SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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SENSITIVITY ANALYSIS OF THE LONG TERM EVOLUTION OF SPACE DEBRIS POPULATION IN LEO

Abstract

Since the launch of Spoutnik-I in 1957 the number of space debris in Earth's orbit has increased continuously. Historically, the primary sources of space debris in Earth orbit has been (i) accidental and intentional break-ups which produce long-lived debris and (ii) debris released intentionally during the operation of launch vehicle orbital stages and spacecraft. In the future, fragments generated by collisions are expected to be a significant source of space debris.

As described by Kessler and Cour-Palais on their 1978 seminal paper "Collision Frequency of Artificial Satellites: The Creation of a Debris Belt", the number of space debris on Earth's orbit may reach a tipping point from which the future space debris population may be dominated by fragments produced by the mutual collisions between the objects already present in the population. This cascade effect is commonly known as Kessler's Syndrome.

For the last years, many of the work done to model the long term evolution of space debris population, aimed to prove that even with a good implementation of the mitigation guidelines (e.g. No explosions and a very good compliance with post mission disposal strategies) the space debris population will continue to grow. Therefore, more aggressive measures are needed to stabilize the growth of the space debris population in LEO, as for example the active removal of space debris from the environment.

The aim of the work that we present on this paper is to analyze, under the hypothesis of good compliance with the mitigation guidelines, the sensitivity of the model to parameters that are usually considered as known. Different long term space debris evolution scenarios, varying the solar activity, considering small uncertainties on the fragmentation models or even changing the configuration of collision detection algorithm will be presented.

By the comparative analysis of each of the studied scenarios, in terms of population growth, number of catastrophic collisions and final population dispersion, to name some of the studied parameters, we want to highlight some of the limitations applying to actual evolutionary models, and encourage the international community to work on the enhancement of the representativeness of the results by improving the long term evolution model or by taking into account the uncertainty of parameters that today are considered as known.