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EROSS-IOD GNC FOR A VERSATILE SERVICING DEMONSTRATION APPLICABLE TO PREPARED AND UNPREPARED CLIENT SPACECRAFT

Abstract

The Horizon Europe project 'EROSS-IOD' aims at demonstrating in orbit future robotic services with a highly-autonomous and coupled GNC architecture for the satellite platform and its embedded robotic arm. This project inherits years of RD development led with the European Commission through the H2020 framework. EROSS-IOD program covers the design and validation of both a robotic Servicer vehicle and a prepared and unprepared Client. The demonstration consists in capturing and servicing the Client satellite with different approach directions and capture concepts. From the GNC perspective, the use-cases will validate in flight that the Servicer can perform with highest autonomy the initial and long-range phases of the Client rendezvous until the performance of robotic services.

The paper introduces the GNC architecture designed to be applicable to both prepared and unprepared Client design, along with the resulting Concept of Operations (CONOPS). First the main GNC modes are presented for such a multiple scenarios mission, then the related test plan is introduced for medium and short-range phases, and eventually the test results obtained in January 2024 for mission PDR review are summarized through sensitivity and robustness analyses.

The high-level CONOPS is also introduced to highlight the targeted level of autonomy as it heavily impacts the GNC architecture. The rendezvous mission is divided in two main parts with the long-range phase first, transitioning from absolute to relative navigation with a handover from ground to board, and then the short-range phase led in full autonomy from board with operational relative sensors driving the GNC loop and feeding specific monitoring layers for safety. The GNC and CONOPS have been designed to comply with the French Space Operations Act (LOS) and the ESA Space Debris Mitigation guidelines.

The GNC operational modes are developed to ensure the successful rendezvous and robotic servicing for both prepared and unprepared Client design. This features paves the way for the future commercial applications of such missions by allowing to service existing satellites in orbit and by demonstrating technical solutions easing the future servicing of spacecraft under development.

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