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Track: WIND RESOURCE Topic: WIN03 Prediction systems

IMPROVING PHYSICAL WIND POWER FORECASTS WITH RECURRENT OR DEEP NEURAL NETWORKS

We have developed an operational system that substitutes a state-of-the-art model output statistics (MOS) estimator with a recurrent neural network (RNN) receiving the same predictors. These are in turn produced by a well-established physical interpolation scheme, that takes as input several numerical weather forecasts as well as a large number of ground stations and existing wind power plants. This way, we ensure a maximum of physical domain knowledge is used for the prediction, while at the same time compensating for any shortcomings of the physical models through a powerful sequence modelling tool, namely RNNs. Predictors are provided on several regional aggregation scales to enable the internal modelling of large and small scale weather patterns.

As an additional benefit, our RNNs are capable of not only producing point forecasts, but accurately estimating the expected accuracy of the forecast in the form of either a single standard error, or a sophisticated, multimodal conditional probability density function of power output. This is made possible by data mining a large data set of historical power and wind measurements.

Current validation results for the German control areas suggest that the RNNs are capable of reducing the normalized RMSE by about 1%-2%, more or less independent of the forecast horizon (up to 120 hrs). This compares to < 0.5% in case of using MOS. We are currently refining this very promising method to predict smaller areas or even single turbines, and to take more diverse input data into account.