PDC2015
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IAA-PDC-15-P-16

ASTEROID IMPACT MONITORING MISSION: MISSION ANALYSIS AND INNOVATIVE STRATEGIES FOR CLOSE PROXIMITY MANEUVERING

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Keywords: *AIM-AIDA, Binary systems, Rendezvous maneuvers, Mission Analysis, Three-Body System*

ABSTRACT

To prevent from future Potentially Hazardous Asteroids (PHA), one of the most relevant techniques to be proved and tested is the deflection of the heliocentric path of the asteroid. Despite many theoretical studies on asteroid deflections are present in literature, this kind of solution has never been tested in a relevant environment before.

ESA's Asteroid Impact Monitoring (AIM) mission is a joint mission with NASA's DART mission (AIM+DART=AIDA mission). AIDA represents the first space mission aimed to assessing the possibility of deflecting the heliocentric orbital path of an asteroid. The target of the study is the binary NEO (65803) Didymos, which will transit close to the Earth (less than 0.7 AU) in late 2022. Didymos is a binary asteroid system composed by a primary asteroid of 800 m diameter and a smaller asteroid of about 170 m diameter. The aim of AIM mission is to characterize the binary couple and before and after the orbital deflection of the asteroid system. The heliocentric deflection is obtained by means of a high velocity (about 6 km/s) kinetic impact, performed by DART spacecraft.

The paper presents the preliminary study for the mission analysis of AIM spacecraft. The study covers all phases of the mission, from the selection of the launch window to the design of the interplanetary transfer, from the far- and close-approach maneuvers to the rendezvous operations with the asteroid system, from close proximity operations to the observation of the kinetic impact.

Innovative solutions are presented to lower station keeping and delta-v budgets during close proximity operations, by exploiting the gravity of the smaller asteroid. The binary system is modeled as a Three-Body system, to better exploit the peculiar dynamic environment and better design the mission.

Even if the paper content focuses on the AIM mission scenario, the here presented approach can be easily generalized and read as a powerful tool to assess the feasibility and costs in terms of delta-v budget and time constraints of a mission to a NEO system

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