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IN-SITU MODELLING OF ASTEROID GRAVITATIONAL FIELDS USING CUBESAT CONSTELLATIONS

Abstract

Various deep space missions to asteroids and comets for in-situ resource utilization (ISRU) are being planned by space agencies and commercial organizations alike. A majority of these asteroids and comets are characterized by highly irregular shapes and gravitational fields. This makes it important to accurately model their gravitational fields a priori in order to reduce the risk of damage to these expensive missions involving complicated landing sequences. In this paper we propose a low cost method of estimating gravitational fields of irregular asteroids to a high degree of accuracy using a distributed network of small cubesat "scouts". Each scout is equipped with a low-power propulsion system and an adaptive Attitude Determination and Control System (ADCS).

In the first phase, the scouts will attempt to validate the predetermined landing trajectory of the main satellite and accordingly provide confirmation for initiation of landing sequence. If the predetermined trajectory is flawed, the scouts will enter the second phase in which they determine a new trajectory by collecting data in multiple orbit orientations around the irregular celestial body. As asteroid missions are becoming increasingly popular, such a system will reduce the planning time while also improving the success rates. Further, the network of scout satellites can be augmented with remote-sensing payloads to enable autonomous mission planning and choice of landing sites.