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THE DEBRIS MITIGATION FACILITY FOR SUSTAINABLE SPACE MISSIONS

Abstract

ESA has been developing their space debris modelling, assessment and mitigation support tool suite for over 30 years, beginning with the core tool MASTER (Meteoroid And Space debris Terrestrial Environment Reference), which presents the space debris environment model. For assessment of the impact on satellite missions and the development of mitigation strategies, the DRAMA (Debris Risk Assessment and Mitigation Analysis) tool suite has been created and maintained.

As the next evolutionary step, MASTER and DRAMA have been integrated and made available in the Debris Mitigation Facility (DMF), following a mission-centric approach of creating the inputs for the analysis. Thus, users can define multiple mission phases and satellite configurations, instead of re-defining the orbits individually for each analysis. The analysis modules are then executed for each phase and satellite, producing results in the respective phases of the mission and satellite configuration. To shift to this mission-centric paradigm, the architecture of DMF has been designed and implemented to be more flexible than previous iterations of the tool suite. By introducing workflows, the user can create inputs and handle outputs for multiple analysis modules, integrating their results and inputs in each step, allowing seamless executions of the analyses.

Furthermore, there is a new feature coming within this iteration of DMF that is the focus of this paper: the possibility to combine analysis modules in workflows to create outputs for the compliance verification for space debris mitigation guidelines, standards, and space laws. In this regard, DMF supports the ISO 24113 standard, the French Space Operations Act (FSOA), and the US Government's Orbital Debris Mitigation Standard Practices (ODMSP). These contain requirements for operators to ensure a limitation of the orbital lifetime after end of mission (the so-called "25-year rule"), limit the collision probability, and to reduce the on-ground casualty risk from a re-entering satellite.

In summary, DMF is a step further into facilitating mission designers and operators to demonstrate during mission feasibility, definition, and design studies as well as operations that their mission contributes to the long-term sustainable use of space.