
Modeling and simulating spatio-temporal, multivariate and nonstationary Gaussian Random Fields: a Gaussian mixtures perspective

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Abstract

Gaussian Random Fields (GRFs) play a critical role in modeling and simulating climate-driven processes in general and SWGs in particular. The simulation of GRFs enables the representation of the variability of the process under study through the generation of multiple equally plausible realizations. Simulations on a large number of sites can be based on the decomposition of the target GRF into spectral waves. This approach has been recently extended in various directions in order to make it more versatile, including in spatial, multivariate and spatio-temporal settings. To further increase the versatility of spectral simulation methods, we propose to revisit them adopting a Gaussian mixture perspective. We leverage the Gaussian mixture perspective to propose extensions covering new classes of covariance functions for nonstationary (univariate or multivariate) spatio-temporal GRFs, as well as simulation algorithms for those that are currently missing in the framework of spectral simulation. An illustration is provided for a bivariate nonstationary spatio-temporal example.

Keywords: Gneiting class of covariance, spectral methods, stochastic simulation, importance sampling

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