Special Issue List in Section

Climate Variability and Renewable Energy: Impact on Resources, Demand and Transition Road
Guest Editors: Dr. Elena García-Bustamante; Dr. Cristobal Gallego-Castillo
Deadline: **10 August 2022**

Advances in Pumped Storage Hydraulic System
Guest Editors: Dr. Deyou Li; Dr. Zhigang Zuo; Prof. Dr. Pengcheng Guo; Prof. Dr. Yongguang CHENG
Deadline: **15 August 2022**

Hydropower in the East European Region: Challenges and Opportunities
Guest Editors: Dr. Janusz Steller; Prof. Petras Punys
Deadline: **30 August 2022**

Recent Advances in Offshore Wind Turbines
Guest Editors: Dr. Maurizio Collu; Prof. Dr. Liang Li
Deadline: **20 October 2022**

Wind Turbine Advances
Guest Editors: Dr. Alessio Castorrini; Dr. Paolo Venturini
Deadline: **31 August 2022**

Solar PV and Wind Energy Systems for Energy Transition
Guest Editors: Prof. Dr. Olimpo Anaya-Lara; Dr. Ayman Attya; Dr. José Luis Domínguez-García
Deadline: **31 August 2022**

Advances in Wind Energy Control
Guest Editors: Dr. David Campos-Gaona; Dr. Hong Yue
Deadline: **15 September 2022**

Trends and Innovations in Wind Power Systems
Guest Editors: Prof. Dr. Mircea Neagoe; Prof. Dr. Radu Săulescu; Prof. Dr. Codruta Jaliu
Deadline: **20 September 2022**

Airborne Wind Energy Systems
Guest Editors: Prof. Dr. Christoph M. Hackl; Dr. Roland Schmehl
Deadline: **1 November 2022**

Advances in Wind Energy and Wind Turbines
Guest Editor: Prof. Dr. Paweł Ligęza
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Wind, Wave and Tidal Energy

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Section Information

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.

Principal topic areas of this Section are listed below. This list is neither exhaustive nor exclusive:

- Wind, Wave and Tidal Devices (Converters and Other Components);
- Resource Assessment Techniques;
- Power Generation;
- Operations and Maintenance;
- Other Related Hybrid and Autonomous Systems.

Section Wind, Wave and Tidal Energy

Feature Papers

DOI: 10.3390/en13123132

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

Jorge Maldonado-Correa; Sergio Martín-Martínez; Sergio Martín-Martínez; EmilioGómez-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/en13040807

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

Mingzhu Tang; Qi Zhao; Steven X. Ding; Huawei Wu; Linlin Li; Wen Long; 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.

Feature Papers

DOI: 10.3390/en13123063

An Assessment of Onshore and Offshore Wind Energy Potential in India Using Moth Flame Optimization

Krishnamoorthy R; Udhayakumar K; Kannadasan Raju; Rajvikram Madurai Elavarasan; Lucian Mihet-Popa

Abstract: Wind energy is one of the supremely renewable energy sources and has been widely established worldwide. Due to strong seasonal variations in the wind resource, accurate predictions of wind resource assessment and appropriate wind speed distribution models (for any location) are the significant facets for planning and commissioning wind farms. In this work, the wind characteristics and wind potential assessment of onshore, offshore, and nearshore locations of India—particularly Kayathar in Tamilnadu, the Gulf of Khambhat, and Jafrabad in Gujarat—are statistically analyzed with wind distribution methods. Further, the resource assessments are carried out using Weibull, Rayleigh, gamma, Nakagami, generalized extreme value (GEV), lognormal, inverse Gaussian, Rician, Birnbaum–Sandras, and Bimodal–Weibull distribution methods. Additionally, the advent of artificial intelligence and soft computing techniques with the moth flame optimization (MFO) method leads to superior results in solving complex problems and parameter estimations. The data analytics are carried out in the MATLAB platform, with in-house coding developed for MFO parameters estimated through optimization and other wind distribution parameters using the maximum likelihood method. The observed outcomes show that the MFO method performed well on parameter estimation...

DOI: 10.3390/en14082319

Analysis of Wind Turbine Aging through Operation Data Calibrated by LiDAR Measurement

Hyun-Goo Kim; Jin-Young Kim

Abstract: This study analyzed the performance decline of wind turbine with age using the SCADA (Supervisory Control And Data Acquisition) data and the short-term in situ LiDAR (Light Detection and Ranging) measurements taken at the Shinan wind farm located on the coast of Bigeumdo Island in the southwestern sea of South Korea. Existing methods have generally attempted to estimate performance aging through long-term trend analysis of a normalized capacity factor in which wind speed variability is calibrated. However, this study proposes a new method using SCADA data for wind farms whose total operation period is short (less than a decade). That is, the trend of power output deficit between predicted and actual power generation was analyzed in order to estimate performance aging, wherein a theoretically predicted level of power generation was calculated by substituting a free stream wind speed projecting to a wind turbine into its power curve. To calibrate a distorted wind speed measurement in a nacelle anemometer caused by the wake effect resulting from the rotation of wind-turbine blades and the shape of the nacelle, the free stream wind speed was measured using LiDAR remote sensing as the reference data; and the nacelle transfer function, which converts nacelle wind speed into free stream wind speed, was derived. A four-year analysis of the Shinan wind farm showed that the rate of performance aging of the wind turbines was estimated to be −0.52%p/year.