

Special Session XIII

Special Session Basic Information:

专栏题目 Session Title

中文：海量异构分布式灵活性资源聚合调控与协同运行
英文：Aggregation, Regulation, and Cooperative Operation of Massive Heterogeneous Distributed Flexibility Resources

专栏介绍和征稿主题 Introduction and topics

中文：

随着新型电力系统建设的深入推进，高比例可再生能源的接入使得系统的随机性与波动性显著增强。在此背景下，海量的分布式电源、储能系统、多元柔性负荷、电动汽车等构成了规模庞大、类型各异、动态特性复杂的异构分布式灵活性资源。这些资源单体容量小、分布广泛、行为模式多样，如何对其进行高效聚合、精准调控与协同运行，是有效平抑可再生能源波动并实现电力系统安全、稳定、经济、低碳运行的关键，也是当前学术研究与工程实践面临的重大挑战。

本期特刊旨在探讨海量异构分布式灵活性资源在建模、聚合、调控与协同运行等方面的前沿理论、关键技术及创新应用，以推动分布式资源从“可观、可测”向“可控、可用”的跨越，为构建清洁低碳、安全充裕、经济高效、供需协同、灵活智能的新型电力系统提供核心支撑。

本期特刊欢迎原创研究论文和评论。研究领域包括（但不限于）以下内容：

- 分布式灵活性资源的统一建模与异构特性分析研究；
- 海量分布式资源的聚合等值理论与可调控潜力评估方法；
- 数据驱动与人工智能赋能的分布式资源集群调控策略；
- 考虑多重不确定性的分布式资源协同运行优化与市场机制设计；
- 面向虚拟电厂、虚拟储能等的分布式资源聚合调控关键技术；
- 基于区块链的分布式资源可信聚合与交易技术；
- 海量资源参与电网调频、调峰及应急响应的协同控制方法；
- 配电网-微网-用户侧资源的分层分区协同运行关键技术。

英文：

With the advancement of new-type power system construction, the high penetration of renewable energy has significantly increased the randomness and volatility of the system. Against this backdrop, massive distributed energy resources, energy storage systems, diverse flexible loads, electric vehicles, and other components have formed a large-scale, heterogeneous, and dynamically complex set of distributed flexibility resources. These resources are characterized by small individual capacity, wide distribution, and diverse behavioral patterns. How to efficiently aggregate, accurately regulate, and coordinate the operation of these resources is key to mitigating renewable energy fluctuations and achieving a safe, stable, economical, and low-carbon power system. It also represents a major challenge in both academic research and engineering practice.

This special issue aims to explore cutting-edge theories, key technologies, and innovative applications in the modeling, aggregation, regulation, and coordinated operation of massive heterogeneous distributed flexibility resources. The goal is to promote the transition of distributed resources from "visible and measurable" to "controllable and usable," thereby providing core support for building a clean, low-carbon, safe, sufficient, economical, efficient, supply-demand coordinated, flexible, and smart new-type power system.

In this Special Issue, original research articles and reviews are welcome. Research areas may include (but not limited to) the following:

- Unified Modeling and Heterogeneity Analysis of Distributed Flexibility Resources;
- Aggregation and Equivalence Theory for Massive Distributed Resources and Methods for Assessing Their Controllable Potential;
- Data-Driven and AI-Enabled Regulation Strategies for Clusters of Distributed Resources;
- Coordinated Operation Optimization and Market Mechanism Design for Distributed Resources Considering Multiple Uncertainties;
- Key Technologies for the Aggregation and Regulation of Distributed Resources in Virtual Power Plants, Virtual Energy Storage, and Similar Frameworks;
- Blockchain-based Trusted Aggregation and Transaction Technologies for Distributed Resources;
- Coordinated Control Methods for Massive Resources Participating in Grid Frequency Regulation, Peak Shaving, and Emergency Response;
- Key Technologies for Hierarchical and Zonal Coordinated Operation of Distribution Networks, Microgrids, and Customer-Side Resources.

Special Session Chair(s):

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Organizer's Brief Biography

中文：朱虹谕，内蒙古工业大学新能源学院，副研究员，硕士生导师，电气工程博士，中国科协青年托举人才（博士专项计划）。长期从事多能耦合分布式能源系统优化运行、源-网-荷-储灵活性资源协同响应与调控技术方面的研究，主持或参与中国科协青年人才托举工程项目、国家重点研发计划项目、国家自然科学基金项目等 10 项；获全国高校电气类专业课程实验教学案例设计竞赛全国二等奖、宝钢教育奖、综合智慧能源大会示范科技成果一等奖等多项奖励；近五年发表高水平期刊论文 30 余篇，其中包括 SCI 中科院一区 Top 期刊论文 10 篇，ESI 全球 Top 前 1%高被引论文 2 篇；授权/受理国家发明专利 4 项。

英文：Hongyu Zhu, Associate Professor, School of New Energy, Inner Mongolia University of Technology. She has been selected for the China Association for Science and Technology Young Talent Support Project (Doctoral Special Program). Her long-term research focuses on the optimal operation of multi-energy coupled distributed energy systems, and the coordinated response and control technologies for source-grid-load-storage flexible resources. She has presided over or participated in 10 research projects, including the CAST Young Talent Support Project, National Key R&D Program of China, and projects of the National Natural Science Foundation of China. She has received multiple awards, including the Second Prize in the National College Electrical Engineering Course Experiment Teaching Case Design Competition, the

Baosteel Education Award, and the First Prize for Exemplary Scientific and Technological Achievements at the Integrated Smart Energy Conference. In the past five years, she has published over 30 high-level journal papers, including 10 papers in Top-tier journals of the Chinese Academy of Sciences (CAS) classification (Q1), and 2 ESI Highly Cited Papers (ranking in the top 1% globally by citations). Additionally, she has 4 national invention patents granted or pending.



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Organizer’s Brief Biography

中文：武晓栋，内蒙古工业大学新能源学院，天津大学外聘智能电网国家科技重大专项项目研究骨干，讲师，硕士生导师，信息与通信工程博士。长期从事新型电力系统通信网络安全、综合能源系统数据挖掘、深度学习及量子算法理论方面的研究，主持或参与国家重点研发计划项目、国家自然科学基金项目、鄂尔多斯市新能源战略性先导科技专项计划等 4 项；获全国高校电气类专业课程实验教学案例设计竞赛全国二等奖、中国电力发展促进会科学技术三等奖、天津市电力公司科技进步二等奖等多项奖励；近五年发表高水平期刊论文 20 余篇，其中包括 SCI 中科院二区及以上期刊论文 8 篇。

英文：Wu Xiaodong, Lecturer, PhD in Information and Communication Engineering, School of New Energy, Inner Mongolia University of Technology. He has been hired as external researcher at Tianjin University for the National Science and Technology Major Project on Smart Grid. His research focuses on network security for new power system communication, data mining of integrated energy systems, deep learning, and quantum algorithm theory. He has led or participated in four national key R&D projects, including projects funded by the National Key Research and Development Project, the National Natural Science Foundation of China, and the Ordos City New Energy Strategic Pilot Science and Technology Special Project. He has received numerous awards, including the second prize in the National College Electrical Engineering Course Experiment Teaching Case Design Competition, the third prize in the Science and Technology Award from the China Electric Power Promotion Council, and the second prize in the Science and Technology Progress Award from Tianjin Power Grid. In the past five years, he has published over 20 high-level journal papers, including 8 papers in journals ranked in the second quartile or above by the Chinese Academy of Sciences.