28th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Spacecraft for Deep-Space Exploration (8)

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DEVELOPMENT OF AN ASTEROID RESOURCE EXPLORATION SPACECRAFT FOR HIGH CONFIDENCE COMPOSITION MAPPING AND PROPERTY MEASUREMENTS

Abstract

It is vital to the space economy that an affordable and accurate asteroid prospecting spacecraft, in comparison to current commercial systems, be developed. With today's growth in the space sector, and in the interest for space exploration/colonization, it is only a matter of time before the demand for resources in space reaches a critical level to enable the economical extraction of asteroidal resources that can be utilized in space. As of today, there has still not been a commercial mission to an asteroid with the intent of proving out its resources in an economic sense - though there are some in development. Spacecraft that have intercepted asteroids and comets have taken several years to complete their missions, and have received on the order of 100s of millions of dollars in government funding. One key requirement for asteroid mining to become a reality is the development of low-cost spacecraft that can accurately map and identify the composition of asteroids with high confidence. There is an increased need for missions that will increase our knowledge of the very diverse population of accessible Near Earth Asteroids and their composition. This development of an affordable and accurate asteroid prospecting spacecraft would entail a design of the different subsystems of the spacecraft along with certain remote sensing and in-situ measurement instruments. This paper examines potential designs of such a spacecraft and the suite of instruments it will carry with it for high confidence analysis of asteroid compositions and property measurements. Although a lot of designs account for the remote sensing aspect of such a prospecting spacecraft, what is usually lacking is a way of conducting close-up in-situ measurements on asteroid bodies of high interest. We propose spacecraft that, along with remote sensing instruments, consist of penetrating probes that can insert themselves into the regolith of the asteroid to provide a much richer level of information that will be critical for establishing the correct methods for mining such objects. By mapping properties such as the density, porosity, conductivity and cohesion among others using the penetrating probe, we will be able to build out a robust model of different asteroids that will be critical to making asteroid mining economical and reliable in the years to come.