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CUBESAT ORBITING DIDYMOS ASTEROID SYSTEM - SIMULATIONS IN THE CONTEXT OF AIDA MISSION

Abstract

The ESA-NASA AIDA mission proposes the investigation of a binary asteroid system using an orbiter and a high velocity impactor. Although ESA's AIM spacecraft will co-orbit the Sun at a fixed safe distance from the asteroid, the mission also proposes the use of low-costs CubeSat probes as part of the COPINS payload, to navigate in close proximity to both bodies. The small masses and hence low escape velocities in the system make the orbits of the CubeSats sensitive to external perturbations. However, orbiting the Didymos binary asteroid system is not a simple problem for a 3U CubeSat with a low-power GNC system due to the system gravitational field irregularities and the relatively high Earth communication delay. The paper presents the simulations performed in order to asses this complex environment. The scenario uses the best available estimates for the shapes, rotations, revolutions, masses and densities of the primary and secondary. Multiple orbit evaluations are presented together with stability estimations. The baseline approach for searching stability around Didymain is co-orbiting in the L4, L5 Lagrange points of the system ahead, or behind the didymoon. This orbits have the added benefit of monitoring the impact between DART and the Didymoon and for assessing the resulting plume ejecta. The main advantage of deploying small satellites in the vicinity of an asteroid is represented by the opportunity of having an improvement of the main mission scientific return with relatively low cost technologies. Dust environment characterization, close surface observations, galactic radiation measurements are just a few key parameters that enable Cubesats technologies to be used in a relatively high risk environment. The simulations have been performed using AGI STK software platform, taking into account the AIM scenario initial conditions (position, release velocity, etc). Moreover, practical aspects has been considered

including: estimated CubeSat delta v budget, CubeSat mission requirements, etc.