frontiers in Energy Research

EDITORIAL
published: 25 March 2022
doi: 10.3389/fenrg.2022.885659

Editorial: Advanced Technologies for Modeling, Optimization and Control of the Future Distribution Grid

Ningyi Dai[1]*, *Yi Ding*[2], *Jiawei Wang*[3] and *Dongdong Zhang*[4]

[1]State Key Laboratory of Internet of Things for Smart City, University of Macau, Macau, China, [2]College of Electrical Engineering, Zhejiang University, Hangzhou, China, [3]Department of Electrical Engineering, DTU, Technical University of Denmark, Lyngby, Denmark, [4]School of Electrical Engineering, Guangxi University, Nanning, China

Keywords: Distribution energy resource, distribution grid, integrated energy system, microgrid, resilience

Editorial on the Research Topic

Advanced Technologies for Modeling, Optimization and Control of the Future Distribution Grid

Future power grids face various challenges due to a rapidly increasing share of renewable energy resources and increasing interplay with other energy sectors. Distributed energy resources (DERs) such as wind, solar, energy storage, combined heat and power plants, electric vehicles, and smart loads become prevalent. As shown in **Figure 1**, it has become an inevitable choice for the energy revolution to develop an integrated energy system that realizes the deep integration of new technologies with distributed energy and diversifies (cold, heat, electricity, gas, etc.) demand. Besides, we are moving towards an integrated energy system on an unprecedented scale. In the continuous development of integrated energy systems, the elements of participation and interaction are becoming more complex. The integration of variable sources and the efficient and synergistic utilization of these energies will be a key focus in the future development.

This issue contains ten research articles focusing on modeling and analysis methods for IES, advanced technologies for DERs and microgrid, active distribution network, impact of DERs interconnection on the distribution network, etc.

The paper by Cao et al. proposed the concept of shared ESS (Shared-ESS) for microgrid owner/operator and applied it to the economic optimal dispatch of a microgrid cluster. The microgrids can achieve the peer-to-peer (P2P) transaction among each other with the use of the Shared-ESS, which significantly improves the energy utilization efficiency. The numerical analysis shows that the Shared-ESS can significantly reduce the energy bills of microgrid owner/operator, shift the usage of energy during peak time, and facilitate the renewable energy consumption.

The orderly deregulation of planned electricity generation and consumption is an important measure for electricity market reform in several countries. Under the plan-market double-track mechanism (PMDM) implemented, a modified linear bidding function of generation companies was first proposed by He et al., and the unified clearing price of unilateral generation market is determined accordingly. Simulations based on data from a provincial electricity market in China illustrate that the market power can be reduced through a reasonable proportion of planned electricity designed by the power exchange.

The paper by Chen et al. discusses a passive sliding mode control strategy of MMC-UPFC to achieve the advantages of both the passive controller and sliding mode controller. An unbalanced grid treatment strategy is also presented with the series side of MMC-UPFC. Negative sequence components of the grid voltages are detected by the cross-decoupling method with second order

Edited and reviewed by:
ZhaoYang Dong,
University of New South Wales, Australia

***Correspondence:**
Ningyi Dai
nydai@um.edu.mo

Received: *28 February 2022*
Accepted: *09 March 2022*
Published: *25 March 2022*

Citation:
Dai N, Ding Y, Wang J and Zhang D (2022) Editorial: Advanced Technologies for Modeling, Optimization and Control of the Future Distribution Grid. Front. Energy Res. 10:885659. doi: 10.3389/fenrg.2022.885659

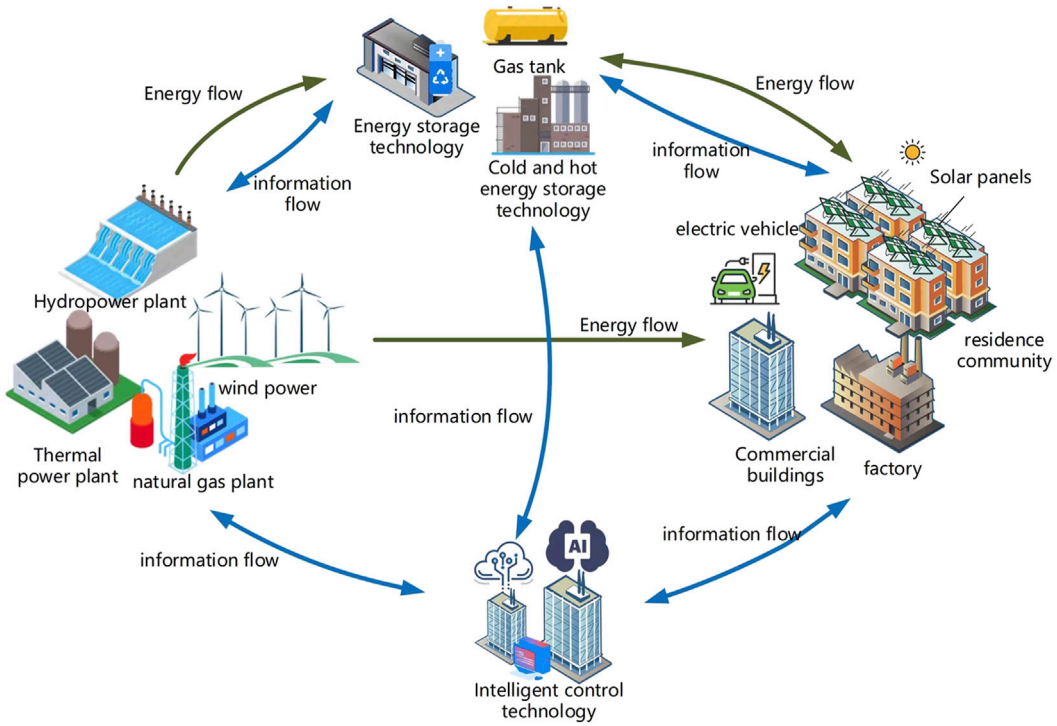

FIGURE 1 | Integrated energy system.

generalized integrator and then compensated by the series side of MMC-UPFC. The series side converter controls the power flow and treats unbalanced grid conditions simultaneously.

The article by Hu et al. is an assessment report meant to address the step-less, and low-cost reactive power to reduce the increasing risks of voltage violations in distribution networks (DNs). Firstly, reactive power compensation models of PVs and EV chargers are investigated and voltage deviation indexes of the regulation results are proposed. Moreover, kernel density estimation (KDE) and slice sampling are adopted to provide the PV output and EV charging demand samples. Then, the risk assessment is carried out with a voltage regulation model utilizing OLTCs, SCs, and available smart inverters.

One study, Wang et al. explored an optimal placement model of voltage sag monitor, which considers the sag economic loss weight, realizes the redundant coverage of important customers, and reduces the risk of sag loss of them. Compared with traditional methods, this method can reduce the risk of loss and ensure the economic benefits of important customers.

Frequency regulation is a critical issue in the islanded microgrids. Zhong et al. proposes an equivalent rotor speed compensation control scheme of PMSG for frequency support in the islanded microgrids. A new variable combining pitch angle and rotor speed is defined as the equivalent rotor speed. The inertia control scheme is optimized by adding a virtual compensation variable to the equivalent rotor speed to obtain the reference of the machine-side converter control loop.

Chen and Bai proposes a mixed-integer nonlinear programming (MINLP) model combining electrical, natural gas, and heating systems, as well as the coupling components, such as CHP and gas-fired generators. The second-order cone and linearized techniques are used to transform the non-convex fundamental matrix formulation of multi-energy network equations to a mixed-integer convex multi-energy flow model, which can improve the computational efficiency significantly.

One study Liu et al., focused on a weak-consistency–oriented collaborative strategy, which was proposed for the practical implementation of the large-scale distributed demand response. Using case studies with different information transmission error rates and other conditions, the proposed strategy is demonstrated to be an effective solution for the large-scale distributed demand response implementation, with a robust response capability under even remarkable transmission errors.

In another study Liu et al., a non-intrusive load disaggregation approach based on an enhanced neural network learning algorithm was proposed. The presented appliance enhances the flexibility and adaptability for diverse scenarios, leading to the improvement of disaggregation performance.

To manage a large scale of distributed energy resources (DERs) dispersed geographically and reduce the impact of DER uncertainties, Zheng et al. propose a distributed two-stage economic dispatch for a virtual power plant (VPP) to track a specified VPP schedule curve. The two-stage distributed optimization problems are solved by an improved

exact diffusion algorithm which is proved to be robust to local communication failure.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.