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Author: Dr. Lorenzo Olivieri
CISAS "G. Colombo" - University of Padova, Italy

Prof. Alessandro Francesconi
University of Padova - DII/CISAS, Italy

A NEW CHARATERISTICH LENGTH DEBRIS DISTRIBUTION MODEL FOR IN-SPACE COLLISION EVENTS

Abstract

The existing literature highlights that the current NASA Standard Breakup Model (SBM) may have some limitations when modern satellite designs are involved, and it is also known that the SBM does not capture the effects of glancing impacts. Specifically, it has been observed that the inclusion of a corrective coefficient may be necessary to account for the fraction of the satellite involved in the event. An updated model for fragmentation events (limited to characteristic length distributions) has been previously developed and is currently available in literature. Instead of the linear distribution (in logarithmic space) defined by the NASA SBM, it is represented by a piecewise line with three branches, each representing different fragmentation processes that a satellite may undergo in the event of a collision. The first branch indicates larger fragments (representative of partially intact satellite parts), the second branch represents intermediate-sized fragments (components surviving the collision, such as reaction wheels, subsystems, or compact and high-density elements), and the third branch represents smaller debris (generated by finer fragmentation of satellite parts directly involved in the impact).
In this paper, an updated and simplified version of this latter model, calibrated with experimental and observational data, is presented. The first part of this work briefly outlines the advantages and limitations of the current piecewise formulation, followed by the presentation of the updated model and the corrective parameters derived from the comparison with the available data. Results demonstrate that the new model accurately captures the trends in experimental and observational data with greater accuracy compared to other existing formulations.