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AI-Enhanced Operation and Management of Renewable Energy-Integrated Power Systems

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This Reprint addresses the emerging paradigm of AI-enhanced operation and management in power systems with high penetration of renewable energy sources. As renewable-rich power systems become increasingly complex and uncertain, AI is poised to reshape traditional operational practices and decision-making processes. The works collated within this Reprint present recent advances in data-driven wind and photovoltaic forecasting, intelligent state estimation and sensing, adaptive and robust scheduling of integrated energy systems, and AI-enabled decision-making for active distribution networks and coupled infrastructures. These studies demonstrate that AI technologies can complement or extend conventional model-based approaches to better manage variability, uncertainty, and scalability challenges. Beyond individual methods, this Reprint highlights a broader shift from static, centralized operation toward adaptive, distributed, and system-aware management frameworks. Several contributions illustrate that AI can integrate heterogeneous information across generation, grids, loads, and external systems, enabling more responsive and low-carbon operational strategies, while others emphasize uncertainty-aware pricing, robust optimization, and voltage or flexibility support aligned with physical and market constraints. By bringing together these perspectives, this Reprint provides a timely overview of how AI-enhanced methodologies are shaping the next generation of renewable-rich power systems.



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