industry of space-based mining to thrive and reduce the environmental costs of terrestrial mining operations. References Endsor, M. (2014, 03 26). The Economics of Asteroid Mining. Retrieved from ROM Economics: http://www.romeconomics.com/economics-asteroid-mining/ Foxman, S. (2013, 01 26). The crazy economics of mining asteroids for gold and platinum. Retrieved from Quartz: http://qz.com/47232/the-crazy-economics-of-mining-asteroids-for-gold-and-platinum/ Going Platinum. (2012, 04 28). Retrieved from The Economist: http://www.economist.com/node/21553419 Kaufman, M. (2013, 01 22). The Promise and Perils of Mining Asteroids. Retrieved from National Geographic: http://news.nationalgeographic.com/news/2013/130122-asteroids-mining-space-science/

French

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Author(s) and Co-Author(s)

Ms. Rachel Bourassa
(UnknownTitle)
Queens University

Mr. Julian Christopher
(UnknownTitle)
Trent University

Ms. Karlene Horsffield
(UnknownTitle)
Queens University

Mr. Jonathan Huber
(UnknownTitle)
McMaster University

Mr. Jonathan Lukic
(UnknownTitle)
Queens University

Mr. Taylor Stewart
(UnknownTitle)
McMaster University