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Editorial

Advanced Control and Optimization for Complex Energy Systems

Chun Wei,[1] **Xiaoqing Bai**,[2] **and Taesic Kim**[3]

[1]*Zhejiang University of Technology, Hangzhou, China*
[2]*Guangxi University, Nanning, China*
[3]*Texas A&M University-Kingsville, Kingsville, USA*

Correspondence should be addressed to Chun Wei; cwei@huskers.unl.edu

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The application of renewable energies such as wind and solar has become an inevitable choice for many countries in order to achieve sustainable and healthy economic development [1]. However, due to the intermittent characteristics of renewable energy, the issue with integrating a larger proportion of renewable energy into the grid becomes prominent. Currently, an energy system with weak coordination capability seriously affects the flexibility of power system operation [2]. As a result, this has led to the development of an effective way to integrate high-proportion renewable energy by developing multienergy systems including wind, solar, thermal, and energy storage to allow for the integration and coordination of different energy resources [3]. The major challenge of the multienergy system is its complexity with multispatial and multitemporal scales. Compared with the traditional power system, control and optimization of the complex energy system become more difficult in terms of modeling, operation, and planning [4, 5]. The main purpose of the complex energy system is to coordinate the operation with various distributed energy resources (DERs), energy storage systems, and power grids to ensure its reliability, while reducing the operating costs and achieving the optimal economic benefits. A total of 58 papers were received from different research fields. After the review process, 29 papers were accepted for publication (around 50% of acceptance ratio).

These papers can be organised in four groups. The focus of the first group of articles is control methods. The paper titled "Finite-Time Observer-Based Adaptive Control of Switched System with Unknown Backlash-Like Hysteresis" by G. Sun and Y. Xu investigates a finite-time observer problem for a class of uncertain switched nonlinear systems in strict-feedback form. The paper by G. Wang et al. entitled "A Decentralized Energy Flow Control Framework for Regional Energy Internet" proposed a decentralized energy flow control framework for regional energy internet. The paper "Finite Control Set Model Predictive Control for Complex Energy System with Large-scale Wind Power" by Y.-W. Shen et al. proposed a strategy to optimize a value function with errors of current magnitudes to predict switching status of the grid-side converter. The paper "Neural Network Identification and Sliding Mode Control for Hysteresis Nonlinear System with Backlash-Like Model" by R. Liu and X. Gao proposed a new neural network sliding mode control for a backlash-like hysteresis nonlinear system. The paper "Tracking Control for Hydrogen Fuel Cell Systems in Zero-Emission Ferry Ships" by M. Khooban et al. proposed a new modified backstepping controller to stabilize the microgrid voltage and currents. The paper "Steady-State Analysis and Output Voltage Minimization Based Control Strategy for Electric Springs in the Smart Grid with Multiple Renewable Energy Sources" by Y. Zou et al. presented a general steady-state analysis and minimal compensating voltage control scheme for the second generation of electric springs in the power system with substantial penetration of intermittent renewable energy sources. The paper "Boost Converters' Proximate Constrained Time-Optimal Sliding Mode Control Based on Hybrid Switching Model" by A. Taheri et al. proposed a proximate constrained time-optimal sliding mode controller based on the hybrid dynamical model of the converter and geometrical representation of its corresponding vector fields. The paper "Adaptive Fixed-Time Sliding Mode Control for Uncertain Twin-Rotor System with Experimental Validation" by L. Shen et al.

proposed an adaptive fixed-time control scheme for twin-rotor systems subject to the inertia uncertainties and external disturbances. The paper "Frequency Regulation and Coordinated Control for Complex Wind Power Systems" by C. Guo et al. presented a variable coefficient coordinated primary frequency regulation scheme for a synchronous generator and doubly fed induction generator. The paper "Homeomorphism Mapping Based Neural Networks for Finite Time Constraint Control of a Class of Nonaffine Pure-Feedback Nonlinear Systems" by J. Zhang et al. proposed a finite time adaptive law for training weights of neural networks. The paper "Variable Speed Pump Storage for the Mitigation of SSR in Power System with Wind Generation" by F. Ye et al. presented a new method of using a doubly fed induction machine based system of a variable speed pumped storage plant to mitigate SSR in the power system with high penetration of wind generation.

The second group of publications is about optimization methods. The paper "A Competitive Swarm Optimizer-Based Technoeconomic Optimization with Appliance Scheduling in Domestic PV-Battery Hybrid Systems" by B. Wang et al. investigated a technoeconomic optimization problem to minimize energy cost, maximize renewable energy penetration, and increase user satisfaction over a finite horizon. The paper "A Selection Hyper-Heuristic Algorithm for Multi-objective Dynamic Economic and Environmental Load Dispatch" by L. Yang et al. presented dynamic economic and environmental load dispatch models for a system consisting of thermal units, wind power generators, photovoltaic generators, and energy storage. The paper "An Optimal Allocation Strategy for Multienergy Networks Based on Double-Layer Nondominated Sorting Genetic Algorithms" by M. Mou et al. proposed an optimal allocation strategy to optimize the allocation of distributed generation and improve the system economy. The paper "Complementary Configuration and Optimal Energy Flow of CCHP-ORC Systems Using a Matrix Modeling Approach" by W. Huang et al. presented a matrix modeling approach to establish a mathematical model of the CCHP-ORC system. The paper "Joint Optimization of Energy Conservation and Migration Cost for Complex Systems in Edge Computing" by X. Xu et al. designed a balanced resource scheduling method for trade-offs between virtual machine migration cost and energy consumption of virtual machine migrations for edge server management. The paper "Convergence Time Calculation for Supertwisting Algorithm and Application for Nonaffine Nonlinear Systems" by J. Zhang et al. proposed an accurate convergence time of the supertwisting algorithm to build up a framework for nonaffine nonlinear systems' finite-time control. The paper "Metaheuristic Optimization of Fractional Order Incremental Conductance (FO-INC) Maximum Power Point Tracking (MPPT)" by H. Ammar et al. proposed a method named FO-INC to control the output voltage of the PV arrays to obtain maximum power point tracking. The paper "A repeatable Optimization for Kinematic Energy System with Its Mobile Manipulator Application" by Y. Kong et al. proposed a special kind of repeatable optimization for kinematic energy minimization based on terminal-time Zhang neural network with finite-time convergence. The paper "A Survey on Optimal Control and Operation of Integrated Energy Systems" by C. Wei et al. reviewed the optimal control and operation behavior of the integrated energy system.

The third group of publications is about performance analysis. The paper "Available Transfer Capability Calculation Constrained with Small-Signal Stability Based on Adaptive Gradient Sampling" by P. Li et al. proposed a sequential quadratic programming method combined with gradient sampling in a dual formulation. The paper "Investigation of Var Compensation Schemes in Unbalanced Distribution Systems" by Y. Huang et al. demonstrated and analyzed the limitation of traditional Var compensation methods in voltage regulation with unbalanced PV power integration. The paper "Power Grid Fault Diagnosis Method Using Intuitionistic Fuzzy Petri Nets Based on Time Series Matching" by M. Tan et al. proposed a fault diagnosis method using intuitionistic fuzzy petri nets to improve the reliability of power grid fault diagnosis. The paper "Performance Analysis of Reheat Steam Temperature Control System of Thermal Power Unit Based on Constrained Predictive Control" by X. Li et al. analyzed the performance of the reheat temperature control system according to the data obtained based on the constrained predictive control algorithm. The paper "Performance Analysis for the Magnetically Coupled Resonant Wireless Energy Transmission System" by J. Liu et al. found the exact parameters of system optimization and verified them by simulation and experiments. The paper "Harmonic Modeling and Experimental Validation of the Converters of DFIG-Based Wind Generation System" by Y. Shen et al. studied the relation between the output current and the harmonic source at grid-side and rotor-side converters based on their control features in the DFIG system.

The last group of publications is related to planning, prediction, and multiagent system. The paper "Planning of Cascade Hydropower Stations with the Consideration of Long-Term Operations under Uncertainties" by C. Wang et al. developed an effective approach that deals with the long-term stochasticity due to the long-lasting effects of the location selections. The paper "Parallel LSTM-Based Regional Integrated Energy System Multienergy Source-Load Information Interactive Energy Prediction" by B. Wang et al. proposed an energy prediction strategy for multienergy information interaction in regional integrated energy systems from the perspective of horizontal interaction and vertical interaction. The paper "Sign-Consensus of Linear Multiagent Systems under a State Observer Protocol" by W. Diao et al. reconstructed the information of the agents' states and proposed a state observer-type sign-consensus protocol.

Conflicts of Interest

The Editors declare that they have no conflicts of interest regarding the publication of this Special Issue.

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Chun Wei
Xiaoqing Bai
Taesic Kim

References

[1] F. Cheng, L. Qu, W. Qiao, C. Wei, and L. Hao, "Fault diagnosis of wind turbine gearboxes based on DFIG stator current envelope analysis," *IEEE Transactions on Sustainable Energy*, vol. 10, no. 3, pp. 1044–1053, 2019.

[2] P. Singh and B. Khan, "Smart microgrid energy management using a novel artificial shark optimization," *Complexity*, vol. 2017, Article ID 2158926, 22 pages, 2017.

[3] C. Wei, M. Benosman, and T. Kim, "Online parameter identification for state of power prediction of lithium-ion batteries in electric vehicles using extremum seeking," *International Journal of Control, Automation and System*, vol. 17, no. 11, pp. 2906–2916, 2019.

[4] Q. Chen, H. Shi, and M. Sun, "Echo state network based backstepping adaptive iterative learning control for strict-feedback systems: an error-tracking approach," *IEEE Transactions on Cybernetics*, pp. 1–14, 2019.

[5] Q. Chen, S. Xie, M. Sun, and X. He, "Adaptive nonsingular fixed-time attitude stabilization of uncertain spacecraft," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 54, no. 6, pp. 2937–2950, 2018.