Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 5, No. 10, October, 2019

A Comparison of Emotional Neural Network (ENN) and Artificial Neural Network (ANN) Approach for Rainfall-Runoff Modelling

Suraj Kumar [a], Thendiyath Roshni [b*], Dar Himayoun [a]

[a] *Research Scholar, Department of Civil Engineering, National Institute of Technology, Bihar, Patna, 800005, India.*

[b] *Assistant Professor, Department of Civil Engineering, National Institute of Technology, Bihar, Patna, 800005, India.*

Received 14 June 2019; Accepted 06 September 2019

Abstract

Reliable method of rainfall-runoff modeling is a prerequisite for proper management and mitigation of extreme events such as floods. The objective of this paper is to contrasts the hydrological execution of Emotional Neural Network (ENN) and Artificial Neural Network (ANN) for modelling rainfall-runoff in the Sone Command, Bihar as this area experiences flood due to heavy rainfall. ENN is a modified version of ANN as it includes neural parameters which enhance the network learning process. Selection of inputs is a crucial task for rainfall-runoff model. This paper utilizes cross correlation analysis for the selection of potential predictors. Three sets of input data: Set 1, Set 2 and Set 3 have been prepared using weather and discharge data of 2 raingauge stations and 1 discharge station located in the command for the period 1986-2014. Principal Component Analysis (PCA) has then been performed on the selected data sets for selection of data sets showing principal tendencies. The data sets obtained after PCA have then been used in the model development of ENN and ANN models. Performance indices were performed for the developed model for three data sets. The results obtained from Set 2 showed that ENN with R= 0.933, R^2 = 0.870, Nash Sutcliffe = 0.8689, RMSE = 276.1359 and Relative Peak Error = 0.00879 outperforms ANN in simulating the discharge. Therefore, ENN model is suggested as a better model for rainfall-runoff discharge in the Sone command, Bihar.

Keywords: Emotional Neural Network (ENN); Artificial Neural Network (ANN); Cross Correlation; Principal Component Analysis (PCA); Rainfall-Runoff.

1. Introduction

The rainfall-runoff relationship is one of the most complex hydrological phenomena due to presence of complex non-linear relationships in the transformation of rainfall into runoff. This process is quite difficult to comprehend, owing to the presence of huge number of variables involved in the demonstration of physical process [1-4]. Therefore its precise modelling is important for water resources management and development and the prediction of natural calamities like droughts and floods. Based on the involvement of physical aspects, rainfall-runoff models are classified as either physical-based models or system theoretic models [5-7]. The physical-based models also called data driven models require the considerable information about the system mechanism as well as its parameters. However, the system theoretic models do not concern much about the physical processes of the problem. These models are primarily based on rainfall and runoff data and seek to characterize nonlinearity and non-stationary behaviour from those data by the use of transfer functions [8-10]. Among the system theoretic models, Artificial Neural Network (ANN) based models for rainfall-runoff modelling have received global attention because of their capability to capture high degree of non-

* Corresponding author: roshni@nitp.ac.in

http://dx.doi.org/10.28991/cej-2019-03091398