: EDITORIAL

IEEE ACCESS SPECIAL SECTION: Emerging Technologies for Energy Internet

With the increased penetration of renewable energy sources such as Photovoltaic (PV), wind, tidal, and ocean waves in the global energy. Energy Internet has been widely regarded as one of the promising solutions for the serious energy crisis and environmental pollution problem. Unlike the conventional centralized power generation structure, energy internet widely utilizes different types of distributed generations (DGs), which are located closer to the user and generate the electric power within distributed networks. Modular energy storage devices (ESDs) such as batteries for electric vehicles can effectively complement the function of DGs through bidirectional plug-and-play power interfaces. Thus, energy internet has the ability to minimize the power loss, enhance the power quality, and improve the system reliability.

However, energy internet technology faces many challenges for its wide applications in industry from different design levels such as device level, power-interface level, and system level. Device level refers to the new material for PV cells, wind turbines, batteries, and supercapacitors. Most important is the availability of wide bandgap (WBG) materials such as Gallium Nitride (GaN) and Silicon Carbide (SiC) for the power semiconductor devices in order to improve the switching frequency and power density. The challenges for power interfaces cover their topology, control, communication, and the protection of various power converters to accommodate the DC/AC voltage bus with DGs or ESDs. Solid State Transformers (SST) have gained more attention as the energy router with good expandability, compatibility and easy regulation of power, control, and communication. For the system-level design in the energy internet, the intelligent energy and fault management with hierarchical control become more and more important.

Until now, only limited research efforts have been done and a limited number of papers have been published to address the key design challenges in the energy internet technology from different levels such as the device, power-interface, and system levels. The goal of this Special Section in IEEE Access is to present and highlight the emerging technologies from different levels to promote the energy internet for wide industry application.

This Special Section has received more than 60 articles, a total of 22 articles have been accepted after a rigorous peer review process. The accepted articles cover various topics, which will be classified into the following categories:

A. WBG Power Semiconductor Devices: four articles in this category have been accepted. In first article, "Monolithic GaN Half-Bridge Stages with Integrated Gate Drivers for High Temperature DC-DC Buck Converters," by Miao Cui, et al., a GaN based synchronous buck DC-DC converter, which monolithically integrates gate drivers and a half-bridge power stage in a 3-μm enhancement-mode (E-mode) GaN-on-Si process is presented. In the second article, "GaN Power Integration for High Frequency and High Efficiency Power Applications: A Review," by Ruize Sun, et al., the GaN power integration technologies in MMIC platforms are summarized in terms of the gate length, operation frequency and power added efficiency of integrated circuits (ICs). In the third article, "Low-Stray Inductance Optimized Design for Power Circuit of SiC-MOSFET-Based Inverter," by Liu Bo, et al., an optimization method including better design of bus-bar structure and parallel connection of snubber capacitors by means of model analysis and formula derivation is proposed in order to minimize the inductance of power consumption in circuits. In the fourth article, "Effect of High-k Passivation Layer on High Voltage Properties of GaN Metal-Insulator-Semiconductor Devices," by Yutao Cai, et al., the GaN-based MIS-HEMTs with Si_3N_4 single-layer passivation, Al_2O_3/SiNx bilayer passivation, and ZrO_2/SiNx bilayer passivation are demonstrated.

B. Renewable Energy Techniques: four articles in this category have been accepted. In the first article, "Comprehensive Studies on Operational Principles for Maximum Power Point Tracking in Photovoltaic Systems," by Xingshuo Li, et al., comprehensive studies on operational principles for maximum power point tracking in photovoltaic systems are illustrated. In the second article, "MEC-Driven UAV-Enabled Routine Inspection Scheme in Wind Farm under Wind Influence," by Peng Cao, et al., a mobile edge computing (MEC) driven UAV routine inspection scheme is proposed, in which the UAV not only detects WTs in multiple sorties, but also provides computing and offloading services. In the third article, "Identification of Partial Shading Conditions for Photovoltaic Strings," by Ziqiang Bi, et al., a modified Tabu search (MTS) based identification method is proposed to estimate the shading matrix. In the fourth article, "Time-Effective Dust Deposition Analysis of PV Modules Based on Finite Element Simulation for Candidate Site Determination," by Zuyu Wu, et al., a

numerical simulation method is proposed to model the dust accumulation on PV panels to detect the effects on PV power generation caused by different wind directions and wind speeds.

C. Energy System Optimization: five articles in this category have been accepted. In the first article, "Piecewise Linear Approximation of Gas Flow Function for the Optimization of Integrated Electricity and Natural Gas System," by Yu-Qing Bao, et al., the formation, the computational speed, and the accuracy of existing piecewise linear approximation methods are compared and a modification method is proposed that achieves both fast-processing and high-accuracy. In the second article, "Research on Distributed Source-Load Interaction Strategy Considering Energy Router-Based Active Distribution Network," by Mei Chen, et al., energy routers are mainly catalogued as source-type and load-type, and then a novel distributed source-load interaction strategy for energy router based active distribution network is proposed, which only requires information exchange between neighbor routers. In the third article, "A Hybrid Approach for Energy Consumption Forecasting with a New Feature Engineering and Optimization Framework in Smart Grid," by Ghulam Hafeez, et al., a fast and accurate hybrid electrical energy forecasting (FA-HELF) framework is developed, which integrates two modules with support vector machine (SVM) based forecaster. In the fourth article, "An Improved Finite Control Set-MPC-Based Power Sharing Control Strategy for Islanded AC Microgrids," by Tianhao Chen, et al., an improved FCSMPC strategy for paralleled Voltage Source Inverters (VSIs) is proposed. In the fifth article, "Federating Smart Cluster Energy Grids for Peer-to-Peer Energy Sharing and Trading," by Ioan Petri, et al., the formation and federation of smart energy clusters using peer-to-peer (P2P) networks with a view to decentralize energy markets and enable access and use of clean energy resources is presented.

D. Power Electronics and Power System: four articles in this category have been accepted. In the first article, "An On-Line State Evaluation Method of Smart Meters Based on Information Fusion," by Hui Cai, et al., an online evaluation method for smart meters by analyzing their power acquisition data. In the second article, "A Modular Multilevel Dual Buck Inverter with Adjustable Discontinuous Modulation," by Dan Lyu, et al., a novel modular multilevel dual buck inverter (MMDBI), capable of processing voltage and power at higher levels, requiring a single dc input voltage, is proposed. Qingsong Wang, et al., have presented their latest researches about the electric springs (ES). In the third article, "Decoupled Power Control with In-depth Analysis of Single-Phase Electric Springs," a new control with in-depth analysis on the decoupling of the active and reactive powers is proposed in order to improve the dynamic responses of the existing power control for ES. In the fourth article, "A Parameter-Exempted, High-Performance Power Decoupling Control of Single-Phase Electric Springs," the closed-loop control of the dq components of the current drawn by the end-user and a feedback of the ES output current into the ES command is proposed to solve the limitations of the conventional control such as the need of an a-priori knowledge of circuit parameters or a slow response to the grid power fluctuations.

E. Electrical Machine for Renewable Energy: two articles in this category have been accepted. In the first article, by Shuye Ding, et al., the authors have presented their latest researches about wind turbine generators, "Temperature Rise Effect of Permanent Magnet Wind Turbine in Different Field Settings," two different solving domain models are established to compare the flow thermal characteristics of the internal and external ventilated paths based on the electrical and numerical heat transfer theories. In the second article, "Research on Relativity of Flow Rate Distribution inside the Rotor Domain for a Large-Scale Air-Cooled Turbo-Generator," two optimization schemes of adding wind deflectors and small fans to the end of the rotor are proposed.

F. Energy Storage System: one article in this category has been accepted. In this article "A Co-Simulation Method Based on Coupled Thermoelectric Model for Electrical and Thermal Behavior of the Lithium-ion Battery" by Huang *et al*., a co-simulation method based on coupled thermoelectric model is developed, which combines equivalent circuit model (ECM) and Computational Fluid Dynamics (CFD) software.

G. Energy Market: one article in this category has been accepted. In this article "Incentive-Compatible Market Clearing for a Two-Stage Integrated Electricity-Gas-Heat Market" by Huang *et al*., a two-stage IEM model is established that promotes compatibility between the incentives of market participants to enhance market fairness.

H. AI for Energy Internet: one article in this category has been accepted. In this article "Evaluation of Machine Learning Approaches for Android Energy Bugs Detection with Revision Commits" by Zhu *et al*., a system-call-based approach to develop a power consumption model for Android devices is developed.

The Guest Editors hope that this Special Section will benefit the scientific community and contribute to the knowledge base, and would like to take this opportunity to thank the contribution of the authors to this Special Section. The efforts of the reviewers to enhance the quality of the manuscripts are also much appreciated.

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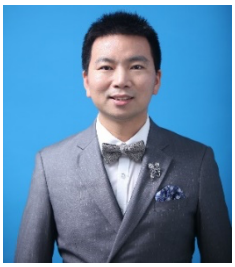

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