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Forecasting offshore wind energy: non-linearity, non-stationarity and varying bounds

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Forecasting is of the utmost importance to the integration of renewable energy into power systems and electricity markets. Wind power fluctuations at horizons of a few minutes ahead particularly affect the system balance and are the most significant offshore. Therefore, we focus on offshore wind energy short-term forecasting.

Since forecasts characterize but do not eliminate uncertainty, they ought to be probabilistic. For short-term forecasting, statistical methods have proved to be more skilled and accurate. However, they often rely on stationary, Gaussian distributions, which are not appropriate for wind power generation. Indeed, it is a non-linear, non-stationary stochastic process that is double bounded by nature.

We extend previous works on generalized logit-normal distributions for wind energy by developing a rigorous statistical framework to estimate the full parameter vector of the distribution. To deal with non-stationarity, we derive the corresponding recursive maximum likelihood estimation and propose an algorithm that can track the parameters over time.

From the observation that bounds are always assumed to be fixed when dealing with bounded distributions, which may not be appropriate for wind power generation, we develop a new statistical framework where the upper bound can vary without being observed. In the context of stochastic processes, we address the bound as an additional parameter and propose an online algorithm that can deal with quasiconvexity.

These new methods and algorithms originate from considering wind power forecasting. However, they are of interest for a much broader range of statistical and forecasting applications, as soon as bounded variables are involved.

Type of presentation

Talk

Classification

Both methodology and application

Keywords

Stochastic processes, bounded variables, online learning

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