Editorial for the special issue on operation and control of power electronics dominated power systems

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Editorial for the Special Issue on Operation and Control of Power Electronics Dominated Power Systems

With the ever increasing penetration of renewable energy and power electronics, the current energy network is being transformed to power electronics dominated power system (PEDPS). Different from conventional power grid, PEDPS has its own characteristics such as much lower inertia, lower short circuit capacity, multi-timescale dynamic behavior, etc. These features bring tremendous challenges to the analysis, design, modeling and control of the modern power grid systems. Significant efforts have been made by researches to address these challenges, and also promote technological advancements for the entire modern power systems in terms of stability, reliability, flexibility, and efficiency.

This special issue intends to report the state-of-the-art developments on the topic of operation and control of PEDPS, and tries to provide a platform for researchers to exchange ideas and share the latest scientific research progresses. Topics of interest include, but are not limited to emerging power electronics topologies, advances in modeling and analysis of power converters, multi-timescale stability analysis and robust control, developments in the simulation tools for PEDPS, etc.

We organized the accepted six (6) papers in this special issue into two groups:

(1) Advances in topologies, modeling and control optimization (3 papers)

In the first group, the first paper "Evaluation of High Step-up Power Conversion Systems for Large-capacity Photovoltaic Generation Integrated into Medium Voltage DC Grids" by S. Lu *et al.* presents a comprehensive study for the dc-dc power conversion system in medium voltage dc grids. Several typical system configurations as well as the proposed solution are compared in terms of input/output performance, conversion efficiency, modulation method, control complexity, power density, reliability, and hardware cost.

The second paper "Python Supervised Co-simulation for a Day-long Harmonic Evaluation of EV Charging" by L. Wang *et al.* proposes a multi-time scale modeling framework and a Python supervised co-simulation for a day-long harmonic evaluation of fast-charging stations (FCSs). The impact of a time-variant charging profile is considered. Simulation results show the harmonic evaluation with the co-simulation features good balance between the accuracy and computational cost.

The third paper "Single-phase Grid-connected PV System with Golden Section Search-based MPPT Algorithm" by S. Xu *et al.* proposes an maximum power point tracking (MPPT) algorithm that combines the golden section search with commonly-used perturb and observe (P&O) and incremental conductance (INC) methods, in order to achieve faster convergence and smaller oscillation simultaneously. This method converges to

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the MPP by repeatedly narrowing the width of the interval at the rate of the golden ratio. Simulation and experimental results show fast dynamic response and high tracking efficiency are both achieved by the proposed MPPT solution.

(2) Stability analysis and robust control (3 papers)

In the second group, the first paper "Controller Design-oriented Analysis of Grid-forming Converters for Stability Robustness Enhancement" by Y. Liao *et al.* proposes a control-loop decomposition approach for grid-forming converters. By combining with impedance-based stability analysis, this approach can reveal how different control loops affect the converter-grid interaction. As a result, the robust controller design that enables the grid-forming converters to operate within a wider range of short-circuit ratios can be conducted.

The second paper "Distributed Control Framework and Scalable Small-signal Stability Analysis for Dynamic Microgrids" by Y. Men *et al.* develops a distributed control method for dynamic microgrids (MGs) operation, based on the hierarchical control framework and the consensus-based averaging approach. A scalable small-signal stability analysis for the presented controllers along with various operation modes is developed, and the exponential stability of the linearized system is revealed. Real-time simulation results verify the effectiveness of the proposed framework and stability analysis.

The third paper "Stability and Robustness of a Coupled Microgrid Cluster Formed by Various Coupling Structures" by S.M.Ferdous *et al.* studies the stability and robustness of various structures for coupling neighboring Microgrids (MGs). The effects of factors, e.g., the length of the interconnecting line among the MGs, the amount of power supplied to the troubled MGs, and the number of coupled MGs, are compared in detail. The findings of this study can help system designers to select a suitable coupling structure depending on the design constraints.

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