66th International Astronautical Congress 2015

SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Orbit Determination (9)

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DETERMINING THE INFLUENCE ON ORBIT PREDICTION BASED ON UNCERTAINTIES IN ATMOSPHERIC MODELS

Abstract

Orbit prediction and knowing its uncertainties is a key part in planning collision avoidance maneuvers or conducting re-entry estimations. For high accuracy forecasts numerical propagators are used. These propagators use force models to estimate the perturbing elements that affect a satellite's orbit. Especially on low Earth orbits (LEO) with decreasing perigee altitude the atmosphere becomes the dominating perturbing force. The available atmospheric models are complex in nature and react very sensible to their input data. As with any model the atmospheric models also come with uncertainties. Because they heavily depend on the solar and geomagnetic activity further uncertainty is introduced due insufficient forecast capabilities of the solar and geomagnetic activity. The uncertainties introduced to the orbit prediction due to the atmospheric model's input parameters are investigated. The approach is to analyze the trajectory of different satellites with well-documented orbits. The satellites are on different altitudes and eccentricities. Using a numerical propagator a baseline is established applying observed solar and geomagnetic activity data of the past and estimate the satellites' orbit between two known states. From that point on different types of solar and geomagnetic activity forecasts are used as implemented in the Orbital Spacecraft Active Removal (OSCAR) software, a tool of ESA's Debris Risk Assessment and Mitigation Analysis (DRAMA) software suite. The orbit prediction is repeated in a Monte Carlo fashion with the different solar and geomagnetic forecasts. The uncertainties of the orbit prediction as a result of the comparison to the baseline are shown. A strategy for solar and geomagnetic activity forecast is derived.