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B2: Wind, Wave and Tidal Energy

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Section Editor-in-Chief

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About the section *B2: Wind, Wave and Tidal Energy*

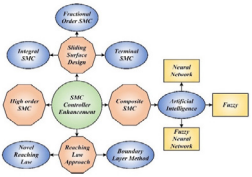
Wind, wave and tidal energy—commonly recognized as clean and environmentally friendly renewable energy resources—are becoming more commonplace, as the fraction of energy from renewable resources continues to increase. Nevertheless, significant challenges remain in reducing the levelized cost of energy for renewable technologies, particularly nascent technologies, such as wave and tidal. Also, as wind moves offshore, with both fixed and floating options, there is further opportunity to combine wind with wave and/or tidal. This Section aims to include contributions across the spectrum of scientific and engineering disciplines concerned with the development of wind, wave and tidal renewable technologies, from fundamental device development/design, supporting technologies (control, condition monitoring, etc.), power conversion, to grid integration and associated storage technologies. Studies on hybrid systems (combined wind/wave/tidal) are particularly encouraged, as are novel applications (apart from electricity production), including potable water production, amongst others.

Content Highlights

DOI:10.3390/en13123132

Using SCADA Data for Wind Turbine Condition Monitoring: A Systematic Literature Review

Authors: Jorge Maldonado-Correa, Sergio Martín-Martínez, Estefanía Artigao and Emilio Gómez-Lázaro



Abstract: Operation and maintenance (O&M) activities represent a significant share of the total expenditure of a wind farm. Of these expenses, costs associated with unexpected failures account for the highest percentage. Therefore, it is clear that early detection of wind turbine (WT) failures, which can be achieved through appropriate condition monitoring (CM), is critical to reduce O&M costs. The use of Supervisory Control and Data Acquisition (SCADA) data has recently been recognized as an effective solution for CM since most modern WTs record large amounts of parameters using their SCADA systems. Artificial intelligence (AI) techniques can convert SCADA data into information that can be used for early detection of WT failures. This work presents a systematic literature review (SLR) with the aim to assess the use of SCADA data and AI for CM of WTs. To this end, we formulated four research questions as follows: (i) What are the current challenges of WT CM? (ii) What are the WT components to which CM has been applied? (iii) What are the SCADA variables used? and (iv) What AI techniques are currently under research? Further to answering the research questions, we identify the lack of accessible WT SCADA data towards research and the need for its standardization. Our SLR was developed by reviewing more than 95 scientific articles published in the last three years.

DOI:10.3390/en13092158

A Super Twisting Fractional Order Terminal Sliding Mode Control for DFIG-Based Wind Energy Conversion System

Authors: Irfan Sami, Shafaat Ullah, Zahoor Ali, Nasim Ullah and Jong-Suk Ro

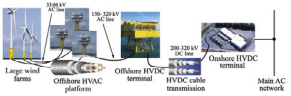
Abstract: The doubly fed induction generator (DFIG)-based wind energy conversion systems (WECSs) are prone to certain uncertainties, nonlinearities, and external disturbances. The maximum power transfer from WECS to the utility grid system requires a high-performance control system in the presence of such nonlinearities and disturbances. This paper presents a nonlinear robust chattering free super twisting fractional order terminal sliding mode control (ST-FOTSMC) strategy for both the grid side and rotor side converters of 2 MW DFIG-WECS. The Lyapunov stability theory was used to ensure the stability of the proposed closed-loop control system. The performance of the proposed control paradigm is validated using extensive numerical simulations carried out in MATLAB/Simulink environment. A detailed comparative analysis of the proposed strategy is presented with the benchmark sliding mode control (SMC) and fractional order terminal sliding mode control (FOTSMC) strategies. The proposed control scheme was found to exhibit superior performance to both the stated strategies under normal mode of operation as well as under lumped parametric uncertainties.

DOI:10.3390/en13040807

An Improved LightGBM Algorithm for Online Fault Detection of Wind Turbine Gearboxes

Authors: Mingzhu Tang, Qi Zhao, Steven X. Ding, Huawei Wu, Linlin Li, Wen Long and Bin Huang

Abstract: It is widely accepted that conventional boost algorithms are of low efficiency and accuracy in dealing with big data collected from wind turbine operations. To address this issue, this paper is devoted to the application of an adaptive LightGBM method for wind turbine fault detections. To this end, the realization of feature selection for fault detection is firstly achieved by utilizing the maximum information coefficient to analyze the correlation among features in supervisory control and data acquisition (SCADA) of wind turbines. After that, a performance evaluation criterion is proposed for the improved LightGBM model to support fault detections. In this scheme, by embedding the confusion matrix as a performance indicator, an improved LightGBM fault detection approach is then developed. Based on the adaptive LightGBM fault detection model, a fault detection strategy for wind turbine gearboxes is investigated. To demonstrate the applications of the proposed algorithms and methods, a case study with a three-year SCADA dataset obtained from a wind farm sited in Southern China is conducted. Results indicate that the proposed approaches established a fault detection framework of wind turbine systems with either lower false alarm rate or lower missing detection rate.



DOI:10.3390/en13081914

Evolution of the HVDC Link Connecting Offshore Wind Farms to Onshore Power Systems

Authors: Roland Ryndzionek and Łukasz Sienkiewicz

Abstract: This paper presents an overview of the DC link development and evolution dedicated to HVDC structure for connecting offshore wind power plants to onshore power systems. The growing demand for the green energy has forced investors in power industry to look for resources further out at sea. Hence, the development of power electronics and industrial engineering has enabled offshore wind farms to be situated further from the shore and in deeper waters. However, their development will require, among other technologies, DC-DC conversion systems. The advantages of HVDC over HVAC technology in relation to transmission distance are given. The different HVDC configurations and topologies of HVDC converters are elucidated. In this context, the HVDC grids are a promising alternative for the expansion of the existing AC grid.

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Deadline: **1 April 2022**

Combined Wind-Wave Energy
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Deadline: **30 April 2022**

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Deadline: **10 May 2022**

Advanced Online Condition Monitoring for Wind and Marine Energy Conversion Systems
Guest Editors: Dr. Shahin Hedayati Kia and Prof. Dr. Hubert Razik
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