23rd IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 23rd IAA SYMPOSIUM ON SPACE DEBRIS (IP)

Author: Mr. Gabriele Amoroso
Politecnico di Torino, Italy

EVALUATING ACTIVE DEBRIS MITIGATION STRATEGIES USING A DYNAMIC NETWORK MODEL OF THE SPACE ENVIRONMENT

Abstract

As space activities expand, the growing accumulation of defunct satellites poses both a sustainability challenge and an opportunity for resource optimization. The SEEDS XVII mission, developed within the SEEDS second-level master's program, proposes a modular space infrastructure dedicated to retrieving, refurbishing, and recycling decommissioned satellites. Using a dynamic network model of the space environment, which was initially created to measure the interactions between space objects and evaluate the overall health of orbital areas, this research assesses the efficacy of the mission developed by the SEEDS students. The study expands on the methodology put forth by the University of Strathclyde, which combines network-theoretic metrics with Life Cycle Assessment (LCA) to offer a thorough assessment of space missions. The evaluation includes assessments of individual space objects' criticality and the wider network effects on orbital sustainability, offering a data-driven foundation for strategic decision-making in space operations. This research provides important insights into how to optimize remediation and mitigation measures aimed at reducing environmental footprints on both terrestrial and orbital levels by integrating LCA with network dynamics. The findings further the continuous effort to design space missions that correspond with sustainable development objectives.