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EXTENDED ABSTRACT

Prediction of Hydraulic Shock Wastewater in Unexpected Events using a Combination of Wavelet Operator and Artificial Intelligence Network Algorithm

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1. Introduction

Due to the development of urbanization and the limitation of freshwater resources, the importance of wastewater treatment and environmental pollution is of great importance. Inlet wastewater flow can be significantly increased during atmospheric phenomena or chronological events, thereby causing hydraulic shock and consequently destroying biological processes in treatment plants. So that these hydraulic shocks are associated with reduced hydraulic retention time and less purification time for microorganisms, the organic matter is removed from the system faster and the efficiency of stabilization and removal of pollutants is greatly reduced. Therefore, the composition of wastewater has a great impact on the local environmental situation, so it is important to study the amount of incoming wastewater as well as its environmental quality indicators (Sarkheil et al., 2018; Sarkheil et al., 2019).

2. Methodology

2.1. Case study

In this study, daily data of Zargandeh treatment plant from 2015 to 2018 were used

2.2. Wavelet and ANN modeling

ANN artificial neural networks are computational models inspired by the human brain. Major improvements have been made in recent years using ANN (Sarkheil et al., 2013; Shweta et al., 2018). An artificial neural network is a highly complex system that has a high fault tolerance system until part of the network is disrupted and the network does not fail (Sarkheil et al., 2009; Jitender et al., 2013). The generalizability of the network enables it to obtain a general rule of thumb by dealing with only a limited number of samples, and to generalize the results of these lessons to similar cases in advance.

The first four years of data were used to train and evaluate the neural network and the fifth-year data were used to test the neural network and were also identified and eliminated by using the MATLAB wavelet operator in the input data. Then its output was determined as input for the neural network algorithm with three hidden layers and 43 neurons in all layers with sigmoid tangent and sigmoid logarithm transfer functions.

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3. Results and discussion

3.1. Denoising by Wavelet

In this study, raw data was used without any initial pre-processing, which was denoised at three levels

3.2. Artificial neural network performance evaluation and validation

The regression values have a minimum of 96% and a maximum of 99% of adaptation, indicating a highly efficient and excellent modeling of the combination of wavelet and neural networks. According to the number of 1825 data available and their difference, the highest RMSE and MSE of the test category were 53.53 and 2865.55, respectively.

3.3. Matching the predicted Q with real data

Since the overall data correlation value is 98%, it has to be expected to provide an accurate prediction of the value of the selected points. The maximum amount of error in these points is just 14 units which are very desirable considering the volume of input and output data and the frequency of them.

4. Conclusions

Due to the development of urbanization and the limitation of freshwater resources, the importance of wastewater treatment and environmental pollution is of great importance. Inlet wastewater flow can be significantly increased during atmospheric phenomena or chronological events, thereby causing hydraulic shock and consequently destroying biological processes in treatment plants. So that these hydraulic shocks are associated with reduced hydraulic retention time and less purification time for microorganisms, the organic matter is removed from the system faster and the efficiency of stabilization and removal of pollutants is greatly reduced. In this study, daily data of Zargandeh treatment plant from 2015 to 2018 were used, the first four years of data were used to train and evaluate the neural network, and the fifth-year data were used to test the neural network and were also identified and eliminated by using the MATLAB wavelet operator in the input data. Then its output was determined as input for the neural network algorithm with three hidden layers and 43 neurons in all layers with sigmoid tangent and sigmoid logarithm transfer functions. The regression values have a minimum of 96% and a maximum of 99% of adaptation, indicating a highly efficient and excellent modeling of the combination of wavelet and neural networks. According to the number of 1825 data available and their difference, the highest RMSE and MSE of the test category were 53.53 and 2865.55, respectively.

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