Probabilistic Forecasts of Solar Irradiance by Stochastic Differential Equations

Probabilistic forecasts of renewable energy production provide users with valuable information about the uncertainty associated with the expected generation. Current state-of-the-art forecasts for solar irradiance have focused on producing reliable point forecasts. The additional information included in probabilistic forecasts may be paramount for decision makers to efficiently make use of this uncertain and variable generation. In this paper, a stochastic differential equation framework for modeling the uncertainty associated with the solar irradiance point forecast is proposed. This modeling approach allows for characterizing both the interdependence structure of prediction errors of short-term solar irradiance and their predictive distribution. Three different stochastic differential equation models are first fitted to a training data set and subsequently evaluated on a one-year test set. The final model proposed is defined on a bounded and time-varying state space with zero probability almost surely of events outside this space.

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