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Forecasting Value of Pollutant Index in Surabaya River Using Fuzzy Radial Basis Function Neural Network

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Abstract

Water resources quality for people in around Surabaya River is an important thing that can be laid aside so it need a management and monitoring system for water quality of Surabaya River. One form of monitoring system for Surabaya River water quality is trend analysis of the system, so it can be used to identify the water system and forecast the next condition. Radial basis function neural network model can be used to analyze the tendency of the water system is based on time series data of the pollutant index value. Taking into account the possibility of parallax error in the measurement, the limited data, and different data characteristics, application of fuzzy theory is imposed on the model. Application of fuzzy theory is also based on its ability for measure the uncertainty by the lower and upper bound. Fuzzy radial basis function neural network model formed expected to give results close to the actual value of forecasting on the testing step of simulation models. Forecasting results obtained pollution index values can also be used as a reference in the management and monitoring system of Surabaya River.

Keywords: Fuzzy radial basis function, Pollutant index, Surabaya river

1. Introduction

One of the most important energy source in the world is water. Water from Surabaya River used for various purposes such as irrigation, drinking water, industrial water and flushing. In accordance with the designation, according to the Decree of the East Java Governor No. 413 on 1997, Surabaya River which is one source of drinking water is expected to meet the quality standards of water quality in B class. Therefore, the set method of evaluating the quality of water system with water quality pollution index stipulated in the Decree of the Environment Minister No. 115 on 2003 on guidelines for the determination of water quality status. In chapter 2 on the decree, the determination of the water quality status can be done by Pollution Index (IP) methods. Pollution index value in the time series can be analyzed to identify the water system. Masduqi and Apriliani (2008) has researched to estimate the quality of water in Surabaya River for a time, but how the behavior of the system can not be analyzed so it's difficult to be used when rapid changes in river conditions occur.

Artificial neural network modeling is one of study about systems engineering that can be used to analyze the mechanisms, patterns, behaviors and tendencies system (Arifin and Irawan, 2009). Neural network is widely used in time series data as a function of time t. The goal is to forecasting value in the future (Bishop, 1995). Suppose there is a single variable x_t. One approach is to generate a sequence of discrete values x_{t-1}, x_t , x_{t+1} and so on. Taken d such that there are $x_{t-d+1},\ldots,x_t$ as input to the network of value x_{t+1} as the target for the network output. Riggs (1987) stated that one way of forecasting is the method of time series which uses historical data (past time data), for example, the data values of water quality parameters today, to make the forecast values of water quality parameters in the future. The purpose of this method is to identify the patterns of historical data and then extrapolate this pattern into the future. In a method of identifying patterns of past data is done by creating an artificial neural network is trained to be able to mimic the pattern of data. Selection of algorithms and corresponding parameters and determining how much the data required in the learning process is very important to determine the accuracy of generated forecasting.

Radial basis function neural network first introduced into the literature on neural networks by Broomhead and Lowe (1998). Qiao et al. (2011) also offer a design algorithm model of radial basis function neural network to model parameters COD in the wastewater treatment process. The results showed that the pattern of COD in the disposal of the wastewater treatment can be predicted with acceptable accuracy using data SS, pH, oil and NH_3-N as input data in the model. Therefore, in this study using a