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ANALYSIS OF INITIAL DEBRIS FRAGMENT CHARACTERIZATION FROM DEBRISAT

Abstract

The DebriSat project is a joint NASA, U.S. Department of Defense (DoD), The Aerospace Corporation, and University of Florida project to characterize debris from hypervelocity collision events. The breakup models developed by NASA and The Aerospace Corporation/DoD were formulated using data from the Satellite Orbital debris Characterization Impact-Test (SOCIT), a 1992 hypervelocity impact test with a 1960's vintage satellite target, and radar tracking data of orbiting debris. Current satellite designs and material compositions have significantly changed since the SOCIT satellite and many of the on-orbit objects that created the tracked debris were constructed. With the advent of these new materials and components in more recent satellites, the breakup models require updates to make accurate predictions of the debris generated from the fragmentation of newer vehicles. Additionally, greater details about fragment characteristics are required to support the more complex fragmentation and damage modeling efforts that are underway. The DebriSat test, one of two conducted for the project, involved a nearly 600 g projectile colliding with a highly realistic mock satellite at approximately 7 km/s in 2014, resulting in more than the 140,000 debris fragments that have been cataloged so far. The University of Florida continues to characterize these debris fragments. The physical characteristics of these fragments, such as material type, size, dimensions, and mass, collectively represent an invaluable source of information about the mechanism of a high-energy fragmentation event.

The Aerospace Corporation's explosion and hypervelocity collision model IMPACT generates fragment numbers, masses, sizes, areas and spreading velocities for debris from fragmentation events. Results from IMPACT are used by a number of debris environment modeling and satellite risk assessment tools as well as for forensic analysis of debris producing events. The available data from the characterized DebriSat fragments has been analyzed and compared to IMPACT predictions. Of particular interest have been the subsets of debris that are sub-trackable and/or composed of newer materials (MLI, composite materials, etc.) This paper will discuss the observations made about the characteristics of the processed fragments in the context of the existing fragmentation model as well as initial model updates suggested by the characterization data. As more data becomes available, the findings will result in overall adjustments of the IMPACT predictions of numbers of fragments, fragment shapes, and/or distributions of fragment sizes.