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Large Constellations & Fleet Operations (5)

Author: Mr. Andrea Muciaccia
Politecnico di Milano, Italy

Dr. Mirko Trisolini
Politecnico di Milano, Italy

Mr. Lorenzo Giudici
Politecnico di Milano, Italy

Dr. Camilla Colombo
Politecnico di Milano, Italy

Mr. Borja Del Campo
Deimos Space UK Ltd, United Kingdom

Dr. Francesca Letizia
European Space Agency (ESA), Germany

ENVIRONMENTAL IMPACT OF LARGE CONSTELLATIONS THROUGH A DEBRIS INDEX
ANALYSIS**Abstract**

In recent years, the number of objects orbiting around the Earth has experienced a continuous growth because of the increase in the number of launches and of space debris produced by fragmentation events. This growth will likely accelerate with the introduction of large constellations in Low Earth Orbit (LEO), unless mitigating measures will be taken. Despite the benefits they will introduce, large constellations will also have a massive influence on the short- and long-term stability of the space environment, by increasing the interaction with the background space debris population and, thus, the probability of hazardous collision events. New mitigation policies and a careful mission design including the post mission disposal are required for ensuring a future sustainable access to space. This work aims at analysing how the inclusion of large constellations will affect the population of objects already in-orbit. The evaluation is performed using the THEMIS software tool, developed at Politecnico di Milano in collaboration with Deimos Space within an ESA-funded project. The impact of a mission on the space environment is assessed, considering the likelihood and associated effects of fragmentations of the satellite(s) during each phase of the mission. The mission analysis design of constellations considers different parameters, such as the number of objects in the constellation, their geometry, the area-to mass ratio of the satellites that is closely linked to the probability of collision with other objects (in particular with inactive objects), the altitude, and the post mission disposal strategy and its reliability (essential to handle the large number of satellites involved). In this work parametric analyses are carried out to evaluate the relevance of each parameter considered individually and in combination with others, and to identify the drivers which rules the proper design of the constellation. The presence of large constellations is not limited to the LEO region, but also extends to other orbital regions (e.g., the navigation satellites orbiting in the medium Earth orbit region), where similar analyses can be performed.