Paper ID: 44243
student

46th STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

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NEW METHOD FOR ORBIT PREDICTION USING LSTM NETWORK BASED ON THE PAST TLES

Abstract

Inspired by recent success of LSTM(Long Short-Term Memory) Network in various fields, we present the new orbit prediction method which employs LSTM Network. LSTM Network is a deep learning algorithm that works well in the domain to understand and predict sequential data. Once we set a target epoch, we converted all TLEs within the specific period before the target epoch (i.e. the past TLEs) into state vectors and then interpolated them at proper intervals. With those interpolated data, we trained our model until the MSE(Mean Squared Error) loss converged. According to a previous research on the precision of orbit prediction using TLE, orbit precision of low-earth orbit satellites contains relatively low level of 1 to 2 km at the moment when the corresponding TLE is distributed by JSpOC(Joint Space Operation Center). On the basis of this research, the orbit which was propagated by SGP4(Simplified General Perturbations 4) orbit propagator using target epoch TLE was set as the reference. Evaluation of the predicted orbit was conducted by comparing the RMS(Root Mean Square) error of the orbit which was propagated using the past TLEs versus that of the orbit which was calculated by LSTM Network. KOMPSAT 5 satellite was selected as a simulation target. The result showed that the RMS error of LSTM Network output was less than that of simply propagated orbit when the proper model architecture was built and trained enough. In this regard, Our simulation seemed that LSTM Network estimated the enhanced state vectors of KOMPSAT 5 by figuring out the tendency of decrease in orbit residuals at each updated epoch.