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TARGET SELECTION FOR M-ARGO INTERPLANETARY CUBESAT

Abstract

The Miniaturised Asteroid Remote Geophysical Observer (M-ARGO) is planned to be the first stand-alone CubeSat mission to rendezvous with and characterise a near-Earth asteroid for the presence of in-situ resources over several months. M-ARGO is a 12U CubeSat equipped with a miniaturised electric propulsion system and planned to be launched in 2023-24 as a secondary payload as part of a larger mission. Beside carrying out the scientific tasks, M-ARGO is a tremendous demonstrator of miniaturised deep-space technologies currently under development in the ESA Technology Programme, and will perform an autonomous navigation experiment using onboard optical sensors. The M-ARGO mission concept was originally conceived and assessed by ESA's Concurrent Design Facility (CDF) team in 2017. The Phase A project is currently led by GomSpace Luxembourg and supported by Politecnico di Milano, under ESA GSTP contract.

This work presents the initial results for what concerns the mission analysis and design of M-ARGO. In particular, we show the original procedure developed to assess the reachable NEO targets and the subsequent down-selection process. An in-house indirect solver, Low-Thrust Trajectory Optimiser (LT2.0) has been used, in combination with a realistic thruster model, featuring bounded, variable input power and variable thrust and specific impulse. The solver implements an accurate switching detection technique along with analytic derivatives. Hundreds of both time- and fuel-optimal problems have been solved, aiming at near-Earth asteroids properly filtered from the Minor Planet Center Database. Rankings have been produced, and mission requirements and constraints have been imposed.

Our analyses show that approximately 150 minor bodies are found potentially reachable by M-ARGO when departing from Sun-Earth L2 within a 3-year transfer duration. Out of these, 41 targets have been down-selected, and a short list of the 5 most promising objects has been extracted. Our preliminary results indicate mission feasibility, yet more refined analysis will be performed in later design stages. Overall, M-ARGO has the potential to enable a completely new class of low-cost, deep space exploration missions.