IAF ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (1)

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HYBRID SGP4 PROPAGATOR BASED ON MACHINE-LEARNING TECHNIQUES APPLIED TO GALILEO-TYPE ORBITS

Abstract

Space Situational Awareness current needs demand innovative solutions to the orbit propagation problem, so as to find new algorithms which are simultaneously accurate and fast. The hybrid methodology for orbit propagation constitutes a recent approach based on modeling the error of any orbit propagator with the aim of complementing its calculations and hence enhancing its precision. Diverse sources of inaccuracy can exist in propagators, such as incomplete perturbation models, forces not considered, low-order of the series expansions, etc. The creation of a time series with the differences be- tween ephemerides computed with low-accuracy propagators and their corresponding real observations (or precisely computed ephemerides) allows applying time-series forecasting techniques so as to create a model that includes any dynamics not contained in the original propagator. Then, the adjusted model can be used in order to correct other future predictions. We present an application of the hybrid methodology, in which the time-series forecasting process is performed by means of machine-learning techniques, to the well-known SGP4 propagator. We have adjusted the resulting Hybrid SGP4 propagator, HSGP4, to the case of Galileo-type orbits. We will show how the use of HSGP4 can reduce the position error of SGP4, hence extending the validity of Two-Line Elements (TLE) from Galileo satellites.