Julija Tastu - DTU Orbit (25/12/2017)

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Organisations

PhD Student, Department of Applied Mathematics and Computer Science
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Dynamical Systems
18/02/2013 → 22/01/2015 Former
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Mathematical Statistics
25/02/2012 → 18/02/2013 Former
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Publications:

Discussion of "Prediction intervals for short-term wind farm generation forecasts" and "Combined nonparametric prediction intervals for wind power generation"
A new score for the evaluation of interval forecasts, the so-called coverage width-based criterion (CWC), was proposed and utilized. This score has been used for the tuning (in-sample) and genuine evaluation (out-of-sample) of prediction intervals for various applications, e.g., electric load [1], electricity prices [2], general purpose prediction [3], and wind power generation [4], [5]. Indeed, two papers by the same authors appearing in the IEEE Transactions On Sustainable Energy employ that score and use it to conclude on the comparative quality of alternative approaches to interval forecasting of wind power generation.

General information
State: Published
Organisations: Department of Electrical Engineering, Center for Electric Power and Energy, Electricity markets and energy analytics, Department of Applied Mathematics and Computer Science, Dynamical Systems
Authors: Pinson, P. (Intern), Tastu, J. (Intern)
Pages: 1019-1020
Publication date: 2014
Main Research Area: Technical/natural sciences

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Web of Science (2016): Indexed yes
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 2.972 SNIP 3.954 CiteScore 7.03
Web of Science (2014): Indexed yes
Probabilistic forecasts of wind power generation accounting for geographically dispersed information

Forecasts of wind power generation in their probabilistic form are a necessary input to decision-making problems for reliable and economic power systems operations in a smart grid context. Thanks to the wealth of spatially distributed data, also of high temporal resolution, such forecasts may be optimized by accounting for spatio-temporal effects that are so far merely considered. The way these effects may be included in relevant models is described for the case of both parametric and nonparametric approaches to generating probabilistic forecasts. The resulting predictions are evaluated on the real-world test case of a large offshore wind farm in Denmark (Nysted, 165 MW), where a portfolio of 19 other wind farms is seen as a set of geographically distributed sensors, for lead times between 15 minutes and 8 hours. Forecast improvements are shown to mainly come from the spatio-temporal correction of the first order moments of predictive densities. The best performing approach, based on adaptive quantile regression, using spatially corrected point forecasts as input, consistently outperforms the state-of-the-art benchmark based on local information only, by 1.5%-4.6%, depending upon the lead time.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Dynamical Systems, Department of Electrical Engineering, Center for Electric Power and Energy
Authors: Tastu, J. (Intern), Pinson, P. (Intern), Trombe, P. (Intern), Madsen, H. (Intern)
Pages: 480-489
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
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BFI (2015): BFI-level 1
Scopus rating (2015): SJR 3.785 SNIP 4.142 CiteScore 8.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 3.105 SNIP 3.799 CiteScore 7.77
Web of Science (2014): Indexed yes
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Scopus rating (2013): SJR 3.175 SNIP 4.831 CiteScore 9.88
Discrimination ability of the Energy score

Research on generating and verification of multivariate probabilistic forecasts has gained increased interest over the last few years. Emphasis is placed here on the evaluation of forecast quality with the Energy score, which is based on a quadratic scoring rule. While this score may be seen as appealing since being proper, we show that its discrimination ability may be limited when focusing on the dependence structure of multivariate probabilistic forecasts. For the case of multivariate Gaussian process, a theoretical upper for such discrimination ability is derived and discussed. This limited discrimination ability may eventually get compromised by computational and sampling issues, as dimension increases.

Short-term wind power forecasting: probabilistic and space-time aspects

Optimal integration of wind energy into power systems calls for high quality wind power predictions. State-of-the-art forecasting systems typically provide forecasts for every location individually, without taking into account information coming from the neighbouring territories. It is however intuitively expected that owing to the inertia in meteorological systems such local approach to power forecasting is sub-optimal. Indeed, errors in meteorological forecasts might translate to fronts of imbalances, i.e. taking the form of a band of forecast errors propagating across entire regions.

My research work deals with the proposal and evaluation of new mathematical models and forecasting methods for short-term wind power forecasting, accounting for space-time dynamics based on geographically distributed information. Different forms of power predictions are considered, starting from traditional point forecasts, then extending to marginal predictive densities and, finally, considering multivariate space-time trajectories.

Point predictions is the most classical approach to wind power forecasting, only providing single-valued estimates of the expected future power generation. The objective is to introduce a statistical model which would improve the quality of state-of-the-art prediction methods by accounting for the fact that forecasts errors made by such locally-optimized
forecasting methods propagate in space and in time under the influence of prevailing weather conditions.

Subsequently, the extension from point to probabilistic forecasts is dealt with, hence requiring to describe the uncertainty associated with the point predictions previously generated. Both parametric and non-parametric approaches to forming predictive densities are considered, while ways to include space-time effects into the corresponding models are analysed.

As a final step, emphasis is placed on generating space-time trajectories: this calls for the prediction of joint multivariate predictive densities describing wind power generation at a number of distributed locations and for a number of successive lead times.

In addition to new improved approaches to wind power forecasting, a part of the research is devoted to problems related to the assessment of high-dimensional (multivariate) probabilistic forecasts.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Dynamical Systems, Department of Electrical Engineering, Center for Electric Power and Energy
Authors: Tastu, J. (Intern), Madsen, H. (Intern), Pinson, P. (Intern)
Number of pages: 289
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Main Research Area: Technical/natural sciences
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Thesis.pdf
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Space-time scenarios of wind power generation produced using a Gaussian copula with parametrized precision matrix
The emphasis in this work is placed on generating space-time trajectories (also referred to as scenarios) of wind power generation. This calls for prediction of multivariate densities describing wind power generation at a number of distributed locations and for a number of successive lead times. A modelling approach taking advantage of sparsity of precision matrices is introduced for the description of the underlying space-time dependence structure. The proposed parametrization of the dependence structure accounts for such important process characteristics as non-constant conditional precisions and direction-dependent cross-correlations. Accounting for the space-time effects is shown to be crucial for generating high quality scenarios.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Dynamical Systems, Department of Electrical Engineering, Center for Electric Power and Energy
Authors: Tastu, J. (Intern), Pinson, P. (Intern), Madsen, H. (Intern)
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Wind energy, Scenarios, Trajectories, Space-time, Precision matrix, Directional CAR
Electronic versions:
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Publication: Research › Report – Annual report year: 2013
Spatio-temporal analysis and modeling of short-term wind power forecast errors

Forecasts of wind power production are increasingly being used in various management tasks. So far, such forecasts and related uncertainty information have usually been generated individually for a given site of interest (either a wind farm or a group of wind farms), without properly accounting for the spatio-temporal dependencies observed in the wind generation field. However, it is intuitively expected that, owing to the inertia of meteorological forecasting systems, a forecast error made at a given point in space and time will be related to forecast errors at other points in space in the following period. The existence of such underlying correlation patterns is demonstrated and analyzed in this paper, considering the case-study of western Denmark. The effects of prevailing wind speed and direction on autocorrelation and cross-correlation patterns are thoroughly described. For a flat terrain region of small size like western Denmark, significant correlation between the various zones is observed for time delays up to 5 h. Wind direction is shown to play a crucial role, while the effect of wind speed is more complex. Nonlinear models permitting capture of the interdependence structure of wind power forecast errors are proposed, and their ability to mimic this structure is discussed. The best performing model is shown to explain 54% of the variations of the forecast errors observed for the individual forecasts used today. Even though focus is on 1-h-ahead forecast errors and on western Denmark only, the methodology proposed may be similarly tested on the cases of further look-ahead times, larger areas, or more complex topographies. Such generalization may not be straightforward. While the results presented here comprise a first step only, the revealed error propagation principles may be seen as a basis for future related work.

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Tastu, J. (Intern), Pinson, P. (Intern), Kotwa, E. (Intern), Madsen, H. (Intern), Nielsen, H. A. (Intern)
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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.196 SNIP 2.086 CiteScore 3.06
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.272 SNIP 3.75 CiteScore 3.42
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.275 SNIP 2.464 CiteScore 2.75
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Scopus rating (2012): SJR 1.126 SNIP 2.39 CiteScore 2.36
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.024 SNIP 2.718 CiteScore 2.49
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.487 SNIP 2.013
Spatio-temporal correction of DONG forecast errors

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Thomsen, S. C. (Intern), Otterson, S. (Intern), Tastu, J. (Intern), Madsen, H. (Intern)
Publication date: 2011

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: DTU Informatics, Building 305
Original language: English
Series: IMM-Technical Report-2011-09
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 276988
Publication: Research › Report – Annual report year: 2011

Spatio-temporal correction targeting Nysted Offshore. Probabilistic forecasts
This report concerns probabilistic forecasts for Nysted Offshore. Different approaches for issuing predictive densities are studied, discussed in details and compared. The results show that the spatial correction of the first order moments of the predictive densities improves the quality of the corresponding forecasts. The spatial correction of the higher order moments is shown to be unnecessary as does not bring any additional amelioration. The best performing of the studied models is based on the adaptive quantile regression using the spatially corrected point predictions as input. This model is shown to outperform the benchmark approach in terms of the CRPS score (accuracy measure) by 1.5%-8.29% depending on the considered prediction horizon.

General information
State: Published
Multivariate conditional parametric models for a spatio-temporal analysis of short-term wind power forecast errors

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Tastu, J. (Intern), Pinson, P. (Intern), Madsen, H. (Intern)
Publication date: 2010

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Conference: 2010 European Wind Energy Conference and Exhibition, Warsaw, Poland, 20/04/2010 - 20/04/2010
Source: orbit
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2010

Spatio-temporal modeling of wind power prediction errors

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Vlasova, J. (Intern), Kotwa, E. (Intern), Nielsen, H. A. O. T. 3. (Intern), Madsen, H. (Intern), Pinson, P. (Intern)
Publication date: 2008

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Title of host publication: Proceedings of the European Wind Energy Conference 2008
Main Research Area: Technical/natural sciences
Conference: 2008 European Wind Energy Conference and Exhibition, Brussels, Belgium, 31/03/2008 - 31/03/2008
Source: orbit
Source-ID: 223278
Publication: Research › Article in proceedings – Annual report year: 2008

Spatio-temporal modelling of short-term wind power prediction errors: 02004/FU5766 - Improved wind power prediction

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Vlasova, J. (Intern), Kotwa, E. (Intern), Nielsen, H. A. (Intern), Madsen, H. (Intern)
Publication date: 2007

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Department of Informatics and Mathematical Modeling  
Period: 01/08/2007 → 12/12/2013  
Number of participants: 6  
Phd Student:  
Tastu, Julija (Intern)  
Supervisor:  
Pinson, Pierre (Intern)  
Main Supervisor:  
Madsen, Henrik (Intern)  
Examiner:  
Poulsen, Niels Kjølstad (Intern)  
Kariniotakis, George (Ekstern)  
Lindström, Erik (Ekstern)

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