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A RE-ENTRY ANALYSIS SOFTWARE MODULE FOR SPACE SURVEILLANCE AND TRACKING OPERATIONS

Abstract

Space Surveillance and Tracking (SST) is growing more and more important in the Space operations and mission analysis field, given how much the crowded environment building up near Earth can hamper them. Italy is involved in SST operations with collaborations both within and outside the EU. The Italian Space Operation Centre (ISOC) has recently upgraded its systems to the ISOC 2.0 Suite, an integrated platform providing multiple functions and services in the SST domain. The platform is web-based, giving users the ability to connect and use the system both locally and remotely via web browser. The software has been designed and implemented through partnerships involving industry and academia. Among the wide range of SST-related activities, one of the most concerning is the controlled or uncontrolled atmospheric reentry of space objects (SO). The analysis and monitoring of such events prove crucial to reacting as promptly as possible when the need arises. The present work describes the reentry analysis module developed for ISOC 2.0 Suite thanks to a collaboration involving the Italian Air Force, Leonardo and Politecnico di Milano. It consists in a tool performing long-term high-fidelity propagations of SOs, re-entry assessment and processing. Its output is structured as a detailed report involving several pieces of information. Firstly, the nominal reentry coordinates are provided and enriched with corrections based on the modulation of the target cross-area used to fit a given time delay or advance through an optimization process. The software also supplies a ground track in the form of a band enclosing the offset from the nominal footprint. Entry and exit times related to areas of interest and national borders are computed too as part of the report for a given time window about nominal reentry epoch. Besides, a ballistic coefficient estimation is performed, based on the latest orbital data files available to counterbalance dynamical model

inconsistencies. A filtering process is embedded in this step not to let outliers affect the quality of the estimate. Finally, a statistical break-up model based on thermal analysis and typical SO properties is included to properly account for the last phase of the event resulting in increased robustness. This module has been tested against both synthetic and real past re-entry events, giving reliable results and predictions.