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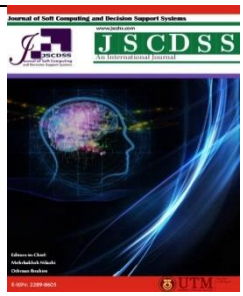

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The Precipitation Modeling through the CPSO-based Artificial Neural Networks

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Abstract

Precipitation has a random chaotic nature, which is hard to model and predict due to various involved parameters. Such affecting parameters include temperature, relative humidity, pressure, radiation, the average sunny hours, the humidity of ground surface and cloudiness. Given the importance of modeling and precipitation estimate in various areas, the current study deals with an effective model using three parameters; humidity, temperature and radiation. The simulation was conducted using real data for the Multi-Layered Perceptron Networks (MLP), the Radial Basis Functions (RBF) and the Compound Neural Networks based on the Particle Swarm Optimization algorithm (CPSO-ANN). From among the advantages this method has is the separate and concurrent examination of the impact of every three entry on the network and the display of the correlations. According to the simulations, the concurrent application of all of the three entries in the network along with the CPSO-ANN leads to an effective model with the minimum of Mean Squared Error (MSE) and appropriate extension capability.

Keywords: Precipitation Modeling, RBF, MLP, CPSO-ANN, MSE.

1. Introduction

The precipitation, because of it non-linear, complex nature, plays an important role in various subjects such as aerology, agriculture and watershed management so that the accurate prediction and modeling of it paves the way for the optimal storage of runoffs and floods. Considering the value of precipitation modeling and prediction, several studies were conducted using statistical techniques, classical and intelligent methods as well as Artificial Neural Networks in the recent years. Thus, the increasing use of Artificial Neural Networks in various areas, as a non-linear method to model and predict precipitation, caught the researcher's attention. To this end, Hung et al. predicted the precipitation in Bangkok using the Artificial Neural Network based on the tangent hyperbolic transitional function and some of the four-year-old parameters related to precipitation including wet bulb temperature, pressure, relative humidity and cloudiness (Hung et al., 2009).

The analysis of the accuracy obtained from the simulations showed that the most important parameter affecting the precipitation is the wet bulb temperature. Moreover, the Artificial Neural Network of Feed Forward Back-Propagation type and the Gradient Descent training algorithm were introduced to model the precipitation in Nigeria in which the best model selected on the grounds of Mean Square Error was obtained through the same number of knots in the entry and hidden layers (Onwukwe & Ikpang, 2015). The precipitation predictive system was also offered based on Data Core Based Fuzzy Min Max Neural Network (DCFMNN) with high accuracy (Palange et al., 2015). Devi et al. (2016) examined and analyzed a model for the prediction of daily precipitation using Nonlinear Autoregressive Exogenous Network (NARX). The results indicate the high capacity of this network based on Levenberg Marquardt algorithm (in order to update the weights). While estimating the monthly precipitation using two different structures, it was revealed that less variation in the rainfall leads to a better model with fewer errors (Purnomo et al., 2016). The estimate of the monthly rainfall was made through various assessment criteria including Mean Squared Error, Root Mean Square Error (RMSE), Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE) using accurate seasonal neural networks (Karthik & Arumugam, 2017). Moreover, a Neural Network in which the linear regression analysis had been used to examine the relationship between the vegetation index shown by the satellite and the rainfall data was offered to model the annual rainfall (Chanklan et al., 2017).