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SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

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SIMPLIFIED S/C VULNERABILITY ASSESSMENTS AT COMPONENT LEVEL IN EARLY DESIGN PHASE AT ESA'S CDF

Abstract

During recent years, the state-of-the-art risk assessment of the threat posed to spacecraft by micrometeoroids and space debris has been expanded to the analysis of failure modes of internal spacecraft components. This method can now be used to perform risk analyses for satellites to assess various failure levels from failure of specific sub-systems to catastrophic break-up. This new assessment methodology is based on triple-wall ballistic limit equations (BLEs), specifically the Schäfer-Ryan-Lambert (SRL) BLE, which is applicable for describing failure threshold levels for satellite components following a hypervelocity impact. The considered component types include electronic boxes, pressure tanks, fuel and heat piping, wire harnesses and batteries. The methodology is implemented in the form of the software tool PIRAT (Particle Impact Risk and Vulnerability Analysis Tool).

During a recent ESA funded study* the PIRAT functionality was expanded in order to provide an interface to ESA's Concurrent Design Facility (CDF). The added interfaces include a geometry importer, for importing the physical model from existing CDF documents, and an OCDT (Open Concurrent Design Tool) interface, for importing mission parameters, material characteristics and configuration details. The new interface delivers both the expanded geometrical flexibility which is provided by external CAD modelling and an ease of import of existing data without the need for extensive preparation of the model.

The reduced effort required to perform vulnerability analysis make is feasible for application during early design phase, at which point modifications to satellite design can be undertaken with relatively little extra effort.

The new interface to PIRAT was successfully demonstrated during a CDF mini-session at the ESA's CDF facility. This paper provides a brief summary of the existing methodology, a documentation of the improved interface and methodology, an overview of the CDF demonstration and the conclusions drawn from the project.