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Assuring a Safe, Secure and Sustainable Environment for Space Activities (4)

Author: Dr. Simonetta Di Pippo
SDA Bocconi School of Management, Bocconi University, Italy

Mr. Andrea Conconi
SEE Lab - SDA Bocconi School of Management, Italy
Mrs. Clelia Iacomino
SEE Lab - SDA Bocconi School of Management, Italy
Mr. Catello Leonardo Matonti
Politecnico di Torino, Italy
Mr. Armando Vittorio Atzori
Politecnico di Torino, Italy
Prof. Marcello Romano
Politecnico di Torino, Italy

SPACE SUSTAINABILITY IN LEO: A MULTIDISCIPLINARY APPROACH TO IDENTIFY AND MITIGATE ECONOMIC, OPERATIONAL AND TECHNOLOGICAL RISKS OF ACTIVE DEBRIS REMOVAL SOLUTIONS.

Abstract

The launch traffic to Low Earth Orbit (LEO) is experiencing a significant increase, since LEO is enabling common use infrastructure critical for the ascent of the space economy. The intensifying commercial use of LEO and the space environment sustainability are a growing discussion among policy makers. Moreover, the rapid increasing of space debris is becoming of primary importance not only for international institutions but also for private companies.

In the very last years, several have been the attempts to assess solutions for posing remedies to the orbit's overcrowding, e.g., active debris removal (ADR) de-orbit technologies including net capture, sail, harpoon, laser system, adhesive magnets, single and multiple robotic manipulators. The current legal framework does not mention who should be in charge of removing debris, and the adoption of these technologies could cause instability and mistrust. Thus, many States view possible interference with their space assets or capabilities as serious national threats. Many of these threats come in the form of anti-satellite (ASAT) capabilities, which can be used to deceive, deny, degrade, disrupt, or destroy space assets. For example, although ADR operations are not inherently ASAT activities, many of the technologies and techniques which are candidates for ADR operations could also be used to damage or destroy a spacecraft in an ASAT form of direct energy-based attacks, proximity co-orbital systems and high velocity or explosive kinetic interactions.

Considering the future scenarios, this paper aims to evaluate the risks associated with identified technologies, and their consequent level of attractiveness. First of all, the analysis assesses the current and under-development solutions for debris removal and monitoring. Second, it evaluates the economic, political, and security risks that affect attractiveness of those technologies. To conclude, building on previous evidences, this paper will dwell on public recommendations on how to guarantee the implementation of the identified technologies while mitigating the associated risks, so to ensure safety, security and sustainability of the space environment.