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Short-term forecasting of renewable production trajectories at high-temporal resolution

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High temporal resolution intra-day and day-ahead renewable energy source (RES) power forecasts are important to maximize the value of RES systems because they give stakeholders the opportunity to participate in both the energy and ancillary services markets. In the realm of electricity markets, day-ahead electricity markets often require bids at hourly temporal resolution. However, the requirements for temporal resolution on intra-day markets are more demanding and may require a temporal resolution of 5 minutes in the near future.

Moreover, high resolution forecasts offer the possibility to employ advanced control strategies to mitigate severe frequency fluctuations in, for instance, island grids. More specifically, battery integration can improve power system management in isolated grids with high RES power penetration. However, battery control requires high temporal resolution forecasts.

Since the temporal dependence structure between time steps is highly relevant in control problems, there is a need to efficiently generate trajectory forecasts that can be used in stochastic optimisation problems. This study proposes an efficient method to generate trajectory forecasts of RES power production that is based on pattern matching. Consequently, we do not need to forecast all forecast horizons separately and estimate a covariance matrix that represents the dependence structure between the forecast horizons. To compare our method against the state-of-the-art, we use quantile regression forests in combination with a Gaussian copula and show that our method performs similar in terms of relevant scores but is approximately 98% faster and simplifies the modelling chain considerably.

The proposed method is evaluated on real data from operating renewable sites in an isolated power system. Considering its fast computation and its applicability to diverse situations (different energy sources, individual sites or aggregated production), the method has the potential to be integrated into the decision-making process of forecasting end-users such as operators of power systems under high renewable penetration.