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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: ADVANCED ENERGY STORAGE TECHNOLOGIES AND THEIR APPLICATIONS

The depletion of fossil fuels, the increase of energy demands, and the concerns over climate change are the major driving forces for the development of renewable energy such as solar and wind. However, the intermittency of renewable energy has hindered the deployment of large-scale intermittent renewable energy, which therefore has necessitated the development of advanced large-scale energy storage technologies [item 1) in the Appendix]. The use of large-scale energy storage can effectively improve the efficiency of energy resource utilization and increase the use of variable renewable resources, energy access, and end-use sector electrification [items 2) and 3) in the Appendix]. Over the years, considerable research has been conducted on many types of energy, such as thermal energy, mechanical energy, electrical energy, and chemical energy, using different types of systems such as phase change materials, batteries, supercapacitors, fuel cells, and compressed air, which are applicable to various types of applications, such as heat and power generation and electrical/hybrid transportation [items 4) and 5) in the Appendix].

This IEEE ACCESS Special Section focuses on the development of large-scale energy storage technology. From a total of 155 submissions, 60 high-quality articles were accepted for publication in this Special Section after a strict peer-review process. IEEE journals are considered to be the flagship journals of the engineering field. IEEE ACCESS is a new multidisciplinary, application-oriented, all-electronic archival journal which continuously presents the results of original research and development across all of IEEE's fields. Thanks to its open-access nature, this Special Section is accessible to readers all over the world.

In the article "State-of-the-art and energy management system of lithium-ion batteries in electric vehicle applications: Issues and recommendations," by Hannan *et al.*, the authors provide a comprehensive review of the state of the art of lithium-ion batteries from the aspects of mechanisms, structures, and performance evaluation. The authors also focus on the management of batteries in electric vehicles and highlight the challenges and ideas for the technical development of electric vehicles powered by lithium-ion batteries.

In the article "Multi-objective optimal design of permanent magnet synchronous motor for high efficiency and high dynamic performance," by Hong *et al.*, the authors propose a multiobjective optimization method to improve permanent magnet synchronous motors. In this method, the mechanical and electrical time constants are considered as the key parameters to be determined to optimize the efficiency. The optimization problem was then solved by the colony algorithm, and validation tests demonstrated desirable results.

In the article "Passivity-based control strategy for SMES under an unbalanced voltage condition," Lei *et al.* propose a novel nonlinear control strategy for a superconducting magnetic energy storage system during network unbalance. Based on the port-controlled Hamiltonian models, passivity-based control strategies were discussed. Simulation results demonstrate the high robustness of the proposed strategies in the dynamic and steady states.

In the article "Optimization of a dual-motor coupled powertrain energy management strategy for a battery electric bus based on dynamic programming method," Wang *et al.* propose a control strategy for electric buses based on a dynamic programming method. In this method, the state of charge (SOC) is considered as the state variable while the torque of electric motors is controlled. Simulation and experimental results under various bus driving cycles show that the proposed strategies could optimize the operation points of the electric motors and, therefore, outperform existing methods.

In the article "A generalized extended state observer for supercapacitor state of energy estimation with online identified model," Zhou *et al.* propose a generalized extended state observer for the estimation of the state of energy (SOE) of a supercapacitor based on a nonlinear mathematical model. The proposed method is demonstrated to be superior to conventional methods in terms of efficiency and accuracy.

Wang *et al.* study the joint state estimation for batteries in electric vehicles in their article "Research on multiple states joint estimation algorithm for electric vehicles under charge mode." A new equivalent circuit model is established, and its order is determined according to the Bayesian information criterion. SOC, state of power (SOP), and battery capacity are then jointly estimated. High accuracy was achieved in the validation tests.

Du *et al.* devise a novel battery self-heating method, which takes advantage of the discharging process, in their article

''Multi-objective optimization discharge method for heating lithium-ion battery at low temperatures.'' The discharging current was optimized using a dynamic programming algorithm which balances battery aging and heating rates. Experimental validation proved its superiority over the heating method based on constant discharge current.

In the article ''Review of energy storage system technologies in microgrid applications: Issues and challenges,'' Faisal *et al.* review energy storage system technologies applied in microgrids. The authors comprehensively discuss their configurations, categories, and mechanisms. In addition, a detailed comparison is provided to highlight the merits and demerits of the discussed technologies. Furthermore, from the perspective of microgrid applications, challenges and corresponding recommendations are provided to motivate the development of energy storage in microgrid applications.

In the article ''Coordination of SMES, SFCL, and distributed generation units for micro-grid stability enhancement via wireless communications,'' Chen *et al.* propose a coordination control method that can smoothly separate the microgrid from the main network in the presence of severe or permanent faults. It can assist the microgrid in achieving fault ride-through in case of minor or temporary faults. The authors validated the proposed method with communication delays taken into consideration.

In the article ''Unscented Kalman filter-based battery SOC estimation and peak power prediction method for power distribution of hybrid electric vehicles,'' Wang *et al.* propose to use an improved unscented Kalman filter to estimate the SOC and predict the peak power of lithium-ion batteries. The experimental results show that the improved unscented Kalman filter has better SOC estimation performance than the conventional counterpart in the presence of signal noise. In addition to suppressing the influence of noise, it enjoys low computational burden. Based on the SOC estimation results, peak power was predicted to facilitate the design of the corresponding power distribution strategy.

Wu *et al.* devised a novel equivalent circuit model with temperature compensation to enhance the SOC estimation accuracy of lithium-ion batteries over a wide temperature range, which is reported in their article titled ''State of charge estimation of lithium-ion batteries over wide temperature range using unscented Kalman filter.'' By incorporating the proposed model into the unscented Kalman filter, the authors demonstrate high estimation accuracy with a maximum error of less than 3%, thereby illustrating the effectiveness and robustness of the proposed method.

In the article ''Hammerstein models and real-time system identification of load dynamics for voltage management,'' Bao *et al.* propose to use the Hammerstein model structures to describe the load types and dynamics in static power flow analysis. The real-time identification algorithm was also designed and discussed to account for the active and reactive load power. The performance of the proposed method was demonstrated through the applications on a generic grid structure and a 33-bus system.

In the article titled ''An on-line state of health estimation of lithium-ion battery using unscented particle filter,'' Liu *et al.* estimate the state of health (SOH) of lithium ion batteries using the unscented particle filter (UPF) in an online manner. A health indicator is extracted from dynamic discharging profiles, and its relationship with SOH is portrayed by the UPF. Besides the low computational burden, the proposed method has the advantage of quantifying the uncertainty of estimation results. The method was validated by experiments on different batteries, which demonstrated its high accuracy and robustness.

In the article ''Using high-control-bandwidth FPGA and SiC inverters to enhance high-frequency injection sensorless control in interior permanent magnet synchronous machine,'' Qian *et al.* propose a high-frequency injection sensor-less control method for interior permanent magnet synchronous machines. The proposed method has improved the rotor position estimation precision and widened the speed range. Experimental results demonstrated the improved position estimation and lifted injection frequency.

Wang *et al.* proposed the use of a model predictive control (MPC) algorithm to suppress vibration of an electric bus in their article titled ''Vibration control method for an electric city bus driven by a dual-motor coaxial series drive system based on model predictive control.'' In the proposed method, a multiobjective optimization problem is formulated based on a simplified transmission system model. The MPC law is then obtained from the solution. Finally, a vibration controller is designed and validated through experiment.

In the article ''Decomposition study of degradation reasons for $LiCoO_2$-based 14500 lithium-ion batteries using a non-destructive method,'' Zhang and Lyu devise a novel aging diagnosis method for an in-depth understanding of battery aging. In this article, a multiphysics model is first developed to simulate the evaluation of capacity, over-potential, and heat generation in the aging test. After parameterizing the model through the genetic algorithm, the latent aging mechanisms such as loss of active materials could be quantified. This study provides an electrochemical insight into battery health management.

In the article ''Accelerated adaptive second-order super-twisting sliding mode observer,'' Lin *et al.* propose an accelerated second-order super-twisting sliding mode observer with an adaptive gain. The proposed algorithm can accelerate the convergence rate of the observation error, and attenuate the chattering issue. The convergence of the proposed algorithm was mathematically proved, and a simulation example was provided to verify its performance.

In the article ''Improved English immersion teaching methods for the course of power electronics for energy storage system in China,'' Wang *et al.* propose a new English immersion teaching mode, which consists of problem-based learning, English-project based assessment, and English-based lab operation, for power electronics courses in China. The authors systematically analyze the drawbacks of traditional teaching methods and highlight the corresponding

solutions. The proposed method provides a paradigm for non-native English speaking countries in the field of engineering teaching.

In the article "Research on the battery charging strategy with charging and temperature rising control awareness," by Ye *et al.*, a multistage battery charging method is proposed. In this method, the genetic algorithm is employed to optimize the charging current based on battery voltage and temperature models. Experimental results on 18 650 cells demonstrate that the proposed method is more efficient than conventional methods and is capable of suppressing temperature rise.

In the article "Research and bench test of nonlinear model predictive control-based power allocation strategy for hybrid energy storage system," Zhao *et al.* propose a power allocation strategy for hybrid energy storage systems based on nonlinear model predictive control. The power demand is predicted to reasonably distribute the power of the hybrid energy storage system. Simulation results demonstrate that the proposed strategy outperforms strategies based on logic threshold and single-battery packs.

In the article, "An integrated energy management strategy with parameter match method for plug-in hybrid electric vehicles," Wang *et al.* propose a three-layer integrated energy management strategy for hybrid energy storage systems. This method is composed of parameter matching, three-level wavelet transform, and fuzzy logic control. The proposed method is demonstrated to be better than the strategy based on only wavelet transform in terms of energy consumption.

Morello *et al.* develop a hardware-in-the-loop platform for the validation of battery state estimation methods in their article "Hardware-in-the-loop platform for assessing battery state estimators in electric vehicles." The established platform can send simulated battery signals directly to the battery management system via a communication link in order to ensure test safety. Two algorithms were tested using the platform to highlight the capabilities of the platform. This experimental study is an outstanding example for the validation of onboard state estimation algorithms.

In the article "A bias correction based state-of-charge estimation method for multi-cell battery pack under different working conditions," Chen *et al.* study SOC estimation of battery packs. The authors combine an equivalent circuit model and artificial neural networks to construct an average cell model which can adapt to dynamic working conditions. This model was then combined with the extended Kalman filter to estimate the SOC of a battery pack at different temperatures.

Lu and Wang developed an integrated multifunctional power electronic interface (PEI), which enables grid-to-vehicle, vehicle-to-grid, and vehicle driving, in their article "A highly efficient multifunctional power electronic interface for PEV hybrid energy management systems." The proposed PEI can reduce the number of components while ensuring high peak and overall efficiency.

In the article "A lag angle compensation strategy of phase current for high-speed BLDC motors," by Tan *et al.*, an advance compensation method for commutation angle of brushless DC motors is proposed. In this method, the advance compensation angle is calculated using the phase current, inductance, and flux linkage. The proposed method can reduce copper loss and widen the rotation speed range, especially at low speed and light load.

In the article "Frequency selection approach for energy aware cloud database," Guo *et al.* propose a frequency selection approach for enhancing the energy efficiency of cloud databases. The genetic algorithm and Monte Carlo tree search algorithms are employed in the proposed method. The optimization results demonstrate improved energy efficiency and desirable robustness.

In the article "Third harmonic injection SPWM method based on alternating carrier polarity to suppress the common mode voltage," by Tan *et al.*, a third harmonic injection sinusoidal pulse width modulation method on the basis of alternating carrier polarity is proposed. Three measures were taken to deal with the difficulty of the injected third-harmonic generation. The performance of the proposed method was verified through experiments on a three-phase pulse width modulation inverter circuit.

In the article "A survey on simultaneous wireless information and power transfer with cooperative relay and future challenges," Hossain *et al.* review the combination of the simultaneous wireless information and power transfer (SWIPT) and cooperative relay (CoR) techniques. The authors discuss their architectures, applications, categories, forms of resource allocation, and relay selection algorithms. The roles of the CoR and SWIPT in the emerging wireless communication techniques are also analyzed based on the discussion of challenges.

In the article "Multi-objective optimization-based real-time control strategy for battery/ultracapacitor hybrid energy management systems," Lu *et al.* propose a novel energy management strategy for hybrid energy management systems in plug-in electric vehicles. A multiobjective optimization problem is formulated and solved by the weight and no-preference algorithms in order to suppress power loss, prolong battery life, and stabilize the voltage of ultracapacitors. Simulation and experimental results validate the effectiveness of the proposed strategy and highlight its real-time performance. As a general approach, this strategy is promising for use in different configurations of hybrid energy management systems.

In the article "Dynamic data allocation and task scheduling on multiprocessor systems with NVM-based SPM," Wang *et al.* propose a hybrid scratch-pad memory which is composed of a static random-access memory and a nonvolatile memory to supersede the cache in the chip multiprocessor system. A new dynamic data allocation and task scheduling algorithm is proposed to dynamically assign processors to tasks and allocate data to memories. The proposed algorithm exhibited superior performance to conventional methods in the context of simulation and experiments.

In the article "A novel dynamic performance analysis and evaluation model of series-parallel connected battery pack for electric vehicles," Ye *et al.* evaluate the influence of cell connections on the performance of battery packs. Through simulation based on equivalent circuit models, the authors found that a pack achieves the best performance in terms of capacity, efficiency, and utilization rate if cells are first connected in parallel and then in series. The simulation results are supported by systematic experiments on eight cells at different aging states. This study provides critical guidance on the design of battery packs.

In the article "State of charge estimation for lithium-ion battery in electric vehicle based on Kalman filter considering model error," by Wang and Mu, the causes of errors in SOC estimation are investigated. They devised an observer that can reduce the influence of modeling errors on SOC estimation results. Modeling errors such as open-circuit voltage drift and sensor drift are considered in the experimental validation. Desirable accuracy and robustness were reported based on comparison with the Kalman filter.

In the article "Adaptive terminal sliding mode control for hybrid energy storage systems of fuel cell, battery, and supercapacitor," Xu *et al.* propose a terminal sliding mode control strategy with projection operator adaptive law to track the current and regulate the voltage. Load power can be effectively distributed to increase the service life of the hybrid energy storage system. Theoretical analysis and simulation results are provided to demonstrate the performance of the proposed method.

In the article "WRF wind speed simulation and SAM wind energy estimation: A case study in Dili timor leste," De Araujo proposes a weather research and forecasting model for the simulation of wind speed for heights of 100 and 120 m above the Hera mountain in Dili. The simulated wind speed was then used to estimate wind energy. This study highlights and quantifies the potential of wind energy as an additional energy source.

In the article "Design and implementation of lead–carbon battery storage system," Li *et al.* develop a two-state topology of a lead–carbon battery-based energy storage system which considers the number and connection of cells. A state feedback linearization method is proposed for dq-axis current decoupling, and a control strategy is used to suppress the resonance peak. Simulation and prototype tests demonstrated the desirable performance of the designed system under dynamic and steady states.

In the article "Experimental testing of variable speed heat pump control strategies for enhancing energy flexibility in buildings," Péan *et al.* develop model predictive control strategies to exploit the potential of the thermal mass of buildings and domestic hot water tanks. The results reveal that the model predictive control strategies can realize load-shifting by charging thermal energy storages appropriately. This study provides valuable insights into the research on thermal energy storage in buildings.

In the article "A novel approach to the optimization of a solid oxide fuel cell anode using evolutionary algorithms," Buchaniec *et al.* introduce evolutionary algorithms to optimize the design of the anode of fuel cells. Sixteen microstructural parameters are considered as the independent variables that can affect the microstructure morphology of the anode. A genetic algorithm and particle swarm optimization were selected to solve this problem. The results show that the optimized anode leads to better cell performance than conventional designs.

In the article "Classification and review of the charging strategies for commercial lithium-ion batteries," by Gao *et al.*, recent advances in the development of battery charging strategies from the aspects of battery models and method structures are comprehensively reviewed. In addition, merits and demerits of the reviewed strategies were thoroughly compared. Finally, technical challenges and corresponding suggestions were highlighted to stimulate innovative breakthroughs in the research on battery charging. This work could be beneficial to the design of battery charging strategies for different applications.

In the article "Supercapacitors: Electrical characteristics, modeling, applications, and future trends," Berrueta *et al.* conduct a thorough review of the research and applications of supercapacitors. The authors discuss material properties and mechanisms of supercapacitors, and then summarize their key features. Furthermore, modeling techniques are classified, explained, and compared along with necessary experimental techniques. Finally, the authors analyze the expansion of the supercapacitor market and identify research trends.

In the article "Elimination of high-frequency oscillation in dual-active bridge converters by dv/dt optimization," Cui *et al.* first derive a frequency-domain model to account for the mechanisms of high-frequency oscillation (HFO). The authors then propose the adjustment of the dv/dt of the dual active bridge to eliminate HFO and improve efficiency. The required capacitance was calculated to obtain the optimal dv/dt. Simulation and experimental results demonstrate the effectiveness of the proposed method.

In the article "An ensemble learning approach for accurate energy load prediction in residential buildings," Al-Rakhami *et al.* propose an extreme gradient boosting algorithm-based approach to accurately predict building energy loads and alleviate overfitting. Eight features are taken as inputs including orientation, height, relative compactness, roof area, wall area, surface area, glazing area, and its distribution. The accuracy of the proposed approach was demonstrated on a data set containing 768 samples.

In the article titled "Changes in derivative orders for fractional models of supercapacitors as a function of operating temperature," by Kopka, the author investigated the influence of ambient temperature on the parameters of a fractional-order supercapacitor model. The author systematically carried out experiments in the temperature range from -30 °C to 60 °C and disclosed the functional relationship between the

derivative order and temperature. A pronounced fractional-order behavior was manifested at elevated temperatures, highlighting the importance of fractional-order modeling.

In the article ''Fractional-order equivalent circuit model and SOC estimation of supercapacitors for use in HESS,'' Wang *et al.* investigate the fractional-order nature of supercapacitors and highlight its influence on the management of hybrid energy storage systems. Thereafter, fractional-order elements are introduced into an equivalent circuit supercapacitor model to improve model accuracy. This model is then incorporated into fractional-order filters to achieve high SOC estimation accuracy. Validation results prove the effectiveness and real-time performance of the proposed method.

In the article titled ''Adaption resizing communication buffer to maximize lifetime and reduce delay for WVSNs,'' Zhang *et al.* propose an adaption communication buffer scheme for maximizing the lifetime of battery-powered wireless video sensor networks and reducing delay. The proposed scheme adjusts the communication buffer size of nodes in the hotspot area to an optimal value and thereby reduces energy consumption and ensures a long network lifetime. The authors provide a thorough theoretical analysis to demonstrate the feasibility of the proposed scheme.

In the article ''Dual-switch boost DC–DC converter for use in fuel-cell-powered vehicles,'' Wu *et al.* implemented a simple and efficient dual-switch boost DC–DC converter topology, which can facilitate voltage matching between the cell stack and batteries in a fuel-cell-powered vehicle. The proposed topology has the advantage of reducing the number of required components and induced stress while maintaining a high gain ratio. Experimental results revealed improved duty ratio and boost ratio compared to conventional counterparts.

In the article ''Energy sharing of zero-energy buildings: A consensus-based approach,'' Liao *et al.* propose a novel perspective to explore energy sharing among buildings with an energy sharing circuit. The energy sharing system is modeled as a cyber-physical system which can characterize the physical energy sharing market and the communication topology. The SOC of the energy storage systems is estimated for balancing purposes. The effectiveness and efficiency of the proposed energy sharing system were validated based on a laboratory prototype.

In the article ''Machine-learning-based lithium-ion battery capacity estimation exploiting multi-channel charging profiles,'' Choi *et al.* implemented a machine-learning-based approach for SOH estimation of lithium ion batteries. Health indicators extracted from the sampled current, voltage, and temperature during battery charging are fed into three types of neural networks. Compared with methods based on only voltage measurements, the proposed method achieves higher accuracy. This article highlights the multidisciplinary nature of battery management and provides an inspiring data-driven solution.

In the article titled ''Parameter-independent battery control based on series and parallel impedance emulation,'' Urtasun *et al.* revealed the latent damage to battery life under inappropriate voltage control. Furthermore, two methods, i.e., the parallel impedance emulation and series–parallel impedance emulation, were proposed to reduce the effect of battery impedance on voltage regulation. Simulation results demonstrated that the proposed methods are easy to implement and can significantly improve the performance of voltage control thanks to the accurate impedance simulation and noise immunity.

In the article titled ''An adaptive energy management strategy to extend battery lifetime of solar powered wireless sensor nodes,'' by Qi *et al.*, the authors propose an adaptive rule-based energy management strategy for the purpose of prolonging the battery life of a solar-powered sensor node. Simulation and experimental results demonstrated the superior effectiveness of the proposed method in comparison with traditional strategies. In addition to extending battery life, another advantage of the proposed method is the improved availability due to the regulated current profiles. This study provides a practical way for extending battery lifetime.

In the article ''Multiple-input deep convolutional neural network model for short-term photovoltaic power forecasting,'' by Huang and Kuo, the authors propose a deep neural network-based method to forecast the output power of solar photovoltaic systems. In this method, meteorological information such as temperature, solar radiation, and historical output power are taken as inputs. Results showed that the proposed method effectively predicts output power for 24 hours. This method is promising to reduce the cost on the initial hardware components and long-term maintenance.

In the article ''An improved optimal solution for the directional overcurrent relays coordination using hybridized whale optimization algorithm in complex power systems,'' Khurshaid *et al.* develop a hybridized version of the whale optimization algorithm for the optimization of directional overcurrent relays coordination. Simulated annealing is deployed to accelerate exploitation and guarantee global optimization. The proposed method outperformed a set of widely employed algorithms in the context of five test systems. This study manifests the efficacy of evolutionary algorithms in engineering problems.

In the article ''Design and implementation of controller for EHPS of intelligent electric bus,'' Li *et al.* designed a controller for the steering power system for an electric bus from the aspects of hardware and control strategies. The designed controller was systematically validated based on bench tests and vehicle tests. Results showed that the designed controller can decrease the torque of the steering wheel and guarantee the power-assisting performance of the steering power systems. This study provides an exceptional example for the controller design of the steering system in electric vehicles.

In the article ''Minimum copper loss direct torque control of brushless DC motor drive in electric and hybrid electric vehicles,'' Zhang *et al.* propose a direct torque control method for the brushless DC motor in electric vehicles. High efficiency and torque control precision were reported, thanks to

the specially designed stator flux linkage trajectory. In addition, experimental results showed that the torque ripple can also be eliminated based on the proposed control method.

In the article "Research on classification and recognition of driving styles based on feature engineering," Liu *et al.* propose a set of driving style classification and recognition methods. Based on driving data collected from a road test, the information entropy was applied to extract 44 features for the characterization of driving styles. The dimension was then reduced through the principle analysis and the classification was achieved by clustering. Superior recognition accuracy to conventional methods was reported.

In the article titled "Research on dynamic coordination active mode switching control strategy for hybrid electric vehicle based on traffic information," Ye *et al.* propose a novel active mode switching strategy for hybrid electro vehicles through the combination of environmental sensing and a networked vehicle. In this strategy, the active control is enabled by the comparison between the current mode and the predicted future mode. The proposed method was validated on a built-in hardware-in-the-loop platform. Results showed it can address the problem of switch lag and improve ride comfort.

In the article "Topologies and control schemes of bidirectional DC–DC power converters: An overview," Gorji *et al.* provide a comprehensive review of bidirectional DC-DC power converters from the viewpoints of topology and control schemes. The converters were divided into two categories, each of which has eight groups. The features of the topologies and control schemes were systematically compared and discussed along with their typical applications. This review article provides a solid basis for the applications of DC–DC power converters.

In the article titled "An improved SOC estimator using time-varying discrete sliding mode observer," Dai *et al.* studied the robustness and real-time performance of SOC estimation methods based on the sliding mode observer (SMO). A recursive fitting technique was proposed to update model parameters and facilitate the SMO based SOC estimation. The stability proof was proposed together with a hardware-in-the-loop validation on two types of cells.

In the article "Coordination control strategy for battery-ultracapacitor hybrid energy storage system in microgrids with unbalanced and nonlinear loads," Zhu *et al.* reported a coordination control strategy for hybrid energy storage systems based on the droop control method. Compared with conventional methods, the proposed strategy can achieve better system performance in the case of unbalanced and nonlinear load profiles. In addition, increased microgrid stability and battery life were also observed from the simulation and experimental results.

In the article "Research on the efficiency optimization control of the regenerative braking system of hybrid electrical vehicle based on electrical variable transmission," Xu *et al.* propose an efficiency optimization strategy for the regenerative braking system in hybrid electric vehicles. The authors formulated the dynamic coupling relationship between the electrical variable transmission and engine, and then proposed a hierarchical controller to switch braking modes and enhance efficiency. The proposed method was validated through simulation.

In the article "Shared electrical energy storage service model and strategy for apartment-type factory buildings," Oh and Son present a shared electrical energy storage service model which comprises the architecture for implementing the service and the strategy for operating the service. The proposed strategy was designed to maximize the profit of participants and also the energy service provider. A Korean case study disclosed increased benefits. This study offers crucial guidance for implementing the shared electrical energy storage service and participating in the service.

We hope that this Special Section will benefit the scientific community and contribute to the knowledge base. We would like to thank all authors for submitting high-quality articles to this Special Section. We greatly appreciate the contributions of the reviewers who participated in the review process and provided valuable comments. We also would like to acknowledge the guidance from the Editor-in-Chief and IEEE staff.

ACKNOWLEDGMENT

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APPENDIX
RELATED WORK

1) J. Tian, R. Xiong, and W. Shen, "A review on state of health estimation for lithium ion batteries in photovoltaic systems," *eTransportation*, vol. 2, Nov. 2019, Art. no. 100028.
2) R. Xiong, Y. Zhang, J. Wang, H. He, S. Peng, and M. Pecht, "Lithium-ion battery health prognosis based on a real battery management system used in electric vehicles," *IEEE Trans. Veh. Technol.*, vol. 68, no. 5, pp. 4110–4121, May 2019.
3) R. Xiong, Q. Yu, W. Shen, C. Lin, and F. Sun, "A sensor fault diagnosis method for a lithium-ion battery pack in electric vehicles," *IEEE Trans. Power Electron.*, vol. 34, no. 10, pp. 9709–9718, Oct. 2019.
4) R. Xiong, J. Tian, W. Shen, and F. Sun, "A novel fractional order model for state of charge estimation in lithium ion batteries," *IEEE Trans. Veh. Technol.*, vol. 68, no. 5, pp. 4130–4139, May 2019.
5) R. Xiong, R. Yang, Z. Chen, W. Shen, and F. Sun, "Online fault diagnosis of external short circuit for lithium-ion battery pack," *IEEE Trans. Ind. Electron.*, vol. 67, no. 2, pp. 1081–1091, Feb. 2020.

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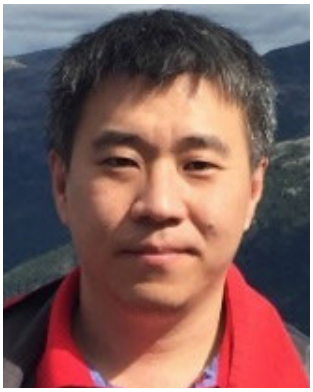
From 2019 to 2020, he was a Visiting Professor with the Massachusetts Institute of Technology, Cambridge, MA, USA. He is currently a Professor with the Beijing Institute of Technology, Beijing. He has conducted extensive research and authored more than 100 journal articles. His research interests include intelligent electrified vehicle, batteries, machine learning, and energy storage.

Dr. Xiong is a Fellow of the Institution of Engineering and Technology (IET). He has been continuously selected as the HIGHLY CITED RESEARCHER from Clarivate Analytics from 2018 to 2020 and a Most Cited Chinese Researchers from Elsevier in 2019. He was a recipient of the First Prize of Natural Science Award of the Ministry of Education of China, in 2018 and the First Prize of the Chinese Automobile Industry Science and Technology Invention Award, in 2018. He serves as an Associate Editor for the *IET Power Electronics*, *IET Intelligent Transport Systems*, and on the Editorial Board for the *Applied Energy and Electrical Engineering*. He is also the Conference Chair for four International Conferences.

SULEIMAN M. SHARKH (Senior Member, IEEE) received the B.Eng. and Ph.D. degrees in electrical engineering from the University of Southampton, U.K., in 1990 and 1994, respectively.

He is currently a Professor of Power Electronics, Machines, and Drives. His main research interests include electrical machine and power electronics with applications to electric vehicles, marine propulsion, exhaust energy recovery, gas compressors, and submersible pumps.

Prof. Sharkh is a member of the IET and a Chartered Engineer. He was the 2008 winner of The Engineer Energy Innovation Award for his work on rim driven thrusters and marine turbine generators. He also received the Royal Academy of Engineering ExxonMobil Excellence in Teaching Award in January 2013.



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Dr. Li is a Subject Editor of the *Journal of Applied Energy*, and was awarded the Outstanding Contribution Award by *Applied Energy* in 2017. He has been organizing the International Conference on Applied Energy (ICAE) since 2012.

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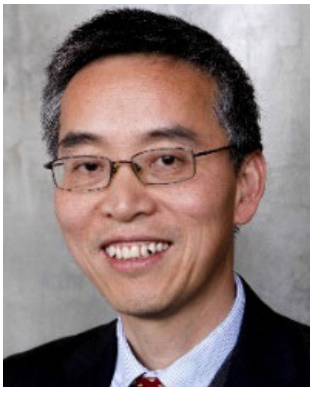

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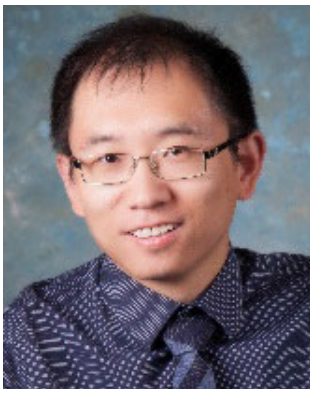

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