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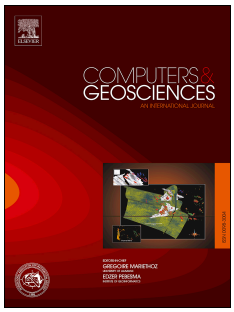

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Method based on the Laplace equations to reconstruct the river terrain for two-dimensional hydrodynamic numerical modeling

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Abstract

The accuracy of the widely-used two-dimensional hydrodynamic numerical model depends on the quality of the river terrain model, particularly in the main channel. However, in most cases, the bathymetry of the river channel is difficult or expensive to obtain in the field, and there is a lack of available data to describe the geometry of the river channel. We introduce a method that originates from the grid generation with the elliptic equation to generate streamlines of the river channel. The streamlines are numerically solved with the Laplace equations. In the process, streamlines in the physical domain are first computed in a computational domain, and then transformed back to the physical domain. The interpolated streamlines are integrated with the surrounding topography to reconstruct the entire river terrain model. The approach was applied to a meandering reach in the Qinhe River, which is a tributary in the middle of the Yellow River, China. Cross-sectional validation and the two-dimensional shallow-water equations are used to test the performance of the river terrain generated. The results show that the approach can reconstruct the river terrain using the data from measured cross-sections. Furthermore, the created river terrain can maintain a geometrical shape consistent with the measurements, while generating a smooth main channel. Finally, several limitations and opportunities for future research are discussed.

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