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Modeling and Risk Analysis (2)

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ENVIRONMENTAL INDEX FOR FRAGMENTATION IMPACT AND ENVIRONMENT EVOLUTION
ANALYSIS**Abstract**

In the framework of the blossoming SST efforts, a number of environmental indexes are being devised as a mean to rapidly picture the current state of the environment and of its short to medium term evolution. Building on the definition of the Criticality of Spacecraft Index (CSI, see Rossi et al., ASR, 2015) and of the Shell Criticality (Bombardelli et al., ASR, 2017), a procedure and an index able to quantify and visualize the medium term effects on the environment of a fragmentation in Low Earth Orbit is derived. The index takes into account the change in the environment caused by the fragmentation of a given mass in a specific orbit by quantifying the contribution of the fragments with respect to the original situation where the whole fragmented mass was contained in the intact object. As a driving factor, the design philosophy subtended in the definition of the CSI is adopted. I.e., the index shall be analytically calculable with a limited, though sufficient, number of parameters in order to be verifiable and repeatable. In order to validate the effectiveness of the index in quantifying the environmental changes and to assess the time frame of its validity, the environmental effects of a series of fragmentations will be computed with the index itself and then evaluated also by means of the SDM and MEDEE long term evolution models. Namely, a large number of medium term (about 20 years) Monte Carlo runs will be performed assuming always the occurrence of a given event. The state of the evolved environment will be compared, at every year timestep, with the simplified picture given by the modified Shell Criticality index. Thus, the representativeness and the time limit of validity of the index representation will be assessed by an ad-hoc metric. Based on the representativeness and time limit validity results, the potential use of this index in the frame of added-value SST service, as the fragmentation detection and impact evaluation service, as well as in support of remediation services (e.g. ADR) will be discussed.