

Use of Actuated Tethers for End to End Assembly, Servicing and Decommissioning of Interplanetary Spacecraft

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There is growing demand for satellite swarms and constellations for global positioning, remote sensing and relay communication in higher LEO orbits. This will result in many obsolete, damaged and abandoned satellites that will remain on-orbit beyond 25 years. These abandoned satellites and space debris maybe economically valuable orbital real-estate and resources that can be re-used, repaired or upgraded for future use. There is also a growing number of interplanetary missions that could benefit from on-orbit assembly, fueling and epairs/upgrades. Current methods for on-orbit capture, servicing and repair require a large service satellite as demonstrated using the DARPA Orbital Express Missions. However, by accessing abandoned satellites and space debris, there is an inherent heightened risk of damage to a servicing spacecraft. Sending multiple small-robots with each robot specialized in a specific task is a credible alternative, as the system is simple and cost- effective and where loss of one or more robots does not end the mission.

In this work, we outline an end to end multirobot system to capture damaged and abandoned space-craft for salvaging, repair and for deorbiting. In addition we look at assembly of interplanetary spacecraft modules on-orbit. We analyze the feasibility of sending multiple, decentralized robots connected by actuated tethers that can work cooperatively to perform capture of the target satellite as a first step, followed by crawling onto damage satellites to perform detailed mapping. After obtaining a detailed map of the satellite, the robots will proceed to either repair and replace or dismantle components for salvage operations or begin assembly of a satellite using standard components. Finally, for decommissioning, remaining components will be packaged with a de-orbit device for accelerated de-orbit.