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Author: Mr. Mohamad Abu amsha
Jordan

SPACE DEBRIS: CURRENT CHALLENGES AND THE PATH TOWARD SUSTAINABLE ORBITAL PRACTICES

Abstract

Space debris has become a critical concern due to its growing impact on the space environment, satellites, and space stations. With increasing space activities and projects like Starlink launching thousands of satellites, the surge in orbital objects poses significant risks to space operations. Notable incidents such as the 2009 collision between Cosmos 2251 and Iridium 33 highlight the dangers of Kessler syndrome—a scenario where a single collision could trigger a chain reaction, creating dense debris fields that render orbits unusable for decades. This paper compares debris mitigation solutions from organizations and companies like ClearSpace-1, Astroscale, and RemoveDEBRIS, while analyzing potential shortcomings of current approaches if trends continue. Through a review of existing publications and analysis of removal strategies, results suggest that combining multiple techniques may enhance debris management efficiency. The study concludes with recommendations for improving space sustainability through debris reduction and advanced removal technologies.