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PERFORMANCE CHARACTERISTICS OF DEBRISAT IMAGING SYSTEMS

Abstract

One of the requirements of the DebriSat project states a 10 percent error bound on the characteristic length measurements (i.e., the mean of the three longest orthogonal dimensions). Another requirement states that all DebriSat fragments with at least one dimension greater than 2 mm are to be collected and characterized and to date in excess of 164,000 fragments have been collected. Due to the sheer number of DebriSat fragments, there is a need to measure tens of thousands of debris fragments in a timely manner. Two automated imaging systems were developed and implemented for size measurements of DebriSat fragments; one is referred to as the 3D imaging system and the other as the 2D imaging system. The two imaging systems utilizes commercial-off-the-shelf cameras to acquire images that are used to measure physical sizes of the DebriSat fragments. The 3D imaging system utilizes a space-carving technique to develop a 3D representation of the fragment from which a 3D point cloud is generated. The 2D imaging system uses an edge detection algorithm to generate a 2D point cloud; a 90-deg wedge mirror is incorporated in the 2D imager to measure the fragment's height (3rd longest dimension). From the point clouds, the largest orthogonal dimensions and the volume are calculated. Other fragment characteristics such as the average cross-sectional area, area-to-mass, and bulk densities are also calculated on the imaging systems. Both imaging systems satisfy the characteristic length accuracy requirement and are capable of processing the debris fragments in a timely manner. This paper describes the verification and validation efforts performed on the two imaging systems where the measurement accuracies (i.e., characteristic length, average cross-sectional area, and volume) and processing times will be shared.