SPACE DEBRIS SYMPOSIUM (A6)
Poster Session (P)

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DERIVING A PRIORITY LIST BASED ON THE ENVIRONMENTAL CRITICALITY

Abstract

The collision of Iridium 33 and Cosmos 2251 as well as the fragmentation of Fengyun 1C showed the consequences such events can have for the space debris environment. In order to avoid future fragmentations disused satellites and rocket bodies should be removed from orbit to reduce the build up of new space debris, as suggested by the Space Debris Mitigation Guidelines. For objects that are posing great risk of being fragmented and thus generating new fragments, but are unable to maneuver, active debris removal missions can be considered. Such elaborate and costly missions have to be planned carefully so they unfold the required effect on the space debris environment. For the selection of target objects priority lists can be compiled, ranking the objects by urgency of removal. The ranking of the objects depends on the criteria that are chosen to be applied. For example it is common to estimate the flux an object is exposed to, or based on its mass the impact it has on the environment when fragmented, or even a combination of both. In this paper a criteria called environmental criticality is used to generate a new priority list based on the current catalogue of on orbit objects. The environmental criticality is defined as a product of the risk of fragmentation and the impact the fragmentation has on the space debris environment. Because the impact on the all over population for the given time span of 200 years is evaluated an analysis of the fragmentation in every year is necessary. This approach puts great computational constraints on the traditional Monte-Carlo based simulations of the future space debris environment. For this reason a new simulation tool based on an analytical model, which has been developed at the Institute of Aerospace Systems, is used to estimate the impact of a given fragmentation on the future space debris environment. A metric for the interpretation of the results of the criticality is proposed. The ranking of objects is compared to lists, which have been derived based on different criteria.