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Transgaussian Bayesian Kriging and Spatial Sampling Design

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The spatial prediction method of kriging is based on the Gaussian assumption for the underlying random field and the assumption, that the covariance function is exactly known. In a lot of practical examples these assumptions do not hold. The distribution of the observed phenomenon is not symmetric and the exactness assumption on the covariance function is not true, since it is just an estimate. As a consequence the true prediction error in kriging is underestimated. In the first part of our presentation we will propose a new Empirical Bayesian kriging type, taking into account the uncertainty of both, the covariance estimation and the optimal transformation of the data to Gaussianity. The new methodology is entirely based on the sample distribution of the estimators of the covariance function and of the Box-Cox parameter of the transformation. By calculating the Bayesian predictive distribution at the location to be predicted, the uncertainty of the covariance estimation and of the right transformation to Gaussianity is taken into account. The methodology can be fully automatised. Our theoretical results are examplified by a practical example with a simulated non-Gaussian data set. Impressive, unusual figures illustrating the uncertainty of the predictions will be presented. The second part of our presentation deals with the spatial sampling design problem, - the optimal planning of monitoring stations in order to get best spatial predictions. We consider an approximation of the spatial process by means of a linear regression model with uncorrelated errors and an extensive number of regression functions, which are provided by the Karhunen-Loeve expansion of the spatial process. Using well known algorithms from standard experimental design theory we are able to improve existing monitoring networks for Universal Kriging predictions. The theoretical results will be examplified by means of a real monitoring network.