

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Emergent Space Systems (3)

Author: Prof. Michèle Lavagna
Politecnico di Milano, Italy

Dr. Stefano Silvestrini
Politecnico di Milano, Italy

Mr. Lorenzo Capra
Politecnico di Milano, Italy

Dr. Michele Bechini
Politecnico di Milano, Italy

Mr. Michele Ceresoli
Politecnico di Milano, Italy

Mr. Matteo Quirino
Politecnico di Milano, Italy

Mr. Demetrio Labate
Leonardo Spa, Italy

Dr. Matteo Duzzi
T4i, Italy

Mr. Stefan-Vlad Tudor
Leaf Space S.p.A., Italy

Dr. Andrea Colagrossi
Politecnico di Milano, Italy

Mr. Robin Biesbroek

ESA european space agency, The Netherlands

E.INSPECTOR:VIS-IR IMAGING REAL DEBRIS TO SUPPORT ACTIVE REMOVAL AND ON ORBIT SERVICING**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 ending 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 sized 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 B, both PIL and HIL. The paper reports about the whole space and ground segments baseline design consolidation, robust to different launching opportunities and potential debris target last change. e.Inspector 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 eclipse alternation. 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 ccompaigned by cold thrusters 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.