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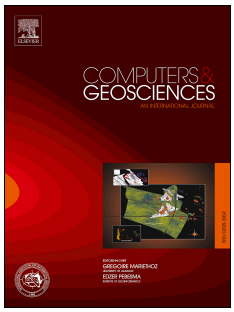

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An Automatic Variogram Modeling Method with High Reliability Fitness and Estimates

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Abstract

Modeling of the variogram is a critical step for most geostatistical methods. However, most of the prevalent variogram-based solutions are designed without sufficient consideration of the effect of the interpolation process on their application. This paper proposes an automated variogram modeling framework, which simultaneously considers the fit of the experimental variogram and interpolation accuracy in the modeling variogram interpolation result. The variogram modeling framework can be treated as a nonlinear optimization problem with two sub-goals. The first is to optimize the goodness of fit between the experimental and theoretical variogram values under the conditions of their designated parameters. Second, we seek to optimize the difference between measured values and the associated kriging estimates with the candidate variogram model. A typical case study was chosen using a public dataset to test the proposed method, which was implemented using a genetic algorithm, and its performance was compared with the ones of other commonly applied variogram modeling approaches. As expected, the traditional variogram modeling method that only considers fitting standard experimental variograms showed severe sensitivity to errors in data and parameters; classical cross-validation modeling results tended to overlook the experimental variograms. By contrast, the proposed method succeeded in producing variogram models with robust, high-quality kriging estimates and favorable fitness of experimental variograms in a more powerful and flexible way.

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Statement of Authorship

(1) Zhanglin Li proposed the method, performed analysis on the implementation, interpreted data, wrote manuscript and acted as corresponding author.
(2) Xialin Zhang helped in improvement of the method in theory, the design and implementation of the algorithm.
(3) Keith C. Clarke supervised development of work, helped to improve the method in theory, edit and evaluate the manuscript.
(4) Gang Liu helped to improve the experiment process.
(5) Rui Zhu helped to edit and improve the manuscript.