Journal of Dynamics, Monitoring and Diagnostics, 2023, 2, 155-156
https://doi.org/10.37965/jdmd.2023.458

ISTP
EDITORIAL

Special Issue on Monitoring and Diagnostics of Renewable Energy Systems

Alhussein Albarbar[1] and Zhipeng Feng[2]
[1]Department of Engineering, Manchester Met University, Manchester M1 5GD, UK
[2]School of Mechanical Engineering, University of Science and Technology Beijing, Beijing 100083, China

(Received 25 September 2023; Accepted 26 September 2023; Published online 26 September 2023)

I. INTRODUCTION AND SCOPE

Concerns about global warming and recent advances in the integration of renewable energy sources into power systems have necessitated the timely need for more powerful control and monitoring methods. The detection and diagnosis of potential to failures, at their onsets, in such power systems would improve their availability thus, increases the generation of clean energy and reduces the carbon footpint. This special issue is devoted to collection of state-of-the-art on modelling, data processing, condition monitoring, and preventive maintenance methods for renewable energy systems, including wind turbines, electric vehicle batteries and solar panels, to enhance their performance and overall effectiveness. The guest editorial would like to thank all the contributing authors for making their research outputs publicly available via this special issue. Thanks also extended to reviewers for their valuable comments for improving the quality of the submitted articles. We also would like to thank the journal's production teams and editorial board for their assistance with the special issue.

II. REVIEW OF TOPICS ADDRESSED

A summary of the topics and papers included in this special issue is presented in this section.

A. WIND TURBINE OPTIMAL PREVENTIVE MAINTENANCE SCHEDULING USING FIBONACCI SEARCH AND GENETIC ALGORITHM

In this paper, a cost-effective plan for a 2MW wind turbine has been developed. The focus of the work is to mitigate the wind turbine's maintenance costs based on reliability model. The work uses two-layer optimization framework: Fibonacci and Genetic Algorithm (GA). The Monte Carlo simulation estimates wind turbine component failure times using their lifetime distributions from the reliability model. Subsequently, this failure time estimates are used to determine the overall corrective and preventive maintenance costs for the lifetime. An optimal preventive maintenance schedule for a 2MW wind turbine is also proposed which could be extended to the whole wind farms.

Corresponding author: Alhussein Albarbar (e-mail: a.albarbar@mmu.ac.uk).

B. ELECTRIC VEHICLES LITHIUM-POLYMER ION BATTERY DYNAMIC BEHAVIOUR CHARGING IDENTIFICATION AND MODELLING SCHEME

A model for monitoring the condition, state of charge and terminal voltage of lithium-polymer ion battery has been developed in this paper. The effects of ambient conditions such as temperature and relative humidity have been considered. This represents the main element for non-linear modelling of the EV battery dynamic behaviour using the Hammerstein-Wiener (H-W). The derived model beholds the boundaries of the charging process that not affecting on the lifetime of the battery. The effectiveness of the developed model has been verified experimentally under various ambient conditions. The best fit using the H-W model reached 91.83% to describe the dynamic behaviour of the battery with a maximum percentage of error 0.1V.

C. WIND TURBINE PLANETARY GEARBOX FAULT DIAGNOSIS VIA PROPORTION-EXTRACTING SYNCHROSQUEEZING CHIRPLET TRANSFORM

A method for understanding the vibration of the wind turbine gearboxes has been reported in this paper. To take account of the time-varying conditions, a method termed the proportion-extracting synchrosqueezing chirplet transform (PESCT) is proposed. Firstly, the proportion-extracting chirplet transform (PECT) is employed to generate underlying TFRs of high time-frequency resolution. Then, the energy concentration of the underlying TFRs is enhanced via the synchrosqueezing transform. Finally, wind turbine planetary gearbox faults are diagnosed via the dominant time-varying components revealed by the concentrated TFRs with high time-frequency resolution. The proposed PESCT was experimentally validated and proven to be suitable for complex nonstationary signals such as wind turbine planetary gearboxes.

D. AN IMPROVED SECOND-ORDER MULTI-SYNCHROSQUEEZING TRANSFORM FOR THE ANALYSIS OF NON-STATIONARY SIGNALS

In this work, an improved algorithm 'improved second-order multi-synchrosqueezing transform' (ISMSST) was developed for mitigating the effects of noise interference in non-stationary signals. Time-frequency (TF) distribution of a non-stationary signal is calculated first using SMSST then, a δ function is constructed based on a newly proposed time-frequency operator (TFO) which is used by ISMSST to produce a noise-free time-frequency representation. The effectiveness of proposed algorithm was validated experimentally by comparing its performance with other time-frequency analysis (TFA) techniques. Results demonstrate the reported algorithm outperform other TFA methods.

E. SMART MONITORING OF SOLAR PHOTOVOLTAIC PANELS BY THE APPROACH OF MACHINE LEARNING

In this paper, smart condition monitoring technique for solar panels has been reported. Thermal infrared images of solar panels, remotely collected by drones, are processed and classified using u-net neural network and support vector machine (SVM). Results show promising accuracy and potentials for improving the asset management and maintenance activities for solar power plants.

F. DAMAGE IDENTIFICATION OF WIND TURBINE BLADES - A BRIEF REVIEW

This article presents an up-to-date literature review on methods used for detection and analysis of damage in wind turbine blades. The study highlights various techniques, including acoustic emission analysis, strain signal monitoring, and vibration analysis, as effective approaches for damage detection. Vibration analysis, in particular, shows promise for fault identification by analysing changes in dynamic characteristics. Damage indices based on modal properties, such as natural frequencies, mode shapes, and curvature, are discussed.

III. CLOSING REMARKS

The articles published in this special issue reported novel methods for detecting, diagnosing failures and degradation in several component used in renewable energy sources. Several topics from wind turbine blades, gearboxes, optimisation of maintenance procedures for wind turbines, modelling of electric vehicle batteries, to monitoring of solar power plants have been covered. The reported methods have been experimentally validated and results demonstrated great potentials for further improvements and industrial applications. The works described in these articles embody the up-to-date method and technology for monitoring and diagnostics of renewable energy systems.

The Editors of this special issue invite professionals, researchers, and students to read the above-mentioned papers, enjoy and contact the associated authors if they have any further questions or to explore options for collaboration.