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SIMULATIONS OF SATELLITES MOCK-UP FRAGMENTATION

Abstract

High energy in-space collisions may lead to the catastrophic fragmentation of entire spacecraft. Current empirical models employed to predict spacecraft breakup are based on ground experiments and observation of debris cloud generated by collision events. Due to the continuous growth of the number of resident objects orbiting the Earth and the risk they pose to operational satellites, in the last years the interest in collecting new test data on spacecraft collisions has increased, as well as the request to improve current breakup models and develop new ones.
In this context the University of Padova performed a set of impact simulations, with a custom fragmentation algorithm, on satellites mock-ups consisting of cubic, cylindrical, and parallelepiped shapes with internal boxes representing on-board components. The considered scenarios include several targets and impactors masses and sizes and different impact geometries (velocity, impact angle and location). Simulations results consist in the generated fragments characteristic length cumulative distributions. It was observed that all distributions show different sections that can be attributed to different damage modes: the smaller fragments are generated by the spacecraft components fragmentation, the intermediate ones by the detached internal boxes, and the largest ones consisting in intact pieces of the spacecraft separated from the main structure. The limits, extent and slope of these sections depend on the impact conditions, the satellite structure and impact point.