Wind Speed Prediction in Non-Monitored Areas Based on Topographic Radial Basis Neural Network (T-RBNN)

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Abstract. This paper shows an improved method for the prediction of wind speed in the areas where wind monitoring station is not available. The model has nine meteorological inputs, and one output, which is wind speed. The model was developed using Matlab/Simulink (R2016). The model was trained, tested and validated for accuracy purposes. The overall performance of the model was judged using statistical measures. It was realized that the developed model is capable of reproducing wind speed in the areas not covered by measurements. The root mean square and covariance of the developed model was 7.18 % and 0.0098 respectively.

1. Introduction

Wind power is well-recognized renewable energy producing, clean, safeguarded and foreseeable electric power. It has absolutely negligible carbon emission, and has reduced operational cost, that can be operated during the day and night times, with virtually zero greenhouse gas emission [1-2]. Before a wind energy system is installed, detailed wind resource assessment (WRA) must be conducted properly. The most important parameter of the WRA is wind speed, followed by wind direction. Because of this, wind speed must be measured or predicted with a high degree of accuracy.

According to [3], most of the early research work conducted on wind speed prediction were performed using either physical or numerical mathematical models, for example [3-4]. However, it was realized in many studies that due to the unpredictable nature of wind speed as it propagates in the atmosphere, it will be difficult to construct a reliable mathematical function, which will model the wind speed perfectly. Furthermore, according to no mathematical model either physical or numerical that will give an approximate solution of the wind speed model.

Generally, due to those weaknesses mentioned above, researchers have devoted time in finding a suitable model that will give an acceptable solution. Soft computing prediction models are found to be acceptable in terms of reliability and accuracy.

Based on the aforementioned, a lot of studies were carried out reported in scientific studies. Generally, wind speed predictions are classified based upon prediction periods/horizons, that is very short-term, short-term, medium-term and long-term. Wind speed prediction using data mining approach has successfully implemented in [5]. Instead of predicting wind power directly, authors [6] in predicting wind speed using support vector machine (SVM). Simulating annealing and SVM was proposed to overcome the use of SVM alone [7]. The fuzzy logic approach has been tested in [8] to predict wind speed values. Wind speed prediction using Radial Basic Function Neural Network (RBFNN) was suggested by [9], the model was validated using real wind speed data, and it was found to be feasible, to reduce wind speed uncertainties. One study [10] proposed the application of Artificial Neural Network (ANN) and Artificial Intelligent (AI). ANN and Markov chain model was