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Editorial: Application of power grid equipment digital and intelligent technology in operation and maintenance

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Editorial on the Research Topic
Application of power grid equipment digital and intelligent technology in operation and maintenance

The fourth industrial revolution, driven by the Internet of Things and cyber-physical systems, is transforming supply chain automation and power equipment maintenance. To adapt to these changes, it is crucial to integrate technologies like cloud computing, big data, 5G communication, and artificial intelligence, enhancing digitalization and intelligence in electric power equipment operation and maintenance. This will help overcome challenges such as incomplete information, low digitization, and inaccurate assessments, improving the overall management of power equipment.

This Research Topic provides a perfect platform to submit contributions that discuss the application of power grid equipment digital and intelligent technology in operation and maintenance, but not limited to: digital theories, digital modeling methods, new sensing technology, condition assessment, intelligence inspection technology, advanced electrical materials, artificial intelligence and machine learning technology.

After a strict review progress, seven high-quality articles contributed by 42 authors were finally accepted to this Research Topic. We will review them in the following.

In the article "*Bi-Level Coordinated Planning of Sectionalizing Switches and Tie Lines Considering Operation Mode Adjustment*", Luo et al. presents a bi-level planning model for sectionalizing switches (SSs) and tie lines (TLs) to enhance distribution network reliability and efficiency. The model optimizes SSs and TLs allocation by adjusting distribution operation modes. The upper level minimizes investment, customer interruption, and line loss costs while determining SSs and TLs' number and location. The lower level adjusts operation modes to minimize line losses. Binary particle swarm optimization (BPSO) and second-order cone programming (SOCP) are employed for stable convergence and reduced complexity. Simulations on the RBTS test system verify the model's feasibility, stability, and effectiveness.

In the article "*Review on online operation insulator identification and fault diagnosis based on UAV patrol images and deep learning algorithms*", Zhang et al. highlights the development and practical success of online insulator location identification and fault diagnosis technologies using unmanned aerial vehicle (UAV) patrols and deep learning algorithms. Additionally, the article compiles recent literature on insulator detection technology to uncover three common application challenges and research difficulties, while providing a comprehensive summary of improved algorithms and comparing the performance evaluation metrics of various approaches.

In the article "*Research on Restrictive Factors and Planning of Charging Piles for Electric Vehicles in the Park Based on the Interpretative Structural Model*", Zhang et al. investigates the constraints of EV charging stations in industrial parks and their impact on planning. Using field research and interpretive structural modeling (ISM), the study examines restrictive factors and their influence on park planning. The findings provide insights for improved planning and design of EV charging stations in industrial parks.

In the article "*Multiple detections of insulation defects partial discharge in gas-insulated equipment*", Kong et al. explores the detection of insulation defects partial discharge (PD) in gas-insulated equipment, a crucial part of power systems. Three types of insulation defects (floating, void, and surface) are examined using ultra-high frequency (UHF), high-frequency current (HFCT), and acoustic emission (AE) methods on a PD simulation platform. Results show that the UHF method effectively detects all three defects, the HFCT method is sensitive to floating defects but less so to void and surface defects, and the AE method effectively detects floating defects but not void and surface defects.

In the article "*Gabor-YOLONet: A lightweight and efficient detection network for low-voltage power lines from unmanned aerial vehicle images*", Feng et al. proposes a novel power line detection method called Gabor-YOLONet for intelligent edge identification devices in UAVs. The method uses the Gabor algorithm to automatically extract power lines and auxiliary targets like insulators from cluttered backgrounds. A new inference method is introduced to verify the rationality of predicted results for power lines by clustering average location and orientation of auxiliary targets. Experiments show that Gabor-YOLONet achieves higher accuracy, consumes fewer computing resources, and has an mAP of 86.6% and a running time of 25 ms, demonstrating excellent performance on intelligent edge devices.

In the article "*A novel approach to design of a power factor correction and total harmonic distortion reduction-based BLDC motor drive*", Bin et al. presents a novel power factor correction (PFC) and total harmonic distortion (THD) reduction-based brushless DC (BLDC) motor drive design. The drive uses a modified Zeta converter operating in discontinuous inductor current mode (DICM) for improved power factor and reduced THD. The design is simulated and assessed in the MATLAB/Simulink environment using SimPowerSystems and Simscape toolbox, aiming for better power factor, lower THD, and enhanced speed control. The proposed PFC modified Zeta converter topology achieves a power factor of 0.981 and a THD of 9.81%, outperforming other topologies and demonstrating the significance of the proposed model.

In the article "*The effects of TiO2 nanoparticles on the temperature-dependent electrical and dielectric properties of polypropylene*", Zhang et al. investigates the effects of nanoparticles on the electrical and dielectric properties of polypropylene (PP) at high temperatures. TiO2 nanoparticles and PP/TiO2 nanocomposite samples are prepared and tested for AC and DC breakdown strength, conductivity, permittivity, and dielectric loss at varying temperatures. Results show that TiO2 nanoparticles improve PP's breakdown strength by introducing charge traps while restraining conductivity. However, the permittivity and dielectric loss of the PP/TiO2 nanocomposite are increased due to interfacial polarization between TiO2 nanoparticles and the PP matrix, particularly at low frequencies.

We have reviewed the accepted seven papers of the Research Topic "Application of Power Grid Equipment Digital and Intelligent Technology in Operation and Maintenance". We can find seven papers accepted under this Research Topic focusing on cutting-edge research directions in the application of advanced artificial intelligence techniques in power equipment fault diagnosis, advanced electrical materials, grid planning, etc. We think this Research Topic can further encourage the development of the intelligent operation and maintenance methods for electrical equipment.

Finally, we, the Research Topic Editors, would like to take this platform to thank all the contributing authors who responded positively to this Research Topic as well as the reviewers for their excellent contributions. Special thanks also go to the Editor-in-Chief and the Editorial Board of the journal for their strong support of this Research Topic.

Author contributions

YZ is responsible for the overall writing of the editorial, while other authors are responsible for providing suggestions. All authors contributed to the article and approved the submitted version.

Conflict of interest

YZ was employed by the company Guangxi Power Grid Corporation.

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.

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