Special Session 01:

Advanced Control for Grid-Connected Converters: From Power Grids to Vehicle-to-Grid and E-Mobility Applications

Session Organizer

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Description of Topical Focus

The increasing integration of renewable energy and electrified transportation is reshaping modern power systems, demanding advanced control strategies for grid-connected converters. These converters serve as critical interfaces not only for renewable generation but also for emerging applications such as electric vehicle (EV) charging, wireless power transfer (WPT), and vehicle-to-grid (V2G) systems. Traditional grid-following and grid-forming control paradigms are being challenged by the dynamic, bidirectional, and decentralized nature of these new energy interactions.

This special session aims to explore cutting-edge control theories and practical implementations for grid-connected converters across a broad spectrum of applications — from utility-scale renewable integration to EV fast charging, wireless charging, and motor drive systems. Emphasis will be placed on robust, adaptive, and intelligent control techniques such as sliding mode control, model predictive control, and AI-enhanced strategies that ensure stability, efficiency, and resilience under uncertain and variable operating conditions.

We invite contributions that bridge the gap between power electronics, control systems, and e-mobility, fostering interdisciplinary research and industrial innovation. Topics of interest include but are not limited to advanced converter control, V2G systems, high-power EV charging infrastructure, wireless charging control, and seamless integration of EVs into smart grids.

Key Words： Grid-Connected Converters; Advanced Control Method; Vehicle-to-Grid; E-Mobility Applications

Topics of interest include, but are not limited to:

1	Advanced control strategies for grid-connected converters
2	Vehicle-to-grid (V2G) control and optimization
3	High-power and fast charging technologies for electric vehicles
4	Wireless power transfer (WPT) control and efficiency optimization
5	Grid-forming vs. grid-following control in converter-dominated systems
6	Sliding mode control (SMC) and robust nonlinear control methods for power converters
7	AI-enhanced and adaptive control for power electronics systems
8	Real-time power tracking and dynamic response enhancement
9	Seamless switching control between grid-tied and standalone modes
10	Integration of EV charging infrastructure with renewable energy sources

Special Session 02:

Artificial Intelligence Empowered Automation Design and Operation for Power Electronics and Microgrids

Session Organizer

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Description of Topical Focus

This special session aims to advance the discussion on Artificial Intelligence (AI) -empowered design and operation of power electronic systems and microgrids. Modern energy networks as complex system evolves toward greater autonomy and faster production, AI is becoming a key enable of adaptive control, intelligent fault management, predictive optimization, and secure operation. This special section will also highlight emerging AI paradigms, including: Continual learning for adaptive decision-making, neuromorphic and edge-AI implementation for real-time control in distributed system, and neuroscience inspired AI models for self-regulation, self-healing and autonomous operation. The objective is to bridge AI, control theory, and power electronics, showcasing how AI, bio-inspired intelligence and digital twins can lead to autonomous, fault-tolerant, and sustainable energy systems. Participants will share the last advances on how AI-driven technologies can improve autonomous power electronics design, enhance energy management under uncertainties, and enable real-time, self-healing operation across interconnected systems.

Topics of interest include, but are not limited to:

- AI algorithms for design, control and optimization in power electronics and microgrids (including reinforcement learning, continual learning, meta-learning, physics inform neural network).
- Brain-inspired and neuromorphic AI approaches for real-time control, emotional learning, and self-healing operation.
- Predictive maintenance, advanced monitoring, and fault diagnosis using data-driven and physics informed learning.
- Cybersecurity and privacy protection in AI-enabled microgrids and converter systems.
- AI-based operational management for microgrid resilience under extreme weather, cyber-attacks and other disasters.
- Development of AI-driven models to empowered automation power electronic design
- AI practical implementations for self-healing and autonomous operation of Microgrids
- Digital twin development for Hybrid Power Electronic Systems
- Model-free adaptive and cognitive controllers for power converters and distributed resources
- Power management system for IoT and other micro-power applications.

Special Session 03:

Hybrid Energy Storage and Smart Management for Electric Vehicles and Renewable Grids

Session Organizer

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Description of Topical Focus

The rapid advancement of renewable energy technologies and the widespread adoption of electric vehicles (EVs) are transforming the global energy sector. Yet, the seamless integration of renewable energy sources with hybrid energy storage systems presents critical challenges in ensuring sustainable, efficient, and reliable energy management. This special session, titled "Hybrid Energy Storage and Smart Management for Electric Vehicles and Renewable Grids," seeks to bring together leading researchers, industry experts, and practitioners to discuss these challenges and showcase innovative solutions. We welcome high-quality contributions that address emerging techniques, methodologies, and technologies in energy management systems, hybrid storage architectures, and their applications in renewable energy and EV ecosystems.

Topics of interest include, but are not limited to:

- Intelligent energy management strategies for renewable energy systems and EVs.
- Design, modeling, and optimization of hybrid energy storage systems (e.g., batteries, supercapacitors, fuel cells).
- Integration of renewable energy sources into smart grids and microgrids.
- Advanced control techniques for energy distribution and storage optimization.
- Role of artificial intelligence and machine learning in energy management.
- Vehicle-to-grid (V2G) and grid-to-vehicle (G2V) technologies.
- Performance analysis and case studies of hybrid renewable and EV systems.
- Advanced Energy Management Strategies for EVs and Renewable Integration
- Hybrid Energy Storage Architectures and Power Converter Topologies
- Control and Optimization of Power Flow in Renewable-Integrated EV Systems
- Reliability, Efficiency, and Lifecycle Management of Hybrid Storage Systems
- Emerging Applications: Vehicle-to-Grid (V2G), Wireless Charging, and Sustainable Mobility

This session provides a platform for the exchange of ideas, the presentation of recent research, and the discussion of emerging trends in these critical areas. We encourage contributions that offer innovative insights and practical solutions to foster a sustainable and energy-efficient future.

Special Session 04:

Advanced Control Techniques for Power Electronics Converters

Session Organizer

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Description of Topical Focus

The demand for high-quality electrical energy has increased considerably in recent years. Basically, the power electronics converters can be used in wide range of applications which require electrical power conversion, conditioning, compensation, and active filtering through the use of well-designed control methods which should meet the desired objectives set for each application. These applications involve integration of renewable energy sources to the utility grid by means of appropriate converter, uninterruptible power supplies, power quality improvement, electrical vehicle charging, DC traction power systems, smart grids, and energy storage systems. This session is intended to provide an insight on the latest advanced control techniques of various power converters employed in the applications mentioned above.

Topics of the Session:

- Lyapunov-function based control of power converters
- Sliding mode control (SMC) of power converters
- Finite control set model predictive control (MPC) of power converters
- Continuous control set MPC of power converters
- Repetitive control of power converters
- Deep reinforcement learning control of power converters
- Novel chattering reduction and fixed switching frequency based methods in SMC
- Novel sensorless MPC for electrical machines
- Novel cost function design and weighting factors tuning in MPC
- Application to microgrids
- Application to mega-watt range wind turbines
- Application to energy storage systems
- Application to electrical vehicle charging

Special Session 05:

Control and optimization of special modern power systems

Session Organizer

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Description of Topical Focus

The "dual-high" characteristics of the new-type power system—namely, the high penetration of renewable energy and the high proportion of power electronic devices—are becoming increasingly prominent. However, renewable energy still lacks sufficient active support capabilities in terms of frequency regulation, voltage regulation, and optimal operation and control. Therefore, it is urgent to conduct overall planning to balance the improvement of the system's regulation capability, control stability, and operational safety.

Meanwhile, with the accelerated digital transformation of the power system, cyber security issues have become increasingly prominent. How to safeguard the cyber security of the new-type power system and ensure the reliability and stability of power supply has become a key task in building a robust and reliable new-type power system. The rapid development of AI technology provides new opportunities for the optimal operation and control of the new-type power system as well as its cyber security protection.

Topics of the Session

Frequency Control Technologies for New-Type Power Systems
Coordinated Control of Renewable Energy and Power Grid
Stability theory for New-Type Power Systems
Optimal Operation and Control for New-Type Power Systems
Energy Storage Technologies for New-Type Power Systems
Forecasting for Renewable Energy and Power Load for New-Type Power Systems
Fault diagnosis for New-Type Power Systems
Cyber attack and detection for New-Type Power Systems

Special Session 06:

Model Predictive Control for Motor Drives

Session Organizer

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Description of Topical Focus

For decades, field oriented control (FOC) has become a de facto industry standard for high performance control of ac motor drives. However, both the industry and academic communities are still striving to find more advanced control techniques to achieve better steady state performance, quicker dynamic response and simpler structure. For this aim, direct torque control (DTC), and more recently, model predictive control (MPC), have attracted increasing attention in the area of ac motor drives.

Predictive Control is one of powerful and attractive alternatives that has received increasing attention in recent years with fast modern microcontrollers growing. Owing to its simple concept, fast transient response and flexibility in incorporating various constraints, MPC is regarded as a powerful and attractive alternative to conventional FOC and DTC. The use of predictive control offers several interesting advantages: it is an intuitive control approach, it does not need linear controllers and modulators, and it is more flexible to include easily nonlinearities and restrictions in the control law.

However, MPC has not yet reached a mature stage for industrial applications. Many aspects, e.g., reduction of computational burden, sensorless control, robustness against parameter mismatches, etc. need to be further investigated. It can be expected that the advantages of predictive control will lead to industrial applications in the future after some further progress.

This Special Section aims to provide a forum for professionals from both academic and industrial communities to exchange their experience and latest achievements in the field of predictive control of motor drives.

Topics of interest include, but are not limited to:

- Finite/continuous control set-model predictive control of motor drives.
- Predictive control applied to power converters for motor drive supply control.
- Multi-vector predictive control of motor drives.
- Speed/position sensorless predictive control of variable-speed motor drives.
- Robust predictive control methods and Model-free predictive control methods.
- Predictive control with modulated switching patterns.
- Long-horizon predictive control schemes and their computationally efficient realization.
- DSP/FPGA implementation of MPC
- AI-aided MPC

Special Session 07:

Advanced Intelligence Control for Energy Conversion System

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Description of Topical Focus

The energy conversion systems, such as electric drive systems, battery management systems and new energy power generation systems, have penetrated into every aspect of production and life. Complex structures with high nonlinearity characterize energy conversion systems, whereas operating under extreme environments complicates the control strategy. Over the last several decades, the rapid development of various advanced intelligent control theories has significantly improved the dynamic performance, anti-disturbance ability, fault tolerance and full life cycle efficiency of the system. The in-depth integration of advanced intelligent control theories with energy conversion systems provides a new path for solving the modeling and control challenges of complex energy conversion systems. Thus, this special session aims to show the application of advanced intelligence control for energy conversion system.

Topics of interest include, but are not limited to:

1	Intelligence algorithms.
2	Intelligence control methods for energy conversion system and energy storage.
3	Intelligence control methods for wind energy and photovoltaic conversion systems.
4	Intelligence control methods for new energy smart grids
5	Intelligence control & observation for battery management systems.
6	Control methods for unmanned systems.
7	Intelligence control methods in motor driver.
8	Coordinated control for multi-motor system.
9	Discrete-time control systems of energy conversion systems.
10	Industrial intelligence control and intelligent manufacturing.