Paper ID: 30025
oral

66th International Astronautical Congress 2015

SPACE DEBRIS SYMPOSIUM (A6)
Interactive Presentations (IP)

Author: Dr. Benjamin Mueller
German Air Force, Germany, benjamin15mueller@bundeswehr.org

ANALYTIC LIFETIME-ESTIMATION AND TLE VALIDATION OF REENTERING SPACE-OBJECTS

Abstract

For a Two Line Element (TLE) based forecast of the remaining lifetime of a space-object, TLEs with poor quality can drastically decrease the accuracy of the forecast. We propose a new analytic expression (a modified power-function) to predict the reentry process of space-debris, rocket-bodies and inactive satellites. Our approach can deal with space-objects with high eccentricity ($\varepsilon > 0.1$) as good as with objects with low eccentricity. The new approach is also able to find incorrectly correlated orbit-data within the orbit-data set, which increases the accuracy of the reentry forecast. These two properties also propose the use of our approach as a pre-filter in advance of time-consuming numerical ballistic coefficient shooting and reentry propagation. Methodology: A certain amount of measured orbit-data are fitted to the modified power-function by means of the minimum mean square error (MMSE) method. The fit is performed for the semi-major axis (SMA) and for the eccentricity. The most current orbit-data (MCOD) is excluded from the fitting process and then compared with the extrapolation of the modified power-function. If the MCOD differs too much the extrapolation the MCOD is rejected from the data set. If the MCOD is in close agreement with the extrapolation the MCOD is included into the data set. This re-enforced learning process increases the accuracy of the reentry forecast with every iteration. The paper provides case studies of single space-objects (with low and high eccentricities) as well as statistical analysis of approx. 2000 reentry-forecasts of approx. 100 orbit-objects which are compared with JSpOC 1-Minute-TIPs (Tracking and Impact Prediction).