applied sciences

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Editorial

Special Issue on "Wind Energy Conversion Systems"

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Received: 27 May 2019; Accepted: 4 June 2019; Published: 9 August 2019

Abstract: A single paragraph of about 200 words maximum. For research articles, abstracts should give a pertinent overview of the work. We strongly encourage authors to use the following style of structured abstracts, but without headings: (1) Background: place the question addressed in a broad context and highlight the purpose of the study; (2) Methods: describe briefly the main methods or treatments applied; (3) Results: summarize the article's main findings; and (4) Conclusions: indicate the main conclusions or interpretations. The abstract should be an objective representation of the article; it must not contain results that are not presented and substantiated in the main text and should not exaggerate the main conclusions.

Wind energy is currently the most competitive renewable energy resource, and it has experienced a rapid increase. The installed capacity of wind turbines worldwide reached 600 GW by the end of 2018. China, by far the largest wind turbine market, installed 25.9 GW in 2018, reaching a total accumulated wind turbine capacity of 221 GW. The USA added 7.6 GW in 2018, reaching a total wind turbine capacity of 96 GW. Many other countries also showed substantial growth, such as Germany, India, United Kingdom, Brazil, and France [1]. EU-28 has a total installed capacity of 178.8 GW. Wind power is the second largest form of electricity generation capacity in the EU-28, and it is likely to overtake natural gas installations in 2019. Wind energy covered 14% of EU electricity demand in 2018 [2].

Wind power technology as a commercialized energy conversion technology covers many disciplines, and large-scale wind power plants are being developed both onshore and offshore worldwide. However, wind power technology still faces many challenges. To further reduce the levelized cost of wind energy, increase reliability, and support power grid operation and control [3,4], research efforts to address various challenges of wind power technology are still very active.

This Special Issue presents some research on wind power technology to highlight the most recent wind power research activities. Ten papers have been selected for this Special Issue, which are related to a number of important topics of wind energy application, including the wind power industry value chain, wind turbine systems, wind farm operation and control, wind speed forecast, and wind power in power systems.

1. Wind Power Industry Value Chain

The quick and large-scale development and deployment of wind turbines and wind power plants around the world is significantly influencing not only the energy generation and utilization sectors but also related industries and society. The review paper, "*Overview of Wind Power Industry Value Chain Using Diamond Model: A Case Study from China*" [5], presents a value chain model and uses the model to analyze the factors that significantly influence the wind power industry. The Chinese wind power industry has been taken as an example for the illustration.

2. Wind Turbine Systems

There are four papers dealing with various aspects of the wind turbine systems; they are, respectively, related to system design, control system upgrade, wind turbine power curve representation, as well as a hydraulic wind turbine with an energy storage system. The paper "*Predicting the Extreme*

Loads in Power Production of Large Wind Turbines Using an Improved PSO Algorithm" [6] proposed a simplified method to assess the extreme loads of a wind turbine, which could predict the extreme loads for the preliminary-design of large-scale wind turbine blade. The method uses the optimisation method to treat extreme loads with rotor speed, wind speed, pitch angle, yaw angle, and azimuth angle as design variables. The impacts of these design variables are explored, which could provide useful information for wind turbine design and operation. In the paper "*Numerical and Experimental Methods for the Assessment of Wind Turbine Control Upgrades*" [7], the impacts of wind turbine control system upgrade have been studied numerically with operational data; it may be used as a tool to evaluate the cost effectiveness of wind turbine control system improvement. The paper "*Wind Turbine Power Curves Based on the Weibull Cumulative Distribution Function*" has discussed the representation of a wind turbine power curve by means of the cumulative distribution function (CDF) of a Weibull distribution [8]. The Weibull functions are used to represent the relationship between wind speed and wind power, and therefore for modelling the wind turbine power characteristic. The paper "*Modeling and Control of a 600 kW Closed Hydraulic Wind Turbine with an Energy Storage System*" [9] proposed a hydraulic wind turbine with an energy storage system, which consists of a wind rotor, a variable pump, a hydraulic bladder accumulator, and a synchronous generator. The hydraulic bladder accumulator functions as an energy storage system to store and release energy for smoothing the fluctuations of wind power. A control scheme has been presented to operate the wind rotor at the optimal aerodynamic condition under varying wind speeds, while the wind generator keeps the synchronous-speed-to-product-constant-frequency electrical power.

3. Wind Farm Design and Control

Two papers related to wind farms have been included. The paper "*Variable-Constrained Model Predictive Control of Coordinated Active Power Distribution for Wind-Turbine Cluster*" [10] proposes a wind-turbine active power control strategy for a wind turbine cluster to optimize the active power set-point for each wind turbine. A power tracking predictive model and the model predictive control (MPC) method is used to optimize the power output of the wind farm. The paper "*Minimizing the Energy Cost of Offshore Wind Farms by Simultaneously Optimizing Wind Turbines and Their Layout*" [11] proposes a method to minimize the energy cost of offshore wind farms by simultaneously optimizing the rated wind speed and the rotor radius of the wind turbines and the layout. The method could be used for selecting wind turbines and designing the wind farm layout. Case studies have been presented to demonstrate the proposed method.

4. Wind Power Forecast

The paper "*Wind Power Short-Term Prediction Based on LSTM and Discrete Wavelet Transform*" presents a wind power short-term forecasting method based on discrete wavelet transform and long short-term memory networks (DWT_LSTM) [12]. The discrete wavelet transform has been used to decompose the non-stationary wind power time series into several more stationarity components which are easier to predict. Each of the decomposed components is associated with an independent LSTM to represent the dynamic behaviour of the wind power time series.

5. Power System Operation

Two papers are related to the wind power operation in power systems. Large-scale wind power integration has changed the power system inertia and could affect the system frequency control and stability. The paper "*Inertia Estimation of Wind Power Plants Based on the Swing Equation and Phasor Measurement Units*" [13] presents a method for the inertia estimation of wind power plants based on the swing equation and phasor measurement units (PMUs). The proposed method has been applied to the case study of a power system with large-scale penetration of wind power plants. The paper "*Congestion Risk-Averse Stochastic Unit Commitment with Transmission Reserves in Wind-Thermal Power Systems*" [14] presents a risk-averse stochastic unit commitment model considering transmission reserves to flexibly manage uncertainty-induced congestion. The key statistical features of line flows and the spatial correlation between wind farms have been taken into account.

In summary, this Special Issue presents some research activities in the fast growing wind energy field, covering various aspects of wind power technology. The collection of 10 papers is believed to benefit readers and contribute to the wind power industry.

Acknowledgments: The Editor would like to thank all authors, the many dedicated referees, the editor team of *Applied Sciences* for their valuable contributions and for making this Special Issue a success.

Conflicts of Interest: The author declare no conflict of interest.

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