A COMPARISON OF UT1-UTC FORECASTS BY DIFFERENT PREDICTION TECHNIQUES

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1. INTRODUCTION

The mean observational error of UT1-UTC is now of the order of 0.006 ms, which corresponds to about 2.8 mm on the Earth's surface. Usually the prediction error even for a few days in the future is several times greater than the observational error. In this paper different stochastic prediction techniques including autocovariance, autoregressive, autoregressive moving average, and neural networks were applied to predict UT1-UTC IERS EOPC04 data (IERS 2004). All known effects such as leap seconds and solid Earth zonal tides (McCarthy and Petit 2003) were first removed from the observed values of UT1-UTC. To predict the LODR time series the combination of the least-squares (LS) extrapolation with different stochastic prediction methods was applied. The results of the combination of the LS extrapolation with different stochastic prediction techniques were compared with the results of the UT1-UTC prediction method currently used by the IERS Rapid Service/Prediction Centre.

2. PREDICTION TECHNIQUES APPLIED AND THEIR RESULTS

In the autocovariance prediction (AC) the first predicted value is determined by the principle that the autocovariance of the extended time series coincide as closely as possible with the autocovariance estimated from the given series (Kosek 2002). In the autoregressive prediction (AR) the estimations of the autoregressive coefficients were derived from the modified Yule-Walker equations using the Friedlander and Porat (1984) algorithm. In the autoregressive moving average prediction (ARMA) the estimates of the autoregressive and moving average parameters were estimated using the algorithm described by Marple (1987). In the Neural Network prediction (NN) the Toolbox of Matlab 5.3, in which the topology of the network consisted of two layers, was used (Kalarus and Kosek 2004).

USNO combines different observational and modeling data sets using a cubic spline approach in its combination procedure. The UT1-UTC predictions are computed using an autoregressive integrated moving average (ARIMA) technique (Luzum *et al.* 2001). To improve USNO's estimate of the UT1-UTC value at the solution epoch a UT1-like quantity derived from IGS rapid solutions of GPS satellites is used (Kammeyer 2000). The recent addition of atmospheric angular momentum (AAM) forecast data into the combination has resulted in a greater than

50% reduction in the prediction error at 10 days into the future (Johnson *et al.* 2004).

In the combination of the LS extrapolation with the AR, ARMA, AC and NN stochastic prediction methods called as LS+AR, LS+ARMA, LS+AC and LS+NN, respectively, the LS extrapolation residuals of LODR were determined as the difference between LODR data and their LS models. The seasonal effects of LODR were determined by the LS method. Next, the stochastic prediction method was applied to the LS extrapolation residuals of LODR. The final prediction of LODR is the sum of the LS extrapolation model and the prediction of the LS extrapolation residuals. The UT1R-TAI forecasts were computed by summing the LODR predictions. The mean prediction errors of the UT1-UTC data from 1984 to 2004.6 for the USNO, LS+AR, LS+ARMA and LS+NN prediction methods are shown in Figure 1.

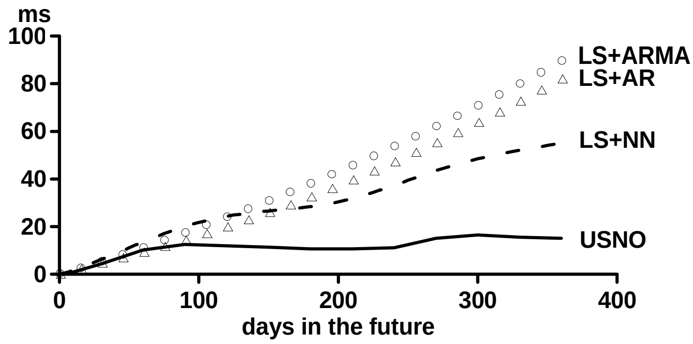

Figure 1: The mean prediction errors of the LOD and UT1-UTC EOPC04 data computed by the combination of the LS extrapolation with the ARMA (circles), AR (triangles), NN (dashed line) from 1984 year to the present and the standard deviation of UT1-UTC prediction for Bulletin A for year of prediction from August 2002 to August 2003 (USNO)(thin line).

3. CONCLUSIONS

The mean prediction errors for 1 to about 70 days in the future are of the same order as those of the method used by the IERS Rapid Service/Prediction Centre. The USNO approach has better prediction capabilities at 1 year into the future.

4. REFERENCES

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