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Space Carrying Capacity Assessment and Allocation (10-E9.4)

Author: Dr. Andrea Muciaccia
Politecnico di Milano, Italy

Prof. Camilla Colombo
Politecnico di Milano, Italy
Dr. Darren McKnight
LeoLabs, United States
Ms. Erin Dale
LeoLabs, United States
Dr. Alessandro Rossi
IFAC-CNR, Italy
Dr. Xiaoran Yan
IFAC-CNR, Italy

COMPARISON OF METHODOLOGIES FOR ASSESSING SPACE CAPACITY AND RANKING ORBITAL REGION RISKS

Abstract

The sustainability of the space in Earth orbit is becoming an increasingly relevant topic within the scientific and operational communities. This is because the growing number of orbiting objects, whether active and manoeuvrable or uncontrollable from the ground, requires careful monitoring to prevent collision events and ensure continued access to space in the future. Among the many studies conducted in this field, various metrics have been developed in recent years to assess the impact of missions and the capacity of space, considering both the near future and longer timeframes. This capacity aspect is essential for determining how many objects can be launched and managed in orbit, which orbits are more congested than others and consequently setting limits on how many missions the space can handle. At the same time, these metrics also provide a means to evaluate the capacity consumption of individual missions or the entire population of orbiting objects and motivate best practices for space operations.

In this work, the Tracking the Health of the Environment and Missions In Space (THEMIS), the Criticality of Spacecraft Index (CSI), and the Risk Balance Model approaches for evaluating the space capacity are compared and analysed to determine any potential alignment in their results and to investigate possible differences. This approach allows for the identification of the most influential parameters in capacity assessment and their relative importance. The work focuses on the low Earth orbit (LEO) region, dividing it in bins in altitude and inclination, and considering the population of orbiting objects at a specific epoch with information on their size, mass, manoeuvrability, and location. The grid is not fixed in size; instead, varying altitude bin sizes are considered to a ssess their impact on capacity evaluation across different altitude shells. The numerical results are normalised to facilitate comparison between different approaches and to highlight the relative importance of each altitude region . This analysis enables the classification of different regions based on their orbital risk, providing space operators and policy makers with valuable tools to evaluate the suitability of various orbital regions for missions.