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Editorial

Symmetry in Renewable Energy and Power Systems II—Including Wind Energy and Fluid Energy

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This Special Issue has focused on symmetry in renewable energy and energy systems II—including wind energy and fluid power. Seven research articles have been accepted for publication focusing on the topics related to their main keywords: power-electronic-based power system dynamics; multi-converter infeed power system; small-signal stability, large scale system analysis, network dynamics, self-consumption, cover factor, load shifting, energy storage, wind energy, simulation, green energy, nanogrid, water heater, battery, multiple input power sources, DC distribution system and full-bridge converter, smart grid cybersecurity, GOOSE message security, IEC 62351, intrusion detection, artificial intelligence, microgrid, optimal scheduling, biogeography-based optimization algorithm, adaptive determination mechanism of migration rate, dynamic migration mechanism, power shifting, interruptible load, convolutional neural network (CNN), energy consumption, ensemble deep learning, long short-term memory (LSTM), multilayer perceptron, forecasting accuracy, time-series forecasting, energy consumption, energy forecasting, extra trees regressor, ensemble voting regressor, forecasting accuracy, K neighbors regressor, gradient boosting regressor, light gradient boost machine, and random forest regressor.

The first article, "Small-Signal Stability of Multi-Converter Infeed Power Grids with Symmetry" [1], is a collaboration between four researchers from China and Germany whose main affiliations were the State Key Laboratory of Advanced Electromagnetic Engineering and Technology (School of Electrical and Electronic Engineering, Huazhong University of Science) and the Technology and Department of Physics (Humboldt University of Berlin). The main conclusion that can be drawn is that the results of large-scale multi-converter analyses help to understand power-electronic-based power system dynamics, such as renewable energy integration.

The second article, "Modelling of Consumption Shares for Small Wind Energy Prosumers" [2], is a collaboration between six researchers from Estonia, Canada, and Russia whose affiliations were: the Institute of Technology (Estonian University of Life Sciences), Canmet ENERGY Research Centre (Natural Resources Canada), the Department of Electrical Power Engineering and Mechatronics (Tallinn University of Technology), the Department of Solar Business (Eesti Gaas A), the Institute of Engineering Sciences (Pskov State University), and the Estonian Centre of Industrial Mathematics. This article describes the simulation of energy distribution in an average household where electricity is produced with a small wind generator or purchased from the public electricity grid. The results found that for the configuration of the proposed nanogrid option, the positive results were readily achieved when the expected level of wind generator production was known an hour ahead; then, the cover factor increased from 0.593 to 0.645.

The third article, "Soft-Switching Full-Bridge Converter with Multiple-Input Sources for DC Distribution Applications" [3], is a collaboration between two researchers from the Department of Electrical Engineering of the Chang Gung University (Taiwan). This research tries to highlight the advantages of power supply systems using the DC distribution method, which involves an increase in conversion efficiency of about 5–10%, a cost reduction of

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about 15–20%; therefore, the authors propose that AC power distribution systems will be replaced by DC power distribution systems in the future.

The fourth article, "Machine Learning-Based Intrusion Detection for Achieving Cybersecurity in Smart Grids Using IEC 61850 GOOSE Messages" [4], is a collaboration between six researchers from Japan, Singapore, and Turkey. Their main affiliations were the Fukushima Renewable Energy Institute (National Institute of Advanced Industrial Science and Technology—AIST), the Department of Computer Science (School of Computing of the National University of Singapore), the Department of Electrical and Electronics Engineering (Necmettin Erbakan University), the Department of Electrical and Electronics Engineering (Abdullah Gul University), and the Advanced Digital Sciences Center (Illinois at Singapore Pte Ltd., University of Illinois at Urbana-Champaign, Singapore). This paper develops a cybersecurity system for intrusion detection in smart grids using GOOSE (Generic Object-Oriented Substation Event) messages of the IEC 61850 standard. The system is developed with machine learning and can monitor the communication traffic of a given power system and distinguish normal events from abnormal events, i.e., attacks.

The fifth article, "Optimal Scheduling of Microgrid Considering the Interruptible Load Shifting Based on Improved Biogeography-Based Optimization Algorithm" [5], is a collaboration between three researchers from the College of Information Science and Engineering of the Dalian Polytechnic University (China). This paper aims to ensure the applicability and symmetry of the microgrid; therefore, on the basis of biogeography, an improved optimization algorithm is proposed and the optimization dispatch algorithm of the microgrid based on said improved optimization is applied.

The sixth article, "Hybrid Ensemble Deep Learning-Based Approach for Time Series Energy Prediction" [6], is a collaboration between two researchers from the Department of Computer Engineering of the Jeju National University (Korea). In this study, a solution is proposed for energy prediction, i.e., to produce an accurate amount of energy to meet the energy needs of the end user, e.g., an industrial area. The hybrid ensemble deep learning model is proposed, which combines multilayer perceptron (MLP), convolutional neural network (CNN), short term memory (LSTM), and hybrid CNN-LSTM to improve the prediction performance.

The seventh article, "Short-Term Energy Forecasting Using Machine-Learning-Based Ensemble Voting Regression" [7], is a collaboration of three authors, two from the previous article and another from the same university but belonging to the Department of Computer Education (Teachers College). In this article, they propose to solve the above problem but this time by machine-learning. For this purpose, five of the best ML algorithms, namely, the additional tree regressor (ETR), random forest regressor (RFR), light gradient boosting machine (LGBM), gradient boosting regressor (GBR) and K-neighbor regressor (KNN) are trained to build the proposed voting regressor (VR) model.

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