Inverse Analysis of Soil Parameters Based on Deformation of a Bank Protection Structure

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Introduction: The deformation of bank protection structure is affected by many factors, such as structural stiffness, soil pressure and hydrostatic pressure and so on. In order to predict the deformation of the structure accurately, the accuracy of the parameters is critical. In this work, we present an inverse analysis method combining numerical simulation and BP neural network by using COMSOL Multiphysics®.

Computational Methods: In order to obtain the training samples of the neural network, the soil-water coupling numerical model describing the deformation mechanism of the bank protection structure was established. Through BP neural network model, the nonlinear mapping relationship between soil parameters and horizontal displacement can be constructed. Finally, by comparing with the measured values of the displacement, we can obtained the optimal parameters. The flow chart of this method is shown in Figure 1.

The sketch of data interaction process between COMSOL and Matlab is shown in Figure 2.

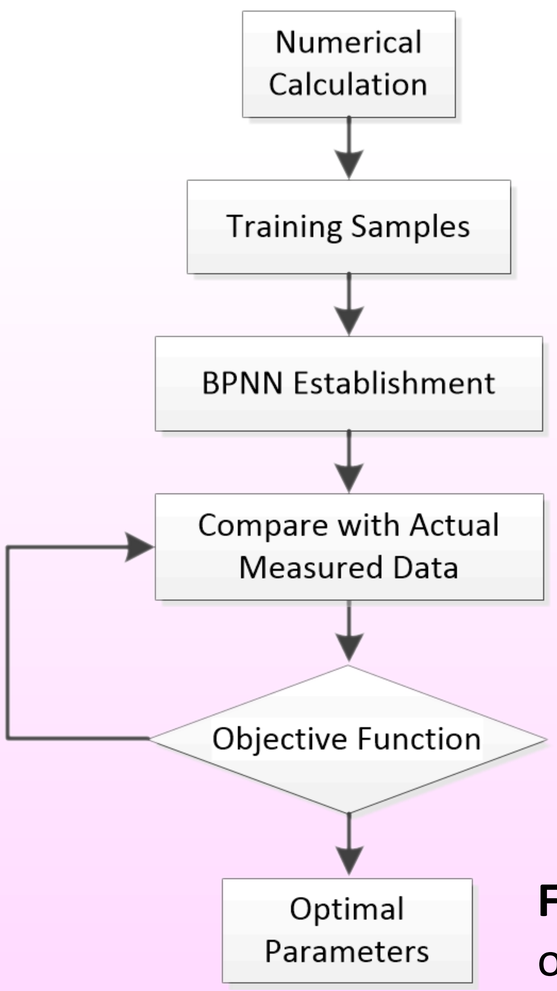


Figure 1. Flow chart of parameters inverse analysis method

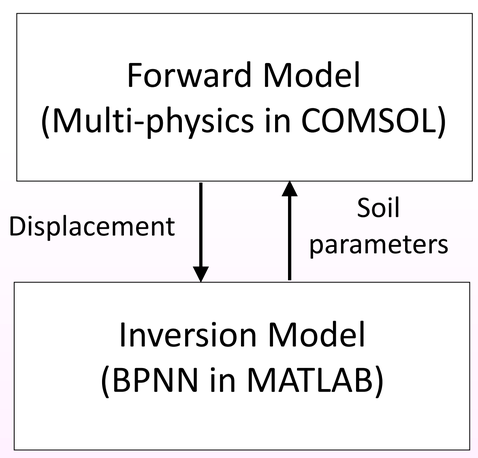


Figure 2. The sketch of data interaction process between COMSOL and MATLAB

Results: Based on the sample data built by numerical model, a BP neural network model consisting of six inputs and three outputs is set up. The regression results of BPNN training, validation, test and all data set are shown in Figure 3.

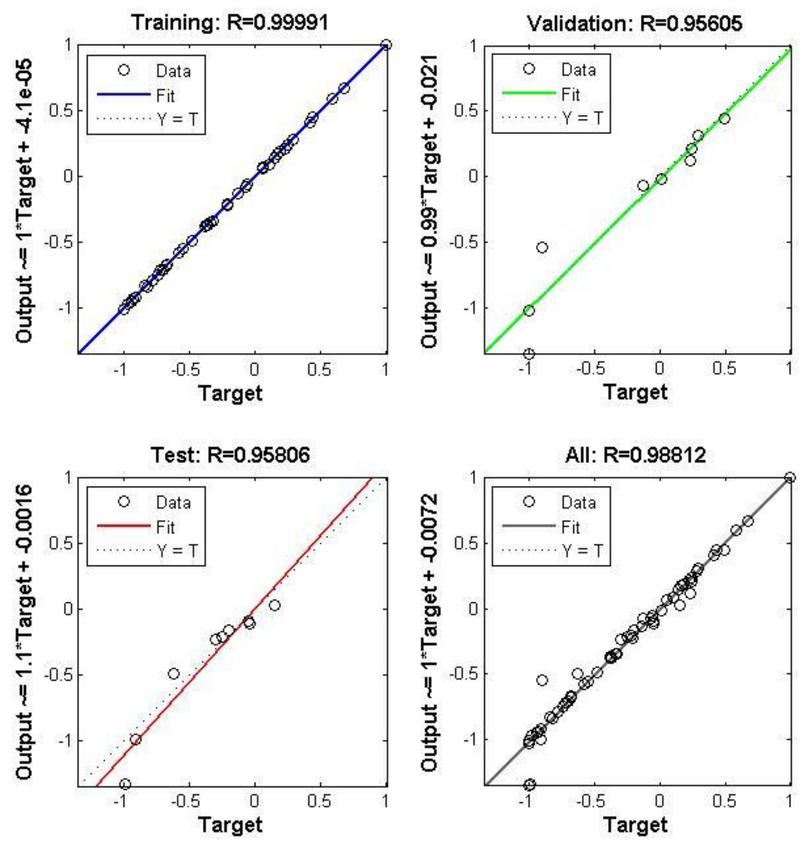
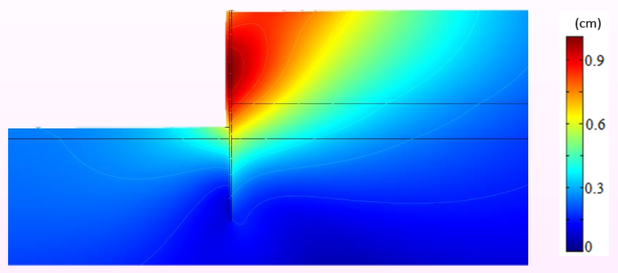


Figure 3. Regression result of training, validation, test and all data set.

Conclusions: Through the inversion analysis of the soil parameters of the bank protection structure, we proved the feasibility of the method. After the inversion, the comparison of the calculated with the measured values of the displacement shows a high accuracy and plausibility of the applied method.

Figure 4. The displacement field using optimized parameters



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2. Hu R, Xing Y, Numerical simulation of bank protection structure deformation effected by the river level fluctuations, 2016 COMSOL Conference in Munich.