Application of fuzzy-techniques in geodetic deformation analysis

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Abstract

Uncertainty plays a key role within the process of information collection by means of observations and its interaction with mathematical models. In this paper the modeling of an extended uncertainty budget in (geodetic) data analysis, especially in the field of geodetic deformation analysis is presented (Neumann, 2009). The aim of geodetic deformation analysis is the detection and monitoring of point and/or object movements. In case of unexpected point or object movements, warning massages are released to avoid damage or collapse of the objects. For this reason, it significantly contributes to the risk and hazard analysis and mitigation of natural and artificial objects.

In order to have realistic warning messages, the relationship between the observed movements and their assigned uncertainty has to be known. This requires a rigorous modeling of the uncertainties. According to Neumann and Kutterer (2009), it is motivated that the (geodetic) uncertainty budget can be modeled using random variability and systematic deviations between the model and the observations (imprecision). Both types of the uncertainty are treated in a comprehensive way using fuzzy-random-variables (FRVs).

The paper shows the complete chain of (geodetic) data analysis from the original observations to the parameters of interest: First, the occurring uncertainties in geodetic data analysis are explained. Then, the characteristic of the uncertainties of measurement results and of the parameters of interest is discussed. Finally, the obtained results are compared to the pure random case. With the aid of real examples it is shown that the consideration of the extended uncertainty budget leads to a refined interpretation of the data in (geodetic) data analysis.

References

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