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Verification of ARMA identification for modelling temporal correlation of GPS observations using the toolbox ARMASA

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One essential deficiency of the stochastic model used in many GNSS (Global Navigation Satellite Systems) software products consists in neglecting temporal correlation of GNSS observations. Analysing appropriately detrended time series of observation residuals resulting from GPS (Global Positioning System) data processing, the temporal correlation behaviour of GPS observations can be sufficiently described by means of so-called autoregressive moving average (ARMA) processes. Using the toolbox ARMASA which is available free of charge in MATLAB® Central (open exchange platform for the MATLAB® and SIMULINK® user community), a well-fitting time series model can be identified automatically in three steps. Firstly, AR, MA, and ARMA models are computed up to some user-specified maximum order. Subsequently, for each model type, the best-fitting model is selected using the combined (for AR processes) resp. generalised (for MA and ARMA processes) information criterion. The final model identification among the best-fitting AR, MA, and ARMA models is performed based on the minimum prediction error characterising the discrepancies between the given data and the fitted model. The ARMA coefficients are computed using Burg's maximum entropy algorithm (for AR processes), Durbin's first (for MA processes) and second (for ARMA processes) methods, respectively.

This paper verifies the performance of the automated ARMA identification using the toolbox ARMASA. For this purpose, a representative data base is generated by means of ARMA simulation with respect to sample size, correlation level, and model complexity. The model error defined as a transform of the prediction error is used as measure for the deviation between the true and the estimated model. The results of the study show that the recognition rates of underlying true processes increase with increasing sample sizes and decrease with rising model complexity. Considering large sample sizes, the true underlying processes can be correctly recognised for nearly 80% of the analysed data sets. Additionally, the model errors of first-order AR resp. MA processes converge clearly more rapidly to the corresponding asymptotical values than those of high-order ARMA processes.