21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Post Mission Disposal and Space Debris Removal 1 - SEM (5)

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E. INSPECTOR: MULTI-SPECTRAL IMAGING THE VESPA DEBRIS IN PREPARATION TO ACTIVE REMOVAL

Abstract

The rapid space technology miniaturization opens the chance to perform In-Orbit Servicing missions with small satellites, gaining in servicers agility, flexibility, time to market and cost reduction. However, still some crucial capabilities servicers shall ensure to perform autonomous proximity, berthing and docking maneuvering, have to be consolidated and on orbit verified. Among those, the target object to service dynamics and actual shape reconstruction is of primary relevance. In fact, those information are prodromic to any further operation which entails the chaser-target contact. The e.Inspector mission, currently under phase B, is an ESA funded mission aimed at flyaround the VESPA debris – 600 km height flying - to precisely reconstruct the target shape and dynamics in preparation of its capture for removal. A consortium, led by Politecnico di Milano is sizing a 12U CubeSat, equipped with two imaging cameras, in the VIS and IR band respectively, for multispectral measurements exploitation for relative GNC and target inspecting. To consolidate the proposed on board multispectral image processing SWarchitecture, extensive breadboarding activities and characterization tests run along the phase B1 the paper is going to report about. Moreover, the whole space asset baseline design is going to be critically discussed in the paper, to support the proposed solution. e.Inspector, expected to launch end 2025 as piggyback satellite,

embarks an electric propulsion unit to ensure reachability of the energetic level of the target debris orbit, no matter of the injection. A six to twelve months transfer from deployment to the target orbit is requested, along which the Earth bulge orbital plane precession effect is exploit to naturally control the target orbital plane reachability. A dedicated control law has been synthetized according to the thruster performance and the numerous trajectory spiralling largely affected by the eclipsealternation. The latter has relevant implications on the thruster on-off applicable law because of its related power demand which constrained the on board power generation and storage sizing. The main propulsion is also exploited to shape the fly around strategy which, starting from a 1km along track holding point, alternates a number of free drifting and holding orbits to further close around the target up to 100m distance to gain a 1cm imaging resolution. The de-risking actions put in place to get compliance with disposal regulations while taking into account the TRL low-thrust solutions in CubeSat applications have, which might turned out in a mission shortstopper, are also reported.