River bathymetry estimation based on the floodplains topography.

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Topographic model including River bathymetry (bed topography) is required for hydrodynamic simulation, water quality modelling, flood inundation mapping, sediment transport, ecological and geomorphologic assessments. The most common way to create the river bathymetry is to use of the spatial interpolation of discrete points or cross sections data. The quality of the generated bathymetry is dependent on the quality of the measurements, on the used technology and on the size of input dataset. Extensive measurements are often time consuming and expensive.

Other option for creating of the river bathymetry is to use the methods of mathematical modelling. In the presented contribution we created the river bathymetry model. Model is based on the analytical curves. The curves are bent into shape of the cross sections. For the best description of the river bathymetry we need to know the values of the model parameters. For finding these parameters we use of the global optimization methods. The global optimization schemes is based on heuristics inspired by the natural processes. We use new type of DE (differential evolution) for finding the solutions of inverse problems, related to the parameters of mathematical model of river bed surfaces.

The presented analysis discuss the dependence of model parameters on the selected characteristics. Selected characteristics are: (1) Topographic characteristics (slope and curvature in the left and right floodplains) determined on the base of DTM 5G (digital terrain model). (2) Optimization scheme. (3) Type of used analytical curves.

The novel approach is applied on the three parts of Vltava river in Czech Republic. Each part of the river is described on the base of the point field. The point fields was measured with ADCP probe River surveyor M9.

References:

Merwade, Venkatesh. "Effect of spatial trends on interpolation of river bathymetry." Journal of Hydrology, 371.1, 169-181, 2009.

Legleiter, Carl J., and Phaedon C. Kyriakidis. Spatial prediction of river channel topography by kriging. Earth Surface Processes and Landforms, 33.6 , 841-867, 2008.

P. Maca and P. Pech and and J. Pavlasek. Comparing the Selected Transfer Functions and Local Optimization Methods for Neural Network Flood Runoff Forecast. Mathematical Problems in Engineering, vol. 2014, Article ID 782351, 10 pages, 2014.

M. Jakubcova and P. Maca and and P. Pech. A Comparison of Selected Modifications of the Particle Swarm Optimization Algorithm. Journal of Applied Mathematics, vol. 2014, Article ID 293087, 10 pages, 2014.