Short-term prediction of UT1-UTC and LOD obtained via Dynamic Mode Decomposition and Vector Autoregressive Model.

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Abstract

In this presentation we report preliminary results of a short-term prediction (30-day forecast horizon) of UT1-UTC and LOD obtained via Dynamic Mode Decomposition (DMD) and Vector Autoregressive Model (VAR). DMD is a relatively new, data-driven, equation free technique capable of reconstructing and forecasting time series in a single numerical procedure. VAR, on the other hand, is a multivariate counterpart of Autoregressive (AR) model. DMD was applied to the separate UT1-UTC and LOD time series prediction whilst VAR model was fed with UT1-UTC, LOD and EAM series in various combinations. EAM information was used to potentially strengthen the prediction of UT1-UTC and LOD.
A prediction experiment was performed separately for the years 2020-2022, with a 7-day step between subsequent 30-day predictions, giving 48 predictions within each year in total. This study uses IERS EOP 14 C04 (IAU2000) series as a reference for all computations and a mean absolute prediction error (MAPE) as a measure of prediction quality. We also examined the difference between the accuracy of prediction with and without removing the effect of zonal tides (IERS Conventions 2010).
In DMD-based forecast procedure, mean absolute prediction errors for UT1-UTC vary from 0.02 – 0.03 ms for the 1st day and 3.14 – 4.81 ms for the 30th day of prediction, whilst those values vary from 0.01 – 0.03 ms and 3.68 – 6.37 ms for VAR(p) based prediction. Corresponding values for LOD vary from 0.02 – 0.03 ms and 0.15 – 0.22 ms for DMD, whilst for VAR(p) these values are 0.02 – 0.03 ms and 0.19 – 0.30 ms. A slight improvement in forecast accuracy by involving the EAM as external data (in VAR(p)) is visible. The results demonstrate that the proposed techniques can efficiently forecast UT1-UTC and LOD but deeper analysis is intended to improve these prediction methods.

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