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Larger scales of wind speeds

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For the simulation of power fluctuations from wind farms, the power spectral density of the wind speed in a single point, and the coherence between two points in the same height but with different horizontal coordinates are estimated based on wind measurements on Risø's test station for large wind turbines in Høvsøre, Denmark.

A major issue in the control and stability of electric power systems is to maintain the balance between generated and consumed power. Because of the fluctuating nature of wind speeds, the increasing use of wind turbines for power generation has caused more focus on the fluctuations in the power production of the wind turbines, especially when the wind turbines are concentrated geographically in large wind farms.

An example of this is observations of the Danish Transmission System Operator (TSO). Based on measurements of power fluctuations from the 160 MW offshore wind farm Horns Rev in Western Denmark, the Danish TSO has found that the fluctuating nature of wind power introduces several challenges to reliable operation of the power system in Western Denmark, and also that the wind power contributes to deviations in the planned power exchange with the central European (UCTE) power system, see Akhmatov et. al. [1]. It was also observed that the time scale of the power fluctuations was from tens of minutes to several hours.

A model for simulation of simultaneous wind speed fluctuations in many points – corresponding to many wind turbines – with different horizontal coordinates has been developed by Sørensen et. al [2] and implemented in the software program PARKWIND.

The model used in PARKWIND is based on power spectral density (PSD) of the wind speed in a single point, and the coherence between wind speeds in two points. The

purpose of the present work has been to assess the presently used PSD and coherence functions.

For that purpose, wind measurements on Risø's test site for large wind turbines in Høvsøre, Denmark have been used. Simultaneous measurements from 4 met masts in 78-80 m height and with distances up to 1228 m are used. The measured PSDs are compared to the conventional Kaimal spectrum [3], and the measured coherences are compared to suggestions by Schlez and Infield [4].

References

1. V. Akhmatov, J. P. Kjaergaard, H. Abildgaard. Announcement of the large offshore wind farm Horns Rev B and experience from prior projects in Denmark. European Wind Energy Conference, EWEC 2004. London. November 2004.

2. P. Sørensen, A. D. Hansen, P. A. C. Rosas. Wind models for simulation of power fluctuations from wind farms. J. Wind Eng. Ind. Aerodyn. (2002) (no.90) , 1381-1402.

3. J.C. Kaimal, J.C. Wyngaard, Y. Izumi, O.R. Coté. Spectral characteristics of surface layer turbulence. Q. J. R. Meteorol. Soc. 98 (1972) 563–598.

4. W. Schlez and D. Infield. Horizontal, two point coherence for separations greater than the measurement height. Boundary-Layer Meteorology 87. Kluwer Academic Publishers, Netherlands 1998. pp.459-480.