Outlier Detection in Geodetic Applications with respect to Observation Imprecision

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Abstract

The monitoring of buildings, slide slopes and crustal movements is a central task of geodetic engineering. The aim is the generation of meaningful motion and deformation models in order to quickly and specifically initiate constructional or geotechnical safety measures. The adequateness of the actions depends essentially on the quality of the observation and analysis techniques. Therefore it is important to correctly derive the model parameters and their uncertainty budget considering that the model parameters are typically estimated from a large number of heterogeneous and redundant observations by means of a least-squares adjustment. Here, the uncertainty budget is assumed to comprise both random variability and remaining systematics (imprecision).

In practice, there are outliers in the data which have to be detected and eliminated. In conventional techniques only random effects are taken into account. When imprecision is considered additionally, the test strategies have to be extended accordingly. This concerns also the actual level of significance. In this study, the imprecision of typical geodetic observations is modelled and propagated to the estimated parameters. This step which is based on correction and reduction models applied to the raw observation data leads to intervals or fuzzy numbers for the description of the imprecision. In this way imprecise extensions are obtained for the estimated outliers which are tested statistically using one- and multidimensional hypotheses. The applied procedure is outlined in detail showing both theory and numerical examples. Its main benefit is an improved interpretation of the model parameters. Thus, it is an essential observation-based contribution to the quality management in engineering.