A Probabilistic Assessment Approach for Wind Turbine-Site Matching

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Mots-clés	Probabilistic performance assessment [5], Random wind conditions [6], Wind turbine performance [7], Wind turbine-site matching [8]
Résumé en anglais	This article provides a new methodology for wind turbine-site matching by using a probabilistic approach. The random behavior of the wind speed climate and the uncertainties of wind turbine characteristics are important to take into account in models used to evaluate the performance of the wind turbine. The proposed formulation of the wind turbine-site matching is derived based on the probabilistic reliability assessment approach. It was experimented using different power curve approximation models, for different random conditions, using time series of wind speed in two sites in Morocco: Dakhla and Essaouira. A comparison based on methods used in literature for the estimation of two-parameter of the Weibull function to fit the wind speed distribution is also carried out. The results revealed that the introduced performance indicators are less sensitive to the models used to approximate the wind power curves compared to the deterministic conventional indicator that leads to different rankings and problems of over-sizing or under-sizing. However, those performance indicators are more sensitive to the variation of the wind speed distribution parameter's and can help on accurately estimate the wind power. Moreover, the proposed formulation allows a global sensitivity analysis using Sobol's indices to observe the influence of each input parameter on the observed variances of the performance of a wind turbine. A numerical application illustrates the interpretation of sensitivity indices and shows the impact of the wind speed and the rated wind speed on the variance of the wind turbine performance. This method can help wind energy developers and manufacturers to optimally select WTGs for their future project and accurately forecast the performance of their WTGs for monitoring and maintenance scheduling under uncertainty.
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