

The role of covariances in the simulation of spatial random fields

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Whereas the prediction by kriging of a spatial random field only requires a covariance model, its simulation necessitates the complete modelling of its spatial distribution. A notable simplification takes place in the case of a gaussian random field because its spatial distribution is fully characterized by its mean and its covariance.

This presentation deals with the way covariances are handled during the simulation process, conditional or not, of a gaussian random function and its excursion sets. The main emphasis is put on algorithms, such as the "turning bands method" (a stereological device that turns the simulation of a gaussian random function in n dimensions into the simulation of a number of stochastic processes in one dimension), or the "Gibbs sampler" (a stochastic version of the Gauss-Seidel algorithm).

In the presence of numerous conditioning data, it sometimes happens that the kriging matrix is not numerically invertible. In such a case, a standard approach is to associate with each target point a kriging matrix built from its neighbouring data, which is not without detrimental consequences. Unaesthetic effects may be observed on the produced simulation. Regarding the Gibbs sampler, the situation is even more serious because the algorithm may diverge.