Analysis of the DebriSat Fragments and Comparison to the NASA Standard Satellite Breakup Model

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Existing DOD and NASA satellite breakup models are based on a key laboratory test, the 1992 Satellite Orbital debris Characterization Impact Test, which has supported many applications and matched on-orbit events involving older satellite designs reasonably well over the years. In 2014, the NASA Orbital Debris Program Office, in collaboration with the Air Force Space and Missile Systems Center, The Aerospace Corporation, and the University of Florida, conducted a hypervelocity impact test using a high-fidelity mock-up satellite, DebriSat, in controlled and instrumented laboratory conditions to update and improve these models. DebriSat is representative of present-day low Earth orbit satellites, having been constructed with modern spacecraft materials and techniques. The DebriSat fragment ensemble provided a variety of shapes, bulk densities, and dimensions. Fragments down to 2 mm in size are being characterized by their physical and derived properties. The data will inform updates to the current NASA Standard Satellite Breakup Model (SSBM), which was formulated using laboratory and ground-based measurements of on-orbit fragmentation events to describe an average breakup for spacecraft and upper stage collisions and explosions. Although individual fragment collection and characterization is still ongoing, this paper will present the current status of the analysis of the DebriSat fragment data including cumulative characteristic length and cumulative mass distributions, area-to-mass distributions, and characteristic length versus mass distributions. Additionally, comparisons to the NASA SSBM will be presented.