Examining Short-term Space Safety Effects from LEO Constellations and Clusters

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ABSTRACT

Typically, the examination of how large satellite constellation deployments and operations might affect the space environment has focused on long-term environmental realities over centuries. This perspective provides valuable insights into the strategic evolution of the debris risk. While environmental stability is clearly an important measure, short-term (i.e., 1 - 20 years) space safety levels for current space systems is also important for all space faring entities.

Stemming from the long term evolution model SDM, a dedicated tool was developed at IFAC-CNR for long-term constellation impact analysis.

Given the similarities between the two physical situations, the tool is now applied in two new ways: (1) focus on immediate (i.e., 1-20 years) effects from constellation deployment and execution and (2) apply to the accumulation of massive derelict objects in a restricted region of space (i.e., clusters). Risk calculations provide an opportunity to examine the relative importance of managing future large satellite constellations and existing large concentrations of massive derelicts.

This study examines short-term measures that can be taken to manage the risks exposed in this analysis. For example, debris remediation options are proposed that might be applied in this timeframe as stopgap countermeasures to potential space safety risks in lieu of active debris removal (ADR) which may take decades to operationalize.

The analysis will explore and quantify the level of mitigation/remediation actions needed to manage the risk in the next few decades for both the cases and will provide a means to directly compare two potentially significant space safety concerns: large satellite constellations and clusters of massive derelict objects.