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Forecast Of Wind Power Development Using On-Line Measurements From Multiple Wind Farms

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Summary

Wind power forecasts are the only way to face the uncertainties of wind energy in grid management. The common forecasts are based on wind velocity forecasts from weather services. Due to complex calculations of these models the forecasts are updated only a few times per day.

We present an approach to forecast based on on-line measurements of wind power. With data from more than 100 wind farms we are able to use their spatial distribution to gather informations about the development of moving weather systems. This leads to forecasts which are able to adapt in near realtime.

Description

The quantity of wind energy installed in Germany has reached a level of 21 GW. A majority of the installed wind farms are located near the coast, since the windspeeds are expected to be high and constant there. In some regions, this leads to a particularly big amount of wind energy which has to be integrated into the grid management. For an efficient integration the Distribution System Operators need a wind power forecast

to anticipate the development of wind power in order to get an accurate basis for their decisions.

Usually these wind power forecasts cover a time horizon of at most 72 hours. They are based on wind velocity forecasts as a result of a Numerical Weather Prediction Model provided by weather services. The underlying complex computations lead to long computation times. Therefore, the forecasts can be updated only a few times per day.

To calculate a forecast horizon of up to four hours, continuing online measurements of generated wind power, can help to improve the common forecasts. Taking these data into account leads to a systems which is able to adapt itself continually to the real developments and therefore reduces the error of the forecasts in near realtime.

In our approach we use online measurements of the power output. We forecast their further development for every wind farm individually. Therefore we take a statistical approach using methods like Artificial Neural Networks and autoregressive models to extrapolate the measurements to the next four hours. The high spatial density of the examined wind parks is used to benefit from spatial correlation effects. Different types of weather systems like cyclones produce a typical spatial pattern which is used to derive informations about the further developments in wind power production.

In this study we examine the wind energy data of over 100 wind farms from the northwest of Germany. The data have a temporal resolution of 15 minutes and cover a period of nearly two years. It is expected that these temporal and spatial high resolution data will enable us to take advantage of typical patterns of spatial development to improve the forecasts of the next hours by adapting the results to the development in near realtime.