PREDICTING THE ENERGY OUTPUT OF WIND TURBINE BASED ON WEATHER CONDITION

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"Katya Vladislavleva- Predicting the Energy Output of Wind Farms Based on Weather Data: Important Variables and their Correlation-February 2013"

Wind energy plays an increasing role in the supply of energy World wide. The energy output of a wind farm is highly dependent on the weather conditions present at its site. If the output can be predicted more accurately, energy suppliers can coordinate the collaborative production of different energy sources more efficiently to avoid costly overproduction. In this paper, we take a computer science perspective on energy prediction based on weather data and analyze the important parameters as well as their correlation on the energy output. To deal with the interaction of the different parameters, we use symbolic regression based on the genetic programming tool DataModeler. Our studies are carried out on publicly available weather and energy data for a wind farm in Australia. We report on the correlation of the different variables for the energy output. The model obtained for energy prediction energy give very reliable prediction of the energy output for newly supplied weather data.

"B.Wu, Mengxuan song- Wind power prediction system for wind fram based on auto regressive statistical model and physical model-2 January 2014"

Extracting energy from renewable sources such as wind is widely investigated in the past decades to mitigate the global energy crisis and environmental pollution. For a wind farm that converts wind energy into electricity power, a real-time prediction system of the output power is significant. In this paper, a prediction system is developed with a method of combining statistical model and physical model. In this system, the inlet condition of the wind farm is forecasted by the auto regressive model. The flow field is computed by the Reynolds average Navier-stokes simulation in the computational fluid dynamics model. The wake flow is calculated by the particle model, which can be used over complex terrain. Taking also the terrain condition, the property of turbines and wake flow model into account, the output power of the wind farm can be further predicted. The proposed prediction system is tested by the data from Wattle Point Wind Farm in Australia. Through the data post-processing, the error of the mean daily output power is less than 5%. The proposed system is effective for power output prediction of wind farm.

"A.Sabitha- Identification of Potential regions for Wind Power development using data Mining-1 February 2019"

In the past decade, energy is generated largely by burning fossil fuels that lead to huge carbon emission in the environment. These fossil fuels are getting extinct and we need an alternative for fulfilling our demand. Due to the increasing power demand day by day renewable energy plays a vital role in the supply of energy worldwide. Wind energy is a clean and eco-friendly energy source. It is increasingly accepted as a major complementary energy source for securing a sustainable and clean energy in developing countries. Wind energy is an alternative source and extensive research work is being conducted to identify the potential regions for the wind sources in india. The energy output of wind farms is dependent on meteorological parameters present at that site and the essential parameter is wind speed. In this research work data mining techniques are used to identify the important meteorological parameters that influences wind power generation. The paper uses clustering algorithms to identify patterns of potential location for wind energy generation based on wind speed.

"Deepak Sangroya- Develpoment of Wind Energy in India-24 March 2015"

Wind energy has been the fastest growing renewable energy sector in India. Energy is vital for the country's economic growth and improving the life standard of its citizen. India has spent lots of resources on increasing its energy capacity since independence. As a result, country's generation capacity has increased considerably. Nevertheless, meeting growing energy needs through conventional sources such as coal, gas, etc. creates environmental problems. Hence, the government embarked on exploring new and clean energy sources. Development and promotion of these new and renewable energy sources such as wind, solar and biomass has gotten considerable attention in India, although coal and natural gas are major sources of electricity. The use of various sustainable, renewable energy technologies has been rising, as it develops rapidly and can be scaled up easily. Wind energy is a clean and eco-friendly energy source and increasingly accepted as a major complementary energy source for securing a sustainable and clean energy future in India. The Indian government has aimed to fully utilize the abundant resources of this energy, which India has. The official assessment shows this country has potential to generate over

100,000 MW of wind energy. Till May 2014, generation capacity of 21,268.3 MW has been created through wind, which places India in the fifth place globally. This paper provides a detailed description of Indian wind energy industry and discuss several developments which accelerated its growth. The paper presents current status, major achievements and future aspect of wind energy in India.

"H.Sarper- Prediction of daily Photovoltaic Energy Production using Weather Data and Regression-1 December 2021"

This paper presents linear regression models to predict the daily energy production of three photovoltaic (PV) systems located in southeast Virginia. The prediction is based on daylight duration, sky index, average relative humidity, and the presence of fog or mist. No other daily weather report components were statistically significant. The proposed method is easy to implement, and it can be used in conjunction with other advanced methods in estimating any given future day's energy production if weather prediction is available. Data from 2013 to 2015 were used in the model construction. Model validation was performed using newer (2016, 2017, 2020, and 2021) data not used in the model construction. Results show good prediction accuracy for a simple methodology, free of system parameters, that can be utilized by ordinary photovoltaic energy users. The majority of the data was collected at the Old Dominion University. The entire data set can be downloaded using the link provided.

"A.Said- Modeling Solar Still production using Local Weather data and artificial neural networks- 1 April 2012"

A study has been performed to predict solar still distillate production from single examples of two different commercial solar stills that were operated for a year and a half. The purpose of this study was to determine the effectiveness of modeling solar still distillate production using artificial neural networks (ANNs) and local weather data. The study used the principal weather variables affecting solar still performance, which are the daily total insolation, daily average wind velocity, daily average cloud cover, daily average wind direction and daily average ambient temperature. The objectives of the study were to assess the sensitivity of the ANN predictions to different combinations of input parameters as well as to determine the minimum amount of inputs necessary to accurately model solar still performance. It was found that 31–78% of ANN model predictions were within 10% of the actual yield depending on the input variables that were selected. By using the coefficient of determination, it was found that 93–97% of the variance was accounted for by the ANN model. About one half to two thirds of the available long term input data were needed to have at least 60% of the model predictions fall within 10% of the actual yield. Satisfactory results for two different solar stills suggest that, with sufficient input data, the ANN method could be extended to predict the performance of other solar still designs in different climate regimes.

"G.Martinez-Arellano-Genetic Programming for wind power Forecasting and Ramp detection-10 December 2013"

In order to incorporate large amounts of wind power into the electric grid, it is necessary to provide grid operators with wind power forecasts for the day ahead,

especially when managing extreme situations: rapid changes in power output of a wind farm. These so-called ramp events are complex and difficult to forecast. Hence, they introduce a high risk of instability to the power grid. Therefore, the development of reliable ramp prediction methods is of great interest to grid operators. Forecasting ramps for the day ahead requires wind power forecasts, which usually involve numerical weather prediction models at very high resolutions. This is resource and time consuming. This paper introduces a novel approach for short-term wind power prediction by combining the Weather Research and Forecasting—advanced Research WRF model (WRF-ARW) with genetic programming. The latter is used for the final downscaling step and as a prediction technique, estimating the total hourly power output for the day ahead at a wind farm located in Galicia, Spain. The accuracy of the predictions is above 85 % of the total power capacity of the wind farm, which is comparable to computationally more expensive state-of-the-art methods. Finally, a ramp detection algorithm is applied to the power forecast to identify the time and magnitude of possible ramp events. The proposed method clearly outperformed existing ramp prediction approaches.

"F.Cassola- Wind speed and Wind energy forecaste through calmen filtering of Numerical Weather Prediction model output- 1 November 2012"

Despite the major progress made by Numerical Weather Prediction (NWP) in the last decades, meteorological models are usually unable to provide reliable surface wind speed forecasts, especially in complex topography regions, because of shortcomings in horizontal resolution, physical parameterisations, initial and boundary conditions. In order to reduce these drawbacks, one of the most successful approaches is the Kalman filtering technique, which combines recursively observations and model forecasts to minimise the corresponding biases. In meteorology, Kalman filters are widely used to improve the prediction of variables characterised by well-defined cyclicities, whereas the evolution of wind speed is usually too irregular. In the present paper, the Kalman filter is analysed in order to find the best configuration for wind speed and wind power forecast. The procedure has been tested, in a hindcast mode, with 2-year-long data sets of wind speed provided by a NWP model and two anemometric stations located in the eastern Liguria (Italy). It is shown that, tuning time step and forecast horizon of the filter, this methodology is capable to provide significant forecast improvement with respect to the wind speed model direct output, especially when used for very short-term forecast. In this configuration, Kalman-filtered wind speed data have been used to forecast the wind energy output of the nearby wind farm of Varese Ligure. After 2 years of testing, the percentage error between simulated and measured wind energy values was still very low and showed a stable evolution.

"G.V.Drisya- Deterministic prediction of surface wind speed variations- 11 June 2014"

Accurate prediction of wind speed is an important aspect of various tasks related to wind energy management such as wind turbine predictive control and wind power scheduling. The most typical characteristic of wind speed data is its persistent temporal variations. Most of the techniques reported in the literature for prediction of wind speed and power are based on statistical methods or probabilistic distribution of wind speed data. In this paper we demonstrate that deterministic forecasting methods

can make accurate short-term predictions of wind speed using past data, at locations where the wind dynamics exhibit chaotic behaviour. The predictions are remarkably accurate up to 1 h with a normalised RMSE (root mean square error) of less than 0.02 and reasonably accurate up to 3 h with an error of less than 0.06. Repeated application of these methods at 234 different geographical locations for predicting wind speeds at 30-day intervals for 3 years reveals that the accuracy of prediction is more or less the same across all locations and time periods. Comparison of the results with f-ARIMA model predictions shows that the deterministic models with suitable parameters are capable of returning improved prediction accuracy and capturing the dynamical variations of the actual time series more faithfully. These methods are simple and computationally efficient and require only records of past data for making short-term wind speed forecasts within practically tolerable margin of errors.

"A.Hering- Powering up with Space-Time Wind Forecasting- 2 March 2010"

The technology to harvest electricity from wind energy is now advanced enough to make entire cities powered by it a reality. High-quality, short-term forecasts of wind speed are vital to making this a more reliable energy source. Gneiting et al. (2006) have introduced a model for the average wind speed two hours ahead based on both spatial and temporal information. The forecasts produced by this model are accurate, and subject to accuracy, the predictive distribution is sharp, that is, highly concentrated around its center. However, this model is split into nonunique regimes based on the wind direction at an offsite location. This paper both generalizes and improves upon this model by treating wind direction as a circular variable and including it in the model. It is robust in many experiments, such as predicting wind at other locations. We compare this with the more common approach of modeling wind speeds and directions in the Cartesian space and use a skew-*t* distribution for the errors. The quality of the predictions from all of these models can be more realistically assessed with a loss measure that depends upon the power curve relating wind speed to power output. This proposed loss measure yields more insight into the true value of each model's predictions.