# Special Session XVI

## Special Session Basic Information:

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| **专栏题目<br>Session Title** | 中文：储能系统能量变换、协同控制、拓扑配置及运行优化<br>英文：Energy Storage Conversion, Control, Configuration and Operation Optimization |

**专栏介绍和征稿主题**
**Introduction and topics**

中文：随着“双碳”目标的持续推进和新型电力系统建设的加速，以风电、光伏为代表的新能源发电在电力系统中的占比不断提升，电源侧、配电侧和用户侧对储能系统的灵活调节能力、能量转换效率和安全稳定运行能力提出了更高要求。储能系统作为支撑新能源消纳、提升电网灵活性、改善电能质量和保障系统安全运行的重要技术手段，正在从单一能量缓冲设备向集成能量变换、协同控制、容量配置和优化运行的综合性关键装备与系统平台发展。储能系统的能量变换与控制主要涉及储能变换器拓扑、双向功率流控制、并网、离网运行控制以及多时间尺度能量管理策略，是实现电能高效转换、灵活传输和源网荷储协同互动的重要基础。在储能系统配置方面，面向不同应用场景合理确定储能选址、容量配置、拓扑结构和运行边界，可有效降低系统运行成本，提高新能源利用率和综合能效。储能系统运行优化则需要综合考虑新能源出力波动、负荷不确定性、电网运行约束、经济性和安全性，通过动态调整充放电策略、功率分配和协同调度方式，实现系统稳定运行与经济效益最大化。本专栏聚焦储能系统能量变换、协同控制、拓扑配置及运行优化等关键理论与技术，旨在汇聚储能变换器、电力电子、微电网、新能源电力系统、综合能源系统和智能优化等领域的最新研究成果，探讨储能系统在高比例新能源接入和新型电力系统建设中的关键作用与发展路径。主题包括但不限于：

- 储能变换器拓扑结构、建模分析与高效能量变换技术
- 储能系统并网/离网运行控制、暂态功率控制与稳定性提升方法
- 面向新能源消纳的储能容量配置、选址规划与拓扑优化技术
- 储能系统多时间尺度能量管理与经济优化运行策略
- 微电网、直流微电网及交直流混合系统中的储能协调控制技术
- 超级电容、电池储能及混合储能系统的功率分配与协同控制
- 储能参与电网调频、调压、功率补偿和电能质量治理的关键技术
- 面向风光储、风储制氢及综合能源系统的储能优化调度方法
- 储能系统状态评估、安全管理、故障诊断与寿命优化技术
- 人工智能、大数据和先进优化算法在储能配置与运行控制中的应用

英文： With the continuous advancement of the “dual carbon” goals and the accelerated construction of novel power systems, the penetration of renewable energy sources represented by wind and photovoltaic generation is increasing rapidly. This trend imposes higher requirements on the flexibility, energy conversion efficiency, and secure operation of energy storage systems at the generation side, distribution side, and demand side. As an important technical solution for renewable energy accommodation, grid flexibility enhancement, power quality improvement, and secure system operation, energy storage systems are evolving from simple energy buffering devices into integrated platforms that combine energy conversion, coordinated control, configuration planning, and optimal operation. Energy storage conversion and control mainly involve converter topologies, bidirectional power flow control, grid-connected/islanded operation control, and multi-timescale energy management strategies. These technologies provide the basis for efficient power conversion, flexible energy transmission, and coordinated interaction among source, grid, load, and storage. In terms of energy storage configuration, proper determination of siting, capacity allocation, topology, and operational boundaries for different application scenarios can effectively reduce system operation costs while improving renewable energy utilization and overall energy efficiency. The optimal operation of energy storage systems requires comprehensive consideration of renewable power fluctuations, load uncertainties, grid constraints, economy, and security. By dynamically adjusting charging/discharging strategies, power allocation, and coordinated dispatching schemes, energy storage systems can support stable system operation and maximize economic benefits. This special

session focuses on key theories and technologies related to energy storage conversion, coordinated control, configuration, and operation optimization. It aims to bring together the latest research achievements in energy storage converters, power electronics, microgrids, renewable power systems, integrated energy systems, and intelligent optimization, and to explore the critical role and development path of energy storage systems in high-renewable-penetration power systems. Topics include but are not limited to:

- Energy storage converter topologies, modeling, analysis, and high-efficiency energy conversion technologies
- Grid-connected/islanded control, transient power control, and stability enhancement of energy storage systems
- Energy storage capacity allocation, siting planning, and topology optimization for renewable energy accommodation
- Multi-timescale energy management and economic optimal operation strategies for energy storage systems
- Coordinated control of energy storage in microgrids, DC microgrids, and AC/DC hybrid systems
- Power allocation and coordinated control of supercapacitor, battery, and hybrid energy storage systems
- Key technologies for energy storage participation in frequency regulation, voltage regulation, power compensation, and power quality management
- Optimal dispatch of energy storage in wind-solar-storage, wind-storage-hydrogen, and integrated energy systems
- State evaluation, safety management, fault diagnosis, and lifetime optimization of energy storage systems
- Applications of artificial intelligence, big data, and advanced optimization algorithms in energy storage configuration and operation control

## Special Session Chair(s):


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| **姓名 Name** | 段建东 Jiandong Duan |
| **称谓 Prefix** | 教授 Professor |
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### Organizer's Brief Biography

中文：段建东分别于 2007 年获得东北林业大学电气工程及其自动化专业工学学士学位，于 2009 年和 2013 年获得哈尔滨工业大学电气工程专业工学硕士和博士学位。现任哈尔滨工业大学电气工程学院教授、院长助理。主要研究方向包括微电网、暂态功率控制、超级电容功率补偿等。近年来主持科研项目 15 项，其中包括国家自然科学基金项目 2 项，以及中国航天科工集团、中国石油集团和中国船舶工业集团等单位的重大横向项目 3 项。已发表学术论文 56 篇，其中 SCI 期刊论文 34 篇、EI 论文 22 篇，并担任 1 部学术专著主编。曾获黑龙江省技术发明二等奖，并入选 2021 年第五届国际储能创新大赛“十大储能创新应用”项目。

英文：Jiandong Duan received the B.Eng. degree in Electrical Engineering and Automation from Northeast Forestry University, Harbin, China, in 2007, and the M.Eng. and Ph.D. degrees in Electrical Engineering from Harbin Institute of Technology, Harbin, China, in 2009 and 2013, respectively. He is currently a Professor and Dean’s Assistant with the School of Electrical Engineering, Harbin Institute of Technology. His research interests include microgrids, transient power control, and supercapacitor power compensation. In recent years, he has led 15 research projects, including two projects funded by the National Natural Science Foundation of China and three major industry-sponsored projects from China Aerospace Science and Industry Corporation, China Petroleum Corporation, and China Shipbuilding Industry Corporation. He has published 56 academic papers, including 34 SCI-indexed journal papers and 22 EI-indexed papers, and served as the chief editor of an academic monograph. He received the Second Prize for Technological Invention of Heilongjiang Province and was recognized among the Top 10 Innovative Energy Storage Applications in the 5th International Energy Storage Innovation Competition 2021.

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| **姓名 Name** | 王尧强 Yaoqiang Wang |
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## Organizer's Brief Biography

中文：王尧强为 IEEE 和中国电机工程学会高级会员。2006 年获得杭州电子科技大学工学学士学位，2008 年和 2013 年分别获得哈尔滨工业大学工学硕士和博士学位。现任郑州大学电气与信息工程学院教授，同时担任郑州大学电气工程系主任、河南省电力电子与能源系统工程研究中心主任。已发表技术论文 100 余篇，其中期刊论文 80 余篇，授权专利 30 余项。主要研究方向包括新能源电力系统、新能源与电力储能、电力系统运行与规划、综合能源系统分析与优化等。

英文：Yaoqiang Wang is a Senior Member of IEEE and CSEE. He received the B.Eng. degree from Hangzhou Dianzi University, Hangzhou, China, in 2006, and the M.Eng. and Ph.D. degrees from Harbin Institute of Technology, Harbin, China, in 2008 and 2013, respectively. He is currently a Professor with the School of Electrical and Information Engineering, Zhengzhou University, Zhengzhou, China. He also serves as Director of the Department of Electrical Engineering of Zhengzhou University and Director of the Henan Provincial Engineering Research Center of Power Electronics and Energy Systems. He has authored more than 100 technical papers, including over 80 journal papers, and holds more than 30 patents. His current research interests include new energy power systems, renewable energy and power storage, power system operation and planning, and integrated energy system analysis and optimization.

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## Organizer's Brief Biography

中文：范绍贵 1989 年出生于安徽。分别于 2012 年和 2014 年获得哈尔滨工程大学电气工程专业学士和硕士学位，于 2019 年获得哈尔滨工业大学电气工程专业博士学位。现任哈尔滨工程大学烟台研究院副教授。近年来主持科研项目 6 项，其中包括国家自然科学基金项目 1 项、国家重点研发计划项目 1 项、山东省重点研发计划项目 1 项。已发表学术论文 22 篇，其中 SCI 期刊论文 12 篇、EI 论文 10 篇。主要研究方向包括无线电能传输、电池管理系统和直流微电网。

英文：Shaogui Fan was born in Anhui, China, in 1989. He received the B.S. and M.S. degrees in Electrical Engineering from Harbin Engineering University, Harbin, China, in 2012 and 2014, respectively, and the Ph.D. degree in Electrical Engineering from Harbin Institute of Technology, Harbin, China, in 2019. He is currently an Associate Professor with the Yantai Research Institute of Harbin Engineering University. In recent years, he has led six research projects, including one project funded by the National Natural Science Foundation of China, one project funded by the National Key Research and Development Program of China, and one project funded by the Key R&D Program of Shandong Province. He has published 22 academic papers, including 12 SCI-indexed journal papers and 10 EI-indexed papers. His research interests include wireless power transmission, battery management systems, and DC microgrids.

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## Organizer's Brief Biography

中文：孙东阳现任哈尔滨工业大学副教授，博士毕业于哈尔滨工业大学电气工程学院。已发表 SCI 或 EI 检索论文 30 余篇，曾获黑龙江省科学技术进步二等奖。主要研究方向包括新能源发电中的次同步振荡抑制、风储制氢电站调频策略以及船舶综合电力系统稳定性研究等。

英文：Dongyang Sun is an Associate Professor at Harbin Institute of Technology. He received the Ph.D. degree from the School of Electrical Engineering, Harbin Institute of Technology. He has published over 30 SCI- or EI-indexed papers and received the Second Prize for Scientific and Technological Progress of Heilongjiang Province. His main research interests include subsynchronous oscillation suppression in renewable energy power generation, frequency regulation strategies for wind-storage-hydrogen production power stations, and stability analysis of ship integrated power systems.