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Radial Basis Function (RBF) Neural Network: Effect of Hidden Neuron Number, Training Data Size, and Input Variables on Rainfall Intensity Forecasting

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***Abstract*— Mean daily rainfall of more than 30mm could result in flood hazard. Accurate prediction of rainfall intensity could help in forecasting of flash flood and help to save lives and properties. One of the common machine learning techniques in rainfall prediction is Radial Basis Function (RBF) neural network. Rainfall intensity is classified into four categories, i.e. light (<10mm), medium (11-30mm), heavy (31-50mm) and very heavy (>50mm) in this study. The rainfall intensity categories is forecasted using the RBF network model utilizing the daily meteorology data for Kuching, Sarawak, Malaysia. The input vectors being considered for the RBF network model are minimum, maximum and mean temperature (°C), mean relative humidity (%), mean wind speed (m/s), mean sea level pressure (hPa) and mean precipitation (mm) for the year 2009 to 2013. The prime focus in this paper is to analyse the ramification of the training data size, number of hidden neurons, and different input variables (i.e. combination of meteorology data) in influencing the performance of the RBF network model. From this study, it could be concluded that, the factor that would influence the performance of the RBF model is only the input variables used, if and only if the network model is equipped with sufficient number of hidden neurons and trained with adequate number of training data. Another interesting observation from this study is that, the RBF network model produced consistent result throughout the testing using a specific hidden neuron number when the RBF network is retrained and tested.**

***Keywords*— rainfall; radial basis function; intensity; forecasting; meteorology data.**

I. INTRODUCTION

Rainfall intensity refers to the measure of the amount of rain that falls over time and this data has been defined as the most critical flood hazard parameter [1-4]. Flood is one of the Earth's most common and destructive natural disasters which accounts for the most significant death and financial lost [5]. Therefore, accurate prediction of rainfall intensity could help in lives and properties saving, as well as securing the national economic activities [6].

Rainfall forecasting could be done using the Numerical Weather Prediction (NWP) model, statistical methods and machine learning techniques [6]. By using the numerical solutions of atmospheric hydro thermodynamic equations, NWP, which is also known as physical models, high accuracy could be obtained as long as the complex and meticulous simulation of the physical equations in the atmosphere model is appropriately solved [7, 8]. However, this could sometimes lead to unsatisfactory due to the instability of these differential equations [9, 10]. Statistical models, which are based on the relationships between the observational relationships, are more straightforward and more comfortable to operate [11]. Yet, the reliance on the stationery relationships between the predictor and predicted variables [12] is the main issue in applying the models in changing climate. Rainfall forecasting is difficult to model as the atmospheric processes is very complicated and non-linear [13]. Due to this, machine learning techniques are more suitable for rainfall forecasting as machine learnings had shown applauding results in dealing with complex, non-linear and with predictor variables which are highly correlated [14]. Among the popular machine learning techniques for rainfall predictions are: Radial Basis Neural Network, Generic Programming, Support Vector Regression, M5-Rules, M5- Model trees and *k*-Nearest Neighbor [15]. An evaluation on these six machine learning methods revealed that Radial Basis Function Neural Network outperforms all other machine learning methods [15].