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DESIGN OF A MULTIPLE ASTEROID SAMPLE RETURN MISSION USING AN OPTIMAL FREE-RETURN FLYBY TRAJECTORY

Abstract

Asteroid sample return is an area of active research for deep space exploration. Primitive bodies such as Near-Earth Objects (NEOs) have the potential to provide critical information about the early stages of the solar system. A mission to take multiple samples from viable NEOs and return them to Earth is not only essential but is technically feasible. Optimal Control Theory is applied to an interplanetary mission to take multiple samples from several NEOs without landing, and return them back to Earth. This paper examines the feasibility of doing this mission using certain free-return interplanetary trajectories. The spacecraft collects the samples during the asteroid flyby crossing the dust cloud produced by a projectile, and delivers them to the Earth. Various launch window opportunities in the coming decade are considered offering several mission options. This methodology is modelled using state-of-the-art tools with respective simulation results proving it to be an optimal solution.