Shahid Chamran University of Ahvaz
Irrigation Sciences and Engineering (JISE) Vol. 42, No. 3, Fall 2019, p. 105-116

EXTENDED ABSTRACT

Evaluvating the Performance of Wavelet Neural Network Models in Estimation of Daily Discharge

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Received: 15 May 2017 Revised: 22 October 2017 Accepted: 30 October 2017

Keywords: Estimation, Flood, Artificial Neural Network, Nourabad. ***DOI:*** 10.22055/jise.2017.22047.1580.

Introduction

River flow prediction is one of the most important key issues in the management and planning of water resources, in particular the adoption of proper decisions in the event of floods and the occurrence of droughts. In order to predict the flow rate of rivers, various approaches have been introduced in hydrology, in which intelligent models are the most important ones. The application of artificial neural networks (ANNs) to various aspects of hydrological modeling has undergone much investigation in recent years. This interest has been motivated by the complex nature of hydrological systems and the ability of ANNs to model non-linear relationships. ANNs are essentially semi-parametric regression estimators and well suited for hydrological modeling, as they can approximate virtually any (measurable) function up to an arbitrary degree of accuracy (Hornik et al., 1989). A significant advantage of the ANN approach in system modeling is that one need not have a well-defined process for algorithmically converting an input to an output.

Materials and Methods

In this study, daily data from Badavar watershed in Lorestan Province was used to evaluate the accuracy of models in river flow prediction. Wavelet neural network and artificial neural network were used to model the daily flow of Badavar River and the results were compared with each other for the accuracy of the studied models. In a few studies, each of the models presented in the prediction of daily flow has been studied, but the purpose of this study is to simultaneously examine these models in a basin to predict the daily flow of the river. In this research, the Badavar River in Lorestan Province was selected as the study area and the daily flow of observations of this basin was used at Badavar hydrometric station to calibrate and validate the models. For this purpose, at first 80% of the daily flow data (2002-2010) was selected for calibration of the models and 20% of the data (2010-2012) were used to validate the models. For this purpose, precipitation different time daily rate at daily scale as input and flood peak discharge as output parameters were selected. The criteria of the correlation coefficient, root mean square error, and of mean absolute error were used to evaluate and compare the performance of models.

Wavenet, called wavelet-based neural network, combined with wavelet theory and neural networks have been created. It also has the support of the benefits and features of neural networks and charm, flexibility, and strong mathematical foundations and analysis of multi-scale wavelet. A combination of wavelet theory with neural network concepts with the creation of wavelet neural network and feedforward neural shock can be a good alternative for estimating approximate

nonlinear functions. Feedforward neural network with the sigmoid activation function is in the hidden layer. While at the nerve shocked wavelet, wavelet functions as activation function of hidden layer feedforward networks are considered in both of these networks, and scale wavelet transformation parameters are optimized with their weight.

Artificial neural networks inspired by the brain's information processing systems were designed and emerged to help the learning process, and with the use of processors called neurons are used to understand the inherent relationships in data mapping between input space and optimal space. Hidden layer or layers, the information received from the input layer and output layer, are the processing and disposal. Based on the artificial neural network structure, its major features are high processing speed, the ability to learn the pattern, the ability to extend the model after learning, flexibility against unwanted errors, and no disruption to an error on the part of the connection due to weight distribution network. The first practical application of synthetic networks with the introduction of the multilayer perceptron network was consultants. for training this network, backpropagation algorithm is used. The basis of this algorithm is based on error correction learning rule that consists of two main routes, which by adjusting the parameters in the MLP model error signal and input signal occurs. Determining the number of layers and neurons is the most important issue in a simulation with an artificial neural network.

Results

The results showed that both models have better results in structures of 1 to 5 daily times than the other specified structures. In addition, according to the evaluation criteria, it was found that between the models used, the wavelet neural network model has the highest accuracy of R = 0.920, the lowest root mean square error of RMSE=0.005m3/s, and the lowest absolute error value of MAE=0.003m3/s at the verification stage.

Conclusions

The results showed that an increase in the number of effective parameters in different models for simulations results in better performance in the discharge estimation. In addition, the results showed that the wavelet neural network model has a better performance than the artificial neural network.

Acknowledgments

The authors are very grateful of Lorestan Regional Water Company, because of their efforts in finalizing and gathering the data necessary for performing this study.

Refereces

Hornik, K., Stinchcombe, M., White, H., 1989. Multilayer feed forward networks are universal approximators, *Neural Networks,* 2(3), pp.359– 366.