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FROM FRAGMENT TO 3D MODEL - IMAGING DEBRISAT FRAGMENTS

Abstract

DebriSat is a joint hyper-velocity impact experiment performed by NASA, the DoD, Aerospace Corp., and the University of Florida that simulates a catastrophic collision of a modern LEO satellite with the purpose of updating existing satellite break-up models. The project aims at providing detailed characteristics about the size, dimensionality, location, and mass-energy distributions of LEO collisions. Data collection of the embedded debris, referred to as fragments, is done at the University of Florida, with students manually removing the fragments from the panels. To streamline the efficiency of handling the substantial number of fragments, several automated and semi-automated systems were developed to aid with the research. One such system is internally designated as the 3D Imager, a fully automated, integrated imaging system used to measure the size characteristics of fragments. The system produces size measurements (three orthogonal size dimensions, volume, area-to-mass ratio, average cross-sectional area, surface point cloud, and 120 evenly spaced images) of the fragments by way of analyzing recreated shapes using a space carving algorithm. Since the system was put in use, several updates have been implemented, with initial development focused on the correctness of theoretical computations while later ones improved on reliability, robustness, and processing speed. The latest iteration decreases the system's fragment output to under 4 minutes with minimal user interaction, increasing fragments throughput by 200% with respect to the previous version. The purpose of this paper is to provide an overview of the internal structure and architecture of the system, discuss the latest changes to the system as it pertains to reliability, robustness, and processing speed, discuss current system limitations, and present additional system development in process.