EE-588 ADVANCED TOPICS IN NEURAL NETWORK

THE PROJECT PROPOSAL

AN APPLICATION OF NEURAL NETWORKS FOR WEATHER TEMPERATURE FORECASTING

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AN APPLICATION OF NEURAL NETWORKS FOR WEATHER TEMPERATURE FORECASTING

Abstract

Weather forecasting has become an important field of research in the last few decades. In this study, temperature will be forecasted using Artificial Neural Networks (ANN) approach. It is determined like parameters wind speed, atmospheric pressure and relative humidity as input values. Output value is also the data of temperature. These values are collected from Turkish State Meteorological Service. Weather temperature has been estimated for Adana city with artificial neural networks for the application part. The productivity of model has been compared in regard to statistical techniques like MSE and MAPE. The model has been normalized to analyze on Matlab software.

Keywords: Artificial neural networks, Temperature forecasting

I. Introduction

Weather simply refer to the condition of air on earth at a given place and time. The application of science and technology are to predict the state of the atmosphere in future time for a given location is so important due to its effectiveness in human life. Today, weather forecasts are made by collecting quantitative data about the current state of the atmosphere and using scientific understanding of atmospheric processes to project how the atmosphere will evolve. The chaotic nature of the atmosphere implies the need of massive computational power required to solve the equations that describe the atmospheric conditions. This is resulted from incomplete understanding of atmospheric processes which mean that forecasts become less accurate as the difference in time between the present moment and the time for which the forecast is being made increases.

Weather is a continuous, data-intensive, multidimensional, dynamic and chaotic process and these properties make weather prediction a big challenge. Generally, two methods are used for weather forecasting (a) the empirical approach and (b) the dynamical approach.

The first approach is based on the occurrence of analogs and is often referred by meteorologists as analog forecasting. This approach is useful for predicting local-scale weather if recorded datas are plentiful.

The second approach is based on equations and forward simulations of the atmosphere and is often referred to as computer modeling. The dynamical approach is only useful for modeling large-scale weather phenomena and may not forecast short-term weather efficiently. (Devi, 2012)

ANN research techniques are applied to various fields such as classification, optimization, forecasting, recognition, modeling and learning. ANNs provide a methodology for solving many types of nonlinear problems that are difficult to solve by traditional techniques. Most meteorological processes often exhibit temporal and spatial variability, and are further plagued by issues of nonlinearity of physical processes, conflicting spatial and temporal scale and uncertainty in parameter estimates. The ANNs exist capability to extract the relationship between the inputs and outputs of a process, without the physics being explicitly provided (Zurada, 1992). Thus, these properties of ANNs are well suited to the problem of weather
forecasting under consideration. (Maqsood, 2004) The basis of the model is neuron structure as shown in Figure 1.

![Neuron model](image)

**Figure 1.** Neuron model (Hayati and Mohebi, 2007)

This study will be based on develop the most suitable ANN method and its associated training technique for weather prediction. Performance quantification of the developed model will be comparison of the regression models based on a number of statistical measures.

II. **The Problems to be Studied**

In this study, weather temperature will be attempted to predict with ANN approach. In prediction, the parameters of affected the temperature are daily max temperature, min temperature, cloudless, relative humidity, solar radiation, wind speed and sunshine. Output parameter of system of ANN designed with these input parameters is daily average temperature. The general structure of the designed system has been shown in Figure 2.

![General structure of input/output for ANN models](image)

**Figure 2.** General structure of input/output for ANN models
In order to predict weather in a very effective way and to help overcome all such problems we have proposed a weather forecasting model using Artificial Neural Network. The advantage which ANN has over other weather forecasting method is that the ANN minimizes the error using various algorithms and gives us a predicted value which is nearly equal to the actual value.

Several works has been done and different artificial neural networks (ANN) models have been tested. Many scientist like Kaur (2011) and Maqsood (2004), Baboo (2010), Coltagirone (2011), Erkaymaz (2011) made studies on forecasting with ANN. The authors was used of Multilayer Perceptron Networks (MLP), Elman Recurrent Neural Network (ERNN), Radial Basis Function Network (RBFN) and the Hopfield Model (HFM). (Abhishek,2012)

In solution of this problem, it is very important to:
   a) define which parameters will be used as input parameter,
   b) determine the rank of data (daily, monthly, yearly..)
   c) collect data set indicating real statistical values and assess training sets with control sets,
   d) implement and determine the ANN model that gives the best results,
   e) seek the suitable learning algorithm, activation function, statistical function.

The main purpose is to develop the most suitable ANN architecture and its associated training technique for temperature prediction.

III. Overview of Current Methods

The project that approximation air temperature with artificial neural network made by Erkaymaz (2011) will be developed in this project. In his project, it was used four input parameters including vapor pressure, relative humidity, wind speed, air pressure; one output parameters including temperature. Weather temperature has been estimated for Karabuk city with artificial neural networks for the application part. Tha datas related these parameters was acquired 66 training datas from Karabuk Meteorological Station. For prediction, 17 of them were used as test training datas.

Feed forward neural network model was used. The temperature has been measured with lowest error using Matlab program. And also for the system, Simulink model of feed forward ANN was performed from input to output. (Erkaymaz,2011)

IV. Proposed Methods

In this study, air temperature forecasting of Adana city is proposed by using ANN. For system of proposed, input parameters have been defined seven parameters, including of daily pressure, wind speed, humidity, maximum temperature, minimum temperature, radiation and cloudless. Output parameter is used also daily available temperature. For prediction of valuables, the daily datas recorded between 2000 and 2013 years are taken from Turkish State Meteorological Service. While the datas of 2000-2010 years is training data, the datas of between 2011-2013 years is used for testing data.
Back Propagation Neural Network (BPN) technique is proposed. The main advantage of the BPN neural network method is that it can fairly approximate a large class of functions. This method is more efficient than numerical differentiation. The simple meaning of this term is that our model has potential to capture the complex relationships between many factors that contribute to certain temperature. After input datas is arranged in chronological order to model which was established, the model is trainined.(Devi,2012)

Application of the model is performed with Neural Network Toolbox in Matlab software. Briefly, comparison of the current method and the proposed method has shown Figure 3.

<table>
<thead>
<tr>
<th></th>
<th>Current Method</th>
<th>Proposed Method</th>
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<tbody>
<tr>
<td>Type of Network</td>
<td>Feed Forward</td>
<td>Feed Forward Back Propagation</td>
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<tr>
<td>Minimum Error</td>
<td>Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE)</td>
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<td>Software&amp;Toolbox</td>
<td>Matlab&amp;Smilunk</td>
<td>Matlab&amp;Neural Network</td>
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<td>The number of input parameters</td>
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<td>7</td>
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<td>The rank of data set</td>
<td>66 days</td>
<td>13 years</td>
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**Figure 3.** Comparison of Methods

The paper examines the applicability of ANN approach by developing effective and reliable nonlinear predictive models for weather analysis also compare and evaluate the performance of the developed models using different activation functions, transfer functions, hidden layers, weight and neurons to forecast.

According to this propose method, neural networks are thought to show similar results to the actual results. Artificial neural networks can generalize by learning nonlinear relationships. Therefore, they can answer with acceptable an error to questions which never met previously. Because of these attribute, ANNs are applied as effected method in forecasting
V. MANAGEMENT PLAN

This research culminates in a formal report, which will be completed by May 21, 2014. To reach this goal, I will follow the schedule presented in Figure 4.

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<tr>
<th>Activity</th>
<th>19-26 March</th>
<th>26 March-2 April</th>
<th>2-9 April</th>
<th>9-16 April</th>
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**Figure 4.** Schedule for completion of literature review
VI. REFERENCES


