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MISSION ANALYSIS AND GUIDANCE AND CONTROL FOR THE SPEYE INSPECTION CUBESAT

Abstract

Novel mission architectures in the framework of On-Orbit Servicing Assembly and Manufacturing (OSAM) are driving the new space market towards a sustainable exploitation of the orbital regions. The space community is moving forward the development of On-Orbit Servicing (OOS) and removal technologies to enable the circular economy in space and improve the future space missions' scientific and commercial return. An instrumental phase for OOS activities is the inspection of the target, which physical status is either totally or partially unknown. In fact, platforms that require servicing or removal are often non-collaborative and uncooperative, which poses strict requirements on the capture and servicing operations. The SpEye CubeSat mission, funded by the Agenzia Spaziale Italiana (ASI) in the framework of the Alcor Program, aims at demonstrating inspection and rendezvous GNC capabilities of a nanosatellite to a LEO platform. The project consortium is led by TSD space, and composed by D-Orbit, T4i, Planetek, University of Napoli Federico II and Politecnico di Milano. A 6U SpEye CubeSat will be released from the D-Orbit's ION satellite carrier and will perform collaborative and non-collaborative inspection phases, and a rendezvous approach demonstration phase. In this work the mission proximity operations design performed by Politecnico di Milano is presented, with specific focus on the relative Guidance and Control (GC) strategies developed to meet the mission requirements. The GC of the inspection phases foresees the operations of autonomous reconfiguration of the relative motion to optimise the information gain obtained from visual sensors, embarked to take images of the target. The conventional walking safety ellipses approach is modified to include the optimisation of the inspection efficiency, specifically the sequence of relative orbits is selected to obtain the best possible images of the target considering the target's features current knowledge and the space environment conditions (i.e. illumination). Passive abort safety is imposed during the whole inspection sequence trajectories by the GC inspection functions, comprehending both the observations segments and reconfiguration segments. The passive abort safety

conditions ensure a high level of robustness in the collision avoidance of the proximity flight with respect to a wide range of mission failures, i.e. total loss of control of the CubeSat. Lastly, SpEye CubeSat will perform a rendezvous, to demonstrate capability to approach a non-collaborative uncooperative object in space. Here a Sequential Convex Programming (SCP) algorithm will be employed to compute safe approach trajectories, which include passive safety conditions during the trajectory actuation.