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FASTMOPS – PLANNING AND ANALYSIS OF OPERATIONS AND NAVIGATION STRATEGIES IN THE PROXIMITY OPERATIONS FOR AN ASTEROID MISSION

Abstract

FASTMOPS comprises a line of activities developed by GMV and ESA to analyse the ground expected main performances and requirements to cope with the operational needs for missions to small bodies, to navigate a spacecraft from a stable and safe observation trajectory to the control delivery point to an autonomous GNC. This paper describes the application to an asteroid mission of the FASTMOPS methodology. The FASTMOPS approach consists of: consolidating assumptions on the mission (spacecraft, environment, operational performances); drawing operational timelines based on acquired knowledge of turnaround times, requirements, and constraints; performing navigation performance analysis through a dedicated tool (SBNav) which simulates trajectories, measurement acquisition and flight dynamics trajectory determination. The reported study case is a mission to where a binary asteroid is investigated at short distance and which where a small lander is delivered at 200 m distance from the surface. The success landing of the lander is highly sensitive to the initial errors with which the autonomous GNC is initialised . The focus of the analysis is thus the assessment and optimisation of the operational and navigation strategies to achieve the best possible navigation and dispersion performances at the start of the autonomous GNC system and also the safety of the detailed characterization phase. This paper describes the main features, adaptation and configuration of the SBNav (Small Body Navigation Analysis tool) tool; the definition of operational timelines based on understanding of the scenarios and knowledge of the constraints and limitations for performances and critical operations turnaround times acquired through extensive iterations with specialists at ESOC; the performances in terms of knowledge and dispersion based on the application of said tool to a set of proximity operations scenarios - the detailed characterization phase (DCP), transition to autonomous phase (TAP), and payload deployment phase (PDP). Conclusions and recommendations are provided as the outcome of the navigation analyses.