Paper ID: 73927
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IP)

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MACHINE LEARNING BASED ORBIT PREDICTION

Abstract

Physics-based models and estimation methods can often limit orbit prediction accuracy for being characterized by a high degree of complexity and nonlinearity. With the hypothesis that a Machine Learning (ML) approach can learn the underlying pattern of the orbit prediction errors from large amounts of observed data. In this paper, a LSTM (Long Short Term Memory) Neural Network is explored for improving orbit prediction accuracy. The LSTM architecture was chosen since it addresses the common long-term dependency problem (vanishing or exploding gradient) when using BPTT (Back Propagation Through Time). To validate the results, a variation of the conventional Kalman Filter was implemented. The EKF (Extended Kalman Filter) was chosen for being the simplest real-time estimation algorithm with adequate tuning of its parameters. The neural network model that was used leveraged on its generality, orbit prediction accuracy, and computational cost for real-time orbit determination and onboard environment. The performance of the algorithm was assessed using TLE data from a set of LEO satellites.