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Space Debris Detection, Tracking and Characterization - SST (1)

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DEBRIS MITIGATION FACILITY - SMALL FLUX UPDATES FROM IMPACT DETECTORS

Abstract

Within a set of different activities, commonly referred to as the Debris Mitigation Facility (DMF), ESA aims to develop a unified set of software tools and procedures in view of the Agency's requirements and international regulation when it comes to space debris mitigation. In the framework of ESA's activity Small Flux Updates from Impact Detectors (DMF-04), available in-situ measurement data on impacts of small particles have been analyzed in order to evaluate their potential for the validation of ESA's MASTER (Meteoroid and Space debris Terrestrial Environment Reference) environment model. The tasks performed within the activity include: a) the acquisition of applicable datasets from in-situ detectors, b) the processing of the acquired datasets, c) the comparison of the datasets with the predictions of MASTER-8 and d) the compilation of guidelines for the acquisition and handling of in-situ impact data.

Following the investigation of the availability of various historical sets, the usability of each acquired set was evaluated. Taking into account the time frame of the activity, datasets from the following detectors were chosen to be analysed: DEBIE-1, DEBIE-2, GORID, SODAD-1 and SODAD-2. For the comparison with MASTER-8, all events registered by a detector needed to be converted into flux vs fragment size distributions. For SODAD-1 and SODAD-2, the size distributions that resulted from previous studies were used. For DEBIE-1, DEBIE-2 and GORID processing chains were developed in order to filter out false impact events, convert measured impact sensor parameters to fragment masses and generate resulting distributions. The detected fluxes were then compared to the simulated fluxes of MASTER-8, with some of the datasets providing a good comparability to the simulated fluxes whilst others showing significant deviations. Following the dataset analysis and comparisons, a list of best practices was established for in-situ detector developers to ensure that impact events registered by a detector can be used for a better validation of space debris and meteoroid models.

This work summarises the findings of the DMF-04 activity. The work logic and the process of acquiring and analysing in-situ detector data is introduced. The processing chain developed for the DEBIE-1, DEBIE-2 and GORID impact datasets is explained and the results of the data comparison with MASTER-8 are discussed. Finally, we present the challenges we faced whilst handling with historical in-situ data

and the collected lessons learned that could assist future in-situ detector designers and operators and thus ensure compatibility with space debris and meteoroid models.