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Abstract

Time series for wind power density forecasting

Introduction

High fluctuations in the speed of the wind make it difficult to prediction of electric power connected to the network. Different types of time series are frequently used to predict day-ahead wind speed. The Box-Jenkins method requires that the series is stationary in the mean, variance and autocovariance. Method combines the autoregressive and moving average parameters to produce a comprehensive model skilled for forecasting. Unfortunately, the series of wind speed can rarely adhere to this due to its intrinsic complexity and volatility so it will be necessary to carry out previous transformations.

Approach

The purpose of this study is to evaluate the use of different time series models to prediction of daily wind power density in coming days. Different approaches based on autoregressive moving average (ARMA) method are employed for this goal.

Main body of abstract

This work summarizes the results of the prediction in Galicia (Spain), at five meteorological stations located in the Atlantic coast. We used the observations recorded every 10 minutes from the wind speed for 5 years by anemometers located 10 m. The collected data has been corrected to a height of 100 m using the power law profile with an exponent calculated as a function of speed and height.

Different models of time series were constructed, seasonal and non-seasonal, with three y six months, but also with one and to five years of data. The choice of this time interval is important and determined the results achieved because it particularly seriously affect the stochastic properties of the series.

By the steps of identification, validation and prediction, different time series models are constructed and their coefficients are calculated. The coefficients of the ARMA model were estimated by minimization of the sum of squared errors and residuals obtained from the prediction are evaluated.

Box–Ljung Q statistic test allow assess autocorrelations and partial autocorrelations of the series. In the validation phase were chosen models they had lower Bayesian information criterion (BIC) and in the step prediction the results are compared using the mean absolute error (MAE) and root mean square error (RMSE) as a measure for forecasting quality. The forecast errors in power density are analyzed and compared with the persistence model.

Conclusion

ARMA time series models provide a useful tool to predict the wind power density in the following days. We have observed the complexity and the difficulty of achieving a good fit in the predictions so a correct selection of the model and input data interval is required for meaningful verification.

Learning objectives

- Assess the possibilities of short-term prediction of the power density by using different ARMA time series
- Visualize power density time series models
- Compare the efficiency of different types of time series
- Reduce wind assessment uncertainty, thanks to ARMA models