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Editorial: Edge computation and digital distribution networks

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Editorial on the Research Topic
Edge Computation and Digital Distribution Networks

Introduction

The development of digital technologies is penetrating all areas of energy revolution. Based on the in-depth integration of advanced digital technologies, distribution networks are gradually transforming into digital distribution networks (DDNs) with tremendous changes from the structure to the operation mode. DDNs is the digitalized appearance of the physical distribution network, in which ubiquitous connections and massive data are the basic characteristics (Huo et al., 2022). It is an important task to utilize the massive data and propose novel operation modes to construct more efficient and intelligent distribution networks (Jian et al., 2022). Among the advanced digital technologies in DDNs, edge computing has received wide attention (Zhao et al., 2022). It has superior performance in local sensing and intelligent computation, which can effectively relieve huge communication pressure. However, the limited computing resources and the complex computing tasks at the edge side significantly challenge the collaboration of distribution network regulation and advanced digital technologies (Hu et al., 2022). It is necessary to find out proper methods to utilize advanced digital technology to construct DDNs.

This Research Topic is organized to introduce the recent progress in the construction, operation and advanced computational methods for DDNs. Finally, seven papers have been accepted, which can be sorted into the following three categories: 1) Evolution and technical features of DDNs, 2) Intelligent operation control of DDNs, 3) Advanced simulation for large-scale DDNs. The three sections below respectively introduce the major research and contributions of the papers covered in each category.

Evolution and technical features of DDNs

The development of digital technology and power electronic technology can support fully flexible interconnection of distribution networks. Research on the evolution and technical features of physical distribution networks is the foundation of operation control of DDNs.

Wang et al. present a honeycomb grid structure for the multi-station integrated system with soft open points (SOP) as flexible nodes. The hydrogen-electricity coupling structure and the conversion strategy of hydrogen and electricity are proposed for the deep application of hydrogen energy.

Intelligent operation control of DDNs

The increasing integration of novel devices with customized user demands will challenge system operation due to high randomness and complexity. The intelligent operation control is desired to comprehensively facilitate the secure, economical, and efficient operation of DDNs.

Cao et al. design a distributed resilient enhancement method in cyber-physical microgrids to cope with control failure by false data injection attack (FDIA). Based on the synchronous mitigation framework, the consensus communication coupling gain is corrected to delete the attack signal. It can reduce the complexity of the conventional controller design.

Wang et al. propose an adaptive forecasting method for community integrated energy system (CIES) based on deep transfer learning. The hour-level local features and day-level coarse-grained features of CIES are extracted with a focus on critical loads. The coupling relationship and uncertainty differences of loads are considered. It has adaptiveness to multiple forecasting scenarios.

Lu et al. develop a dual-timescale energy management method for distribution system. To confront load surging and renewable energy fluctuations, exp-function is used to improve droop control. The reference power and parameters of improved droop control are optimized in different timescales to improve the operational economy and power quality.

Yang et al. present an adaptive model predictive scheduling method for flexible interconnected distribution networks considering preferences of electric vehicles (EVs). Through the dynamic update of scheduling window, energy loss and load fluctuation can be further reduced under real-time scheduling of controllable EVs.

Advanced simulation for large-scale DDNs

The real-time simulation of distribution networks can facilitate the decision-making of operation control strategies. However, the explosion of operation data and system scale challenges the rapid operation simulation in the digital twin environment. It is necessary to develop advanced simulation methods for large-scale DDNs.

Liu et al. build a micro electric field measurement sensor model based on piezoelectric-piezoresistive coupling. It is aimed at solving problems of large size, high energy consumption, and difficult operation and maintenance of the existing electric field measurement sensors in power distribution systems.

Luo et al. establish an ontology modeling method for time-series operation simulation of distribution networks. The simulation expression and modeling efficiency are verified. It provides a reference for the technical realization of power grid modeling in digital twin environments.

Conclusion

The papers on this Research Topic cover various technical solutions for *Edge computation and digital distribution networks*, such as the evolution of future distribution networks, novel operation methods, and advanced simulation methods for DDNs. The research will facilitate high-quality intelligent electricity services under complex environments.

Author contributions

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

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Conflict of interest

WX was employed by the company China Southern Power Grid.

The remaining 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.

Publisher's note

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