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Multifractal and local correlation of simultaneous wind speed-power output from a single wind trubine

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The wind energy production is a nonlinear and no stationary resource, due to the intermittent statistics of atmospheric wind speed at all spatial and temporal scales ranging from large scale variations to very short scale variations. Recently, Rudy et al.[1] observed the intermittent and multifractal properties of wind energy production. Classically, IEC standard 4100 is used by the wind energy community, for modeling the interactions of wind speed with the wind turbine. However, this model reflects gaussian statistics contrary to observed wind and energy production measurements. Modeling of power curve of a single wind turbine remains a challenge. The precise understanding of the dynamics of nonlinear power curve over very short time scales, is necessary.
Hence, multifractal cross-correlation methods such as Generalized Correlations Exponents (GCE), multifractal detrended cross-correlation analysis (MFXDFA), multifractal detrending moving average cross-correlation analysis (MFXDMA) are applied to simultaneous wind speed power output from a single wind turbine to determine the nature of scaling correlation behavior. Furthermore, in order to detect eventual local correlation, an application of empirical mode decomposition based on time dependent intrinsic correlation to simultaneous measurements is performed.
The simultaneous wind speed-power output measurements are recorded continuously with a sampling rate $f = 1Hz$, during 115 days in 2006. The wind speed measurements are obtained at 31 m above the ground, and the power output is delivered by 500 kW Nordtank wind turbine positionned at the Technical University, Risœ, Denmark.

References

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