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# A probabilistic wind power forecasting method based on NWP and Kalman filtering

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During the recent years, a substantial energy amount stems from renewable applications, including wind farms of significant spatial extent. The prosperous penetration and management of the provided power ensures power grid balance as well as the prevention of instabilities that may result to financial losses. In terms of wind power installations, remarkable advancements have been obtained over the last few years in the reduction of the estimated error of the produced power by several scientific and technical approaches. Concurrently, wind power forecasts mostly incorporate the assessment of wind speed forecasts, a meteorological variable of inherit uncertainty and intense variability. As a result, discrepancies between actual and prognostic values are unavoidable in cases of point predictions, especially over areas with complex topography. An alternative way of estimation lies in the provision of a range of values within which the observation is expected to be occurred. This encloses confidence intervals and quantification of the corresponding uncertainty for the forthcoming examined value and is defined as probabilistic forecast. This approach addresses drawbacks such as the error of point predictions, rapid alterations in observations, inadequate system response and extreme values.
This work focuses on the construction of prediction intervals of wind power using an atmospheric model and taking into account for the uncertainty enclosed in the prediction of wind speed and wind power. The development of the probabilistic forecasting methodology is based on the analysis of the deterministic prediction error. It exploits information deriving from error characteristics in terms of discrete counterparts, repeatability and forecasting efficiency. Furthermore, a non-linear Kalman filtering method in different regions of power curve is applied, in an attempt to transform non-Gaussian error distributions into Gaussian ones. This allows for generation of normally distributed random errors and the extraction of the corresponding confidence intervals. The proposed methodology is applied for a number of wind power farms and the efficiency is examined through statistical indexes of performance for probabilistic forecasting and comparison against other common methods.