CHAPTER VIII

Proposed Model and Implementation

In our study we use the historical data for each of the 10 sites, and design several Prolog based implementations for achieving the following:

- Calculation of mean speed value.
- Calculation of Weibull and Rayleigh Shape parameters and Scale parameters.
- Calculation of wind power density, Weibull power and Rayleigh power.
- Plotting of mean wind speed, Weibull probability and Rayleigh probability plots.
- Prediction of wind speed using ANN.

In our research work the initial and the most important step is to estimate the mean wind speed value of the expected site under consideration and afterwards, to estimate the wind power that a selected wind farm could produce in a year.

The Weibull and Rayleigh shape parameters and scale parameters is calculated for each site, which has a data of year 2006 to 2010 for all the ten sites and the code model will handle both monthly and yearly wind probability distributions.

The results obtained from the above implementation are used to plot functions of probability density and cumulative frequency for various Weibull and Rayleigh shape and scale parameters. The code was also able to calculate density of the wind power density, power of Weibull and Rayleigh power in both months and years for the sites.

An implementation is attempted to predict wind speed for year 2010 and compared with the actual values using prolog. Using ANN BP, a model is created and implemented in prolog and several iterations were compared with matlab to rid of any errors and to improve the overall performance.

The model input that was used in excel file was an unprocessed data. It was training data in 2006-2009 and testing data in 2010 for the ten sites.
For selecting an ANN model the layer count and elements in each layer is a crucial decision. It is the art of the designer to select these values in the topology of feed forward back propagation.

There is no in particular best network layout in any specific application. Simple rules for selecting best answer are: The two rules are:

1. With the increase in complexity in input and required output relationship is increased then the processing elements number in the layer that is hidden also increases.
2. When model is separated into several other models then more number of hidden layers is required.

In this model, after testing for few times, the choice was made to take up 20 units as hidden layers. The process of training is repeated to achieve the regression value near to 1.

Wind speed data is sampled hourly on height of 10m, 30m and 50m. Selected information are utilised for input in model that is prepared following the method of back propagation neural network. In Back propagation network, any function that is non linear can be made of a three layer theoretically. Hence a network of three layer model is designed with a layer that is hidden. Hidden layer's transfer function of activation is tan-sigmoid function. Linear function is used at a layer which is at output. In overall we have used Feed Forward Back-propagation algorithm using Levenberg-Marquardt method.

In this model, wind speed information of 48 months were utilised in training of networks and the other date of every day of the full 12 months helped in testing the prediction result. The input to the model is speed of the wind with no consideration of any other factors affecting the speed of wind. Wind speed is the output itself. The structure of the model is shown in Fig 8.1.

Variation in result can exists in the same set of input, which means that even if the training conditions are same, the difference in the initial matrix of weight can lead to variations in output. So, the error output is bounded in the process of training a proposed network model to achieve the desired network results.
The software’s used for programming the proposed Model are:

**MATLAB 7.12.0 (R2011a)**
- nntool
- nnstart
- nntrain tool

**PROLOG SWI**

Prolog (programming in logic) is one of the widely used programming language in the field of artificial intelligence research. This is a novel method for predication of wind speed data compared to other higher level programming languages like C, C++ or Java (object-oriented) a declarative programming language. That means, giving the solution to a problem, specifying achievement of a goal for a given situation, the thesis inputs what the situation (facts and rules) are and goal (query) and let the Prolog perform solution to the need. The implementation of the prolog programming model is shown as flow charts in Fig 8.2 to Fig 8.7.
Fig 8.2: Prolog Flow Chart for determining Mean Wind Speed Monthly and Yearly
Fig 8.3: Prolog Flow Chart for Implementation of Monthly Weibull and Rayleigh Distribution
Fig 8.4: Prolog Flow Chart for Implementation of Yearly Weibull and Rayleigh Distribution
Fig 8.5: Prolog Flow Chart for Plotting Monthly Weibull and Rayleigh Distribution
Fig 8.6: Prolog Flow Chart for Plotting Yearly Weibull and Rayleigh Distribution
Fig 8.7: Prolog Flow chart for Implementation Prediction of wind speed using ANN