

Wind Speed Interval Forecasting Under Uncertainty Quantification Pattern Based on Deep Learning Method

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Abstract— Global demand for energy is on the rise. The incorporation of renewable energy sources into the grid presents an engineering and economic challenge. Wind and solar power are considered to be the next generation of electricity. However, the wind is often difficult to forecast, as wind speed is typically stochastic and non-stationary. The prediction depends on the site of the users and the feasibility of the forecasting should be observed under technological and regulatory conditions. In this paper, we propose a wind speed interval forecasting under the uncertainty quantification pattern. It is well accepted that wind differs in patterns and weather conditions. Deep learning called Recurrent Neural Network (RNN) algorithm is applied to seeking for the optimal prediction error weights. The implementation considering the two-season situation that carried out by observation of the three-month wind speed pattern. The result shows that the trained and tested model can achieve higher quality forecasting value.

Keywords— Deep learning, optimal prediction, artificial intelligence, recurrent neural network, wind speed forecasting.

I. INTRODUCTION

Wind speed interval estimation plays an important role in renewable energy generation. Especially in solar power generation and wind power generation. The output of wind energy and solar energy is outstanding among many new energy sources. The International Energy Agency (IEA) forecasts that wind capacity is projected to increase by 60% (325 million KW) by 2019 [1]. As wind speed can change drastically in just a few hours, the issue of wind power generation and solar power generation lies in its reliance on wind fluctuations. In the wind power generation, it further hinders incorporation of getting wind power. In the solar power generation case, the wind speed determines the cloud motion condition that affects the output of the power system. Therefore, prediction of reliable wind speed is an important prerequisite for large-scale production and utilization.

II. MODELLING TECHNIQUES AND STRUCTURES

In several power systems, the stability and sustainability of power generation and the reduction of greenhouse gas emissions are key concerns to consider. Wind power prediction, which is commonly considered to be a highly variable time sequence, plays a key role in overcoming such challenges [2]. Generally, the studies divided into four categories: physical model, conventional statistical model, spatial correlation model and artificial intelligence model [1]. The proposed wind speed forecast methods offer point

estimates of future values. In practice, the precision of point estimates can be influenced by variability in model parameters and input data. For practical applications, information on the uncertainty of forecasts is important to properly manage the energy system. [3].

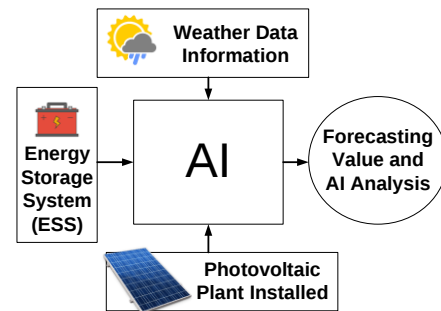


Figure 1 Modelling techniques and structure of wind speed forecasting

Artificial intelligence construction prediction model is proposed to minimize the error estimation of the wind speed condition. Variable wind speed data is used to decompose complex wind speed time series. The Recurrent Neural Network (RNN) model is designed to predict wind speed and the error. The prediction error for this model is given by weight and accumulated to obtain the width of the forecast interval.

A. Data Collection

The condition of wind speed will vary under changes in the weather situation. Voltage and current output power will change because it is influenced by wind speed. In the case of solar power generation, wind speed will determine the cloud size that affects the total solar radiation to the photovoltaic system. Besides, in the wind generation system, it will determine the rotation of the wind turbine system. The inherent variability and uncertainty affecting renewable energy sources which have a major impact on the power supply, and accuracy and reliability forecasts of the power production from renewable energy sources are required at different time scales. For this purpose, forecasting the performance of renewable energy sources is crucial for their efficient incorporation into the grid and for dealing with their uncertain and intermittent existence [3].

B. Wind Speed Forecasting

Wind prediction is complicated due to the high degree of uncertainty and variance of the wind. Windspeed is a time series that can be defined as a collection of observations of a parameter or a set of parameters taken at several time intervals. Time scale needs to be established. Wind speed forecasting in this paper is described every one hour ahead of prediction. These intervals are typically of normal duration. If the time step between data points is not compatible or data is incomplete, this should be corrected to a standard time step if the data is to be used for forecasting purposes. Real-world time series are very diverse. Some time-series data shifts slowly and reasonably smoothly. Monthly energy demand can be a sequence of periods like this. Other time series can exhibit relatively chaotic behavior, making them difficult to predict [4].

III. IMPLEMENTATION RESULT OF DEEP LEARNING MODEL FOR WIND SPEED

Comprehensive studies should be included in a systematic assessment of wind speed forecasting process, as this will improve confidence in the results. We use wind velocity datasets for solar panels located in South Korea. The data used is from January 2020 until April 2020.

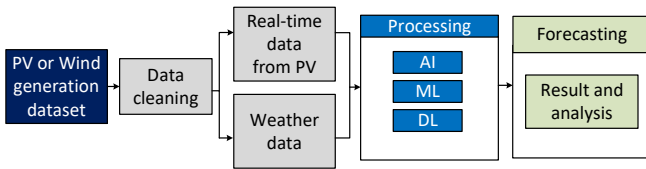


Figure 2. Wind speed prediction architecture.

This paper uses Jupyter software, which gathers the data from the renewable energy company. The algorithm obtains the precision of analytics. We can predict the value of their data in the future using the RNN algorithm by using wind speed data.

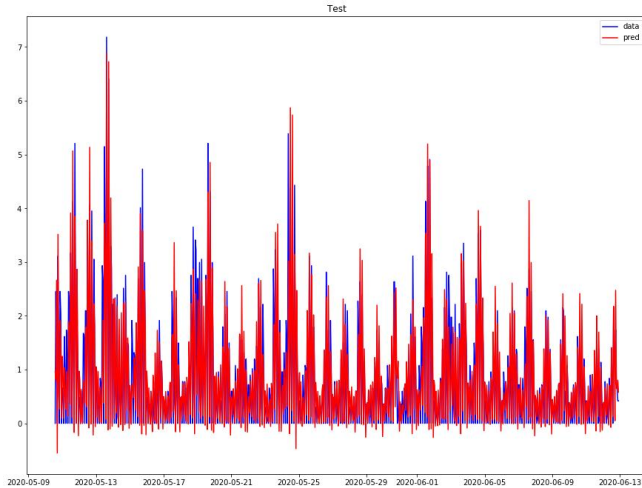


Figure 3. Wind speed predicted



Figure 4. Wind speed forecasted

IV. CONCLUSION

Implementation of the AI algorithm is presented to provide data stability, reliability, and data pattern-based interoperability. The algorithm will find the pattern of the data by using deep learning and will forecast using RNN in the next stage. This implementation can be used as the Energy Factories approach technique. Hence, in terms of electricity efficiency, we should have a reasonable maintenance plan. To give the outcome of the forecast, more reliably and effectively, structural changes were essential for this implementation. In order to offer the outcome of prediction, more reliably and accurately, sustainable improvements necessary for this study.

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