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Advanced Mathematical and Numerical Methods in Control and Optimization for Smart Grids

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Editorial

Advanced Mathematical and Numerical Methods in Control and Optimization for Smart Grids

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While renewable energy, as a part of smart-grid technologies, brings clean energy, it also brings a series of power quality problems. An increasing number of power electronic devices and new smart-grid technologies are used to ensure a safe, reliable, and high-quality operation of the power grid. However, the effectiveness of these control devices and technologies largely depends on the accuracy of the model, the advancement of control methods, and the numerical optimization of the parameters.

This special issue focuses on recent advances in modeling, numerical analysis, control, and optimization of smart grids with some special emphasis on the mathematical problems encountered at any stage of power grid operation. It contains seven papers, the contents of which are summarized as follows.

In the study of numerical analysis and optimization operation of a smart grid, L. Tao et al. use the genetic algorithm and cross-validation method to optimize the parameters of the support vector regression (SVR) model from the SCADA (Supervisory Control and Data Acquisition) system to realize the wind turbine condition monitoring in "Abnormal Detection of Wind Turbine Based on SCADA Data Mining." K.-K. K. Kim considers problems of economic dispatch in power networks that contain independent power generation units and loads in "Distributed Learning Algorithms and Lossless Convex Relaxation for Economic Dispatch with Transmission Losses and Capacity Limits."

In the area of modeling and analysis of smart grids, M. A. S. Vázquez et al. propose the use of switching functions for the modeling of power converters of a hybrid power system (HPS), allowing the reduction of hardware resources of the FPGA in "Emulator Based on Switching Functions for a Dual Interleaved Buck-Boost Converter." A mechanical model of progressive ice shedding (PIS) to analyze PIS during thermal de-icing to ensure the security of transmission lines is established by Y. Xie et al. in "Modeling and Analysis of Progressive Ice Shedding along a Transmission Line during Thermal De-Icing."

Regarding control methods of smart grids, M. A. Rodríguez-Licea et al. propose an energy management strategy (EMS) that operates autonomously and noninvasively as an additional layer to the battery management system (BMS) to increase the life expectancy of the Li-ion battery bank in "Noninvasive Vehicle-to-Load Energy Management Strategy to Prevent Li-Ion Batteries Premature Degradation." A model predictive control (MPC) strategy is presented by Y. Zou et al. for electric spring (ES) to address the power quality problems, especially the voltage regulation and harmonic suppression in "Model Predictive Control of Electric Spring for Voltage Regulation and Harmonics Suppression." A. Elnady and M. AlShabi show the operation of a microgrid using a new adaptive PI controller-based operational (control) scheme for voltage amplitude and frequency stability in "Operation of Parallel Inverters in Microgrid Using New Adaptive PI Controllers Based on Least Mean Fourth Technique."

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Conflicts of Interest

The guest editors declare that they do not have conflicts of interest regarding the publication of the special issue entitled "Advanced Mathematical and Numerical Methods in Control and Optimization for Smart Grids."

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