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SPACE CARRYING CAPACITY ASSESSMENT AND ALLOCATION: A FRAMEWORK FOR SUSTAINABLE NEAR-ORBITAL ENVIRONMENT MANAGEMENT

Abstract

The assessment and allocation of space carrying capacity is essential for ensuring the sustainability and safety of Earth's near-orbital environments amidst growing space activities. This paper introduces a novel framework for quantifying space capacity, incorporating ecological principles to define dynamic thresholds beyond traditional metrics. By integrating scientific, technical, and policy perspectives, this framework not only measures but also manages the cumulative impact of satellite operations, space debris, and potential future missions. The proposed methodology emphasizes dynamic capacity modeling, accounting for orbital congestion, debris mitigation, and mission related impacts on space sustainability. Furthermore, the paper explores existing international regulatory frameworks, offering practical recommendations for creating a global consensus on space capacity limits and allocation procedures. The study highlights the importance of advanced simulation tools and real-time monitoring systems to ensure compliance with established capacity thresholds, thus providing a comprehensive approach to space traffic management. This research aims to foster international cooperation while promoting a sustainable and transparent approach to space utilization, ensuring the long-term viability of near-Earth environments for future generations.