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# Identification of AR(I)MA processes for modelling temporal correlations of GPS observations

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In many geodetic applications observations of the Global Positioning System (GPS) are routinely processed by means of the least-squares method. However, this algorithm delivers reliable estimates of unknown parameters und realistic accuracy measures only if both the functional and stochastic models are appropriately defined within GPS data processing. One deficiency of the stochastic model used in many GPS software products consists in neglecting temporal correlations of GPS observations. In practice the knowledge of the temporal stochastic behaviour of GPS observations can be improved by analysing time series of residuals resulting from the least-squares evaluation.

This paper presents an approach based on the theory of autoregressive (integrated) moving average (AR(I)MA) processes to model temporal correlations of GPS observations using time series of observation residuals. A practicable integration of AR(I)MA models in GPS data processing requires the determination of the order parameters of AR(I)MA processes at first. In case of GPS, the identification of AR(I)MA processes could be affected by various factors impacting GPS positioning results, e.g. baseline length, multipath effects, observation weighting, or weather variations. The influences of these factors on AR(I)MA identification are empirically analysed based on a large amount of representative residual time series resulting from differential GPS post-processing using 1-Hz observation data collected within the permanent SA*POS*® (Satellite *Positioning Service* of the German State Survey) network. Both short and long time series are modelled by means of AR(I)MA processes. The final order parameters are determined based on the whole residual database; the corresponding empirical distribution functions illustrate that multipath and weather variations seem to affect the identification of AR(I)MA processes much more significantly than baseline length and observation weighting. Additionally, the modelling results of temporal correlations using high-order AR(I)MA processes are compared with those by means of first order autoregressive (AR(1)) processes and empirically estimated autocorrelation functions.