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Master Thesis Abstract

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Application of Wavelet Transformation and Artificial Neural Network in Combined Sewer Flow Simulation

Combined sewer flow simulation is a critical and challenging task for the optimal operation of the combined sewer systems. Combined sewer flow is varying all the time since it is influenced by daily wastewater inflow, infiltration, and precipitation. Modeling the sophisticated, dynamic and nonlinear behavior of the combined sewer systems is difficult and needs an accurate intuition and a precise performance.

This study presents a hybrid model for the prediction of dry and wet-weather flows in a combined sewer system. For this aim, a model based on wavelet transformation and artificial neural network (WANN) is developed. High-resolution rainfall and combined sewer flow data set from a catchment in Germany are used in the hybrid model. To simulate the combined sewer flow, dry-weather flow is firstly modeled employing ANN. Subsequently, another ANN is applied and fed with rainfall time series, dry-weather flow simulated in the previous step and lagged combined sewer flow time series as the primary input variables, to simulate the combined sewer flow. In modeling both the dry-weather flow and the combined sewer flow, the wavelet transformation is firstly applied to extract the temporal and spectral features of the measured sewer flow time series before using them in the ANN.

To improve the WANN hybrid model performance, different mother wavelet functions, and decomposition levels, various lagged times for input variables, different input vectors, several training functions and network structures are implemented in the model, and their influence on the hybrid model is investigated. According to this study, the proposed hybrid model has the ability to learn about the complex and nonlinear nature of the combined sewer systems, so it is a powerful tool for the combined sewer flow prediction.

Keywords: Combined sewer flow; Artificial neural network; Wavelet transformation