SPACE DEBRIS SYMPOSIUM (A6)
Interactive Presentations (IP)

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NET-BASED SPACE DEBRIS CAPTURE TECHNOLOGY DEVELOPMENT PLAN: TESTING IN RELEVANT ENVIRONMENT

Abstract

Nowadays the European community, working on large space debris active removal methodologies, has concluded feasibility and phase A studies focused on identifying the most promising techniques to be further investigated up to the final implementation. Both the selected solutions, the robotic arm and the tethered net, require for dedicated technologies development to increase their readiness level up to flight readiness requirements compliance. The current paper focuses on the flexible capture solution, highlights the state of the art for the design of each critical component in the system, and proposes the development plan to fill the gap in technology readiness to flight. While the net dynamics numerical simulator, on the development of which Politecnico di Milano worked under ESA contract, is almost verified and validated by performing a dedicated net throwing experiment on parabolic flight, still the performance of crucial components needs to be fixed in the design, then experimentally tested and verified. In particular, the net ejection mechanism, the net mouth closing mechanism after impact and wrapping around the target, the tether support mechanism, to reliably release the tether during the net throwing, the targetfree and controlled dynamics behavior in microgravity while connected through the flexible cable must step over the design to the bread-boarding and testing. Testing must firstly characterize the real parameters for the design technological solutions, then verify the functional requirements and finally lead to the quantification of performance and requirements verification in relevant environment. The paper firstly critically discusses the detailed design for two different closing mechanisms based on passive and active actuators respectively, the design refinement for the net ejection mechanism and the tether stowing and support; then, proposes the test plan to step from TRL3 to 4 for each of them; in particular, the on ground tests to characterize the tether properties depending on its manufacturing and operational thermal conditions are presented, with some preliminary results; the exploitation of a frictionless table on one side and on underwater scaled dynamics reproduction is explained as a powerful tool to preliminarily verify the numerical simulator developed to analyse the stack dynamics during the tethered connection. The paper closes the proposed development roadmap by presenting the design of the whole scaled system –at cubesat size - and the procedures to test it into two alternative relevant microgravity environments: the suborbital flight by sounding rocket launch and the ISS labs with test repeatability opportunity, to reach TRL6.