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Correlation analysis for long time series by robustly estimated autoregressive stochastic processes

Wolf-Dieter Schuh, Jan-Martin Brockmann, and Boris Kargoll
University Bonn, Geodesy and Geoinformation, Theoretical Geodesy, Bonn, Germany (schuh@uni-bonn.de)

Modern sensors and satellite missions deliver huge data sets and long time series of observations. These data sets have to be handled with care because of changing correlations, conspicuous data and possible outliers. Tailored concepts for data selection and robust techniques to estimate the correlation characteristics allow for a better/optimal exploitation of the information of these measurements.

In this presentation we give an overview of standard techniques for estimating correlations occurring in long time series in the time domain as well as in the frequency domain. We discuss the pros and cons especially with the focus on the intensified occurrence of conspicuous data and outliers. We present a concept to classify the measurements and isolate conspicuous data. We propose to describe the varying correlation behavior of the measurement series by an autoregressive stochastic process and give some hints how to construct adaptive filters to decorrelate the measurement series and to handle the huge covariance matrices.

As study object we use time series from gravity gradient data collected during the GOCE low orbit operation campaign (LOOC). Due to the low orbit these data from 13-Jun-2014 to 21-Oct-2014 have more or less the same potential to recover the Earth gravity field with the same accuracy than all the data from the rest of the entire mission. Therefore these data are extraordinarily valuable but hard to handle, because of conspicuous data due to maneuvers during the orbit lowering phases, overall increase in drag, saturation of ion thrusters and other (currently) unexplained effects.