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SPACE DEBRIS IMPACT ANALYSIS FOR LUNAR-BOUND SPACECRAFT IN LEO

Abstract

The increasing presence of meteoroids and space debris in Earth's orbit is a looming challenge, particularly for ambitious lunar missions navigating complex orbital dynamics. Through extensive research and analysis, this study addresses this pressing concern by providing a comprehensive examination of the cluttered environment within Low Earth Orbit (LEO) and its impact on spacecraft integrity. The research effort has two main objectives: first, to meticulously assess the precise threats facing spacecraft bound for the Moon; and second, to propose pragmatic mitigation strategies. Sophisticated computational models are used to predict the trajectories of undetectable debris and to conduct in-depth analyses of their potential impact on spacecraft systems. The study covers a broad spectrum of debris management, including detection, tracking, spacecraft reinforcement, and innovative removal methods. In addition, the study delves into the complexities of space traffic management and advocates for the implementation of robust regulatory frameworks to govern orbital activities. The culmination of this research underscores the imperative of advancing technological solutions in the pursuit of space exploration and debris mitigation. The study also emphasizes the need for continuous technological advancements in space exploration and debris mitigation, as illustrated by case studies from lunar missions. The findings underscore the crucial role of global cooperation in ensuring the sustainability and safety of future space endeavours.

Keywords: Space debris, Low Earth Orbit (LEO), System-level effects, Debris impact resistance, Lunar mission implications, Space exploration, Computational model, Regulatory frameworks, Space traffic management, Economic impacts