

Predicting the corrections for the polish timescale UTC(PL) using GMDH & GRNN neural networks

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Problem of maintaining the best compatibility of the UTC(PL) with the UTC is due to a complexity in calculating the UTC scale ¹. This consequently leads to a delay in publication of the “Circular T” bulletin by the BIPM, which contains the corrections for the UTC(PL) relative to the UTC. In order to ensure the maximum compatibility of the UTC(PL) with the UTC a prediction of the correction for a given day of the month is required, which is the basis for correcting the UTC(PL) scale. Predicting the corrections may be carried out using analytical methods or neural networks. Central Office of Measures (COM), which is responsible for maintaining the UTC(PL), is predicting the corrections using linear regression method. However, this method is very laborious and requires a lot of experience from the person who perform the analysis.

The paper presents the research results on predicting the corrections for the polish timescale UTC(PL) using GMDH and GRNN neural networks, which were compared with the results obtained in the COM using analytical linear regression method. Predicting the corrections was carried out based on two methods: regression method for GMDH and GRNN neural networks, and time series analysis method for GMDH networks. The input data for the neural network was formed on the basis of two time series: ts1 (without elimination of the trend described by the linear regression equation $y = a_1 \cdot x + a_0$) and ts2 (with elimination of this trend). Predictions was designated on the 15th day for 5 consecutive months of 2008. The lowest values of prediction error was obtained for the GMDH neural networks for time series analysis method and data prepared on the basis of times series ts1. These results were significantly better than the values of prediction error obtained in the COM using analytical linear regression method. In the case of GRNN neural networks the obtained values of prediction error using regression method for the data prepared on the basis of time series ts2 are very close to the values of prediction error obtained in the COM. However, for the data prepared on the basis of time series ts1 they reached a very high values.

These facts have decided that further research was carried out based on GMDH neural networks. Thus the paper will also present the research results on predicting the corrections for the UTC(PL) using GMDH neural networks for 28 consecutive months, from January 2008, to April 2010. Better method of predicting the corrections for the polish timescale UTC(PL) has proven to be the time series analysis method. The obtained values of prediction error were much smaller than the results obtained in the COM.

¹ BIPM Annual Report on Time Activities, Vol. 6, Sevres, BIPM 2011.