SS Advanced Topologies and Control Strategies for DC-DC Power Converters

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Description:
In the rapidly evolving sector of power electronics, DC-DC power converters have become indispensable for efficient energy regulation across various applications, including distributed generation, hybrid electric vehicles, aerospace systems, satellites, and microgrids. The integration of advanced topologies and intelligent control strategies is revolutionizing power conversion, and enhancing voltage regulation, stability, and overall system efficiency. Modern converter designs are not just addressing current energy demands but are paving the way for next-generation solutions by optimizing power density, cost-effectiveness, and dynamic performance.

This special session aims to bring together leading researchers and industry experts to discuss innovations in converter topologies, mathematical modeling, circuit synthesis, control dynamics, and techno-economic optimizations and aligns with SDG 7 and 12, contributing to a sustainable energy ecosystem.

Session Topics:
- High gain DC-DC converters
- Next-gen isolated and non-isolated DC-DC converters
- Advanced control strategies for DC-DC converters
- Wide bandgap semiconductor-based converters
- Multi-input DC-DC converters for renewable energy
- Bidirectional DC-DC converters for EVs and energy storage
- Sliding mode, predictive, and adaptive control techniques
- Fault-tolerant and robust converter designs
- High-power density DC-DC converters for emerging technologies
- Techno-economic optimization of DC-DC power electronics
- Other related topics

SS Grid-Integrated Electric Vehicle Charging Systems -Advancements in Microgrid and Power Distribution

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Description:
Power converters are fundamental components in the evolution of microgrid technology, enabling the integration of renewable energy sources, energy storage systems, and electric vehicle (EV) charging infrastructure. This Special Issue explores the critical role of power converters, investigating various types, control strategies, advantages, limitations, and real-world applications—ranging from consumer electronics to large-scale industrial systems. Focusing on microgrids, it highlights the diverse converter topologies used in these systems, including DC/DC converters, single-phase DC/AC, and three-phase DC/AC converters, and sophisticated control methods employed in these converters.

This special focus on power converters, control strategies, and their practical applications for the efficient integration of renewable energy and electric vehicle charging in microgrids, contributing to achieving SDGs 7 and 12.

Topics of the Session
- Power Electronics for Renewable Integration
- Hybrid Converter Topologies: Multilevel & Z-Source
- Bi-Directional Power Flow in Microgrids
- Renewable Energy Integration in Microgrids
- Smart Control for Inverter-Based Microgrids
- Advanced Energy Storage Solutions in Microgrids
- Robust Power Converter Designs for Harsh Environments
- Efficiency & Reliability in Power Converters
- Fault-Tolerant Power Converters
- Power Electronics for EV Charging & V2G
- Any other related topic.

SS Integration of Renewable Energy Sources for Fast, Superfast, and Ultra-Fast EV Charging Stations: A Sustainable Solution

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Description:
The rapid growth of electric vehicles (EVs) demands an equally fast-paced evolution in charging infrastructure. Integrating renewable energy sources, such as solar and wind, with energy storage systems (ESS) and the power grid, presents a sustainable approach to meet the energy requirements of fast, superfast, and ultra-fast EV charging stations. The session will focus on technical, economic, and environmental aspects, ensuring a sustainable and efficient transition to electrified transportation.

Topics of Interest:
This session will cover a wide range of topics related to the integration of renewable energy sources for high-power EV charging, including:

- Integration of solar PV, wind energy, and ESS with EV chargers
- Modular and scalable designs for renewable energy-powered charging stations
- Role of hybrid systems in reducing grid dependency
- Predictive and adaptive energy management algorithms
- Dynamic load balancing using renewable energy and ESS
- Optimizing renewable energy utilization under variable charging demands
- Strategies for seamless interaction between renewable energy systems and the grid
- Mitigating grid instability during superfast and ultra-fast charging events
- Enhancing grid resilience with renewable energy-powered charging infrastructure
- Novel control strategies for renewable energy and ESS integration
- Advances in power electronics for high-efficiency energy conversion

SS Efficient and Reliable DC Protection Technologies

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Description:
Direct Current (DC) power systems' protection presents a major challenge due to the absence of natural zero current crossing points, low impedance, and fast fault propagation. Thanks to their features, DC protection devices allow the safe and fast commutation of the fault current. Selective protection and fast fault isolation are key features that any direct current circuit breaker (DCCB) should attain, assuring minimal power outages and the effective protection of sensitive electronic components. Another major area is system protection against transient surges.

This Special Session focuses on the discussion of challenges and emerging solutions suitable for the fast and reliable protection of DC power systems.

Topics of interest include, but are not limited to:

- DC circuit breakers
- Hybrid circuit breaker technologies
- Transient over voltage and lightning protection
- Coordination of DC protection devices
- Failure mode analysis in DC protections
- Solid-state circuit breaker technologies
- Wide Bandgap (WBG) semiconductor-based DC protections
- Fault-tolerant DC protection systems
- Over voltage /over current protection
- Efficiency optimization of DC protection devices
- Cost reduction strategies
- Commutation mechanisms for DC protections
- Transient surge protection

SS Integration of EV Charging Infrastructure and Renewable Energy Sources: Challenges and Opportunities

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Description:
The rapid adoption of electric vehicles (EVs) presents both challenges and opportunities for integrating renewable energy sources (RES) into EV charging infrastructure. The synergy between EV charging stations and RES such as solar and wind can contribute to sustainable energy utilization, carbon footprint reduction, and enhanced grid stability. However, various technical, economic, and regulatory challenges must be addressed to enable efficient integration. This special session aims to bring together researchers, industry experts, and policymakers to discuss innovative strategies, emerging technologies, and policy frameworks that can facilitate the large-scale integration of RES into EV charging networks.

Topics of Interest: We invite contributions on, but not limited to, the following topics:

- Smart charging strategies for RES-integrated EV charging infrastructure
- Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) technologies
- Power quality and grid stability issues due to EV-RES integration
- Optimization of renewable energy utilization for EV charging stations
- Role of battery energy storage systems (BESS) in mitigating intermittency issues
- AI and IoT-driven predictive analytics for EV-RES synergy
- Techno-economic feasibility studies of solar- and wind-powered EV charging stations
- Regulatory policies and market mechanisms for RES-based EV charging
- Case studies and pilot projects on RES-integrated EV charging infrastructure

SS Advanced Signal and Image Processing Techniques for Condition Monitoring of Electric Machines and Drives

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Description:
The use of advanced signal processing tools and techniques in the electrical machines and drives condition monitoring area has drawn the attention of many researchers over recent years. Conventional diagnosis techniques relying on classical tools such as the Fast Fourier Transform are being complemented, or even replaced, by new methods based on modern signal processing tools suited for the analysis of non-stationary signals. This special session is intended to attract research papers showing novel applications of these signal analysis techniques in the electric machines and drives condition monitoring area. The scope also covers papers including applications of pattern recognition algorithms or image processing techniques for diagnostic or prognostic purposes both in electrical machines and drives whatever the application (power generation, drive system, etc.).

SS Recent Advances of Renewable Energy Utilization in Intelligent Power Distribution Systems

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Description:
In recent years, continuous breakthroughs and innovations in power electronics technology have enabled the wide application of various renewable energies, such as solar, wind, etc. These new types of energy systems can generate, store, distribute, and flexibly use clean energy sources, and further by monitoring and predicting the operational status of the power distribution systems in real-time, smart grids can promote the large-scale application of clean energy, improve energy utilization efficiency, and enhance the flexibility and stability of the power system. Meanwhile, as the main body of energy consumption in cities, green buildings, low-carbon buildings and near-zero energy consumption buildings are the future development trends. Therefore, the special session aims to provide a research venue for exchanging and discussing the technical trends and challenges of renewable energy utilization in intelligent power distribution systems.

Technical topics, but are not limited to:

- Advances in renewable energy technology
- Networked and multi-network cooperative control
- Optimization and control of renewable energy systems
- Energy storage and integration
- Building Integrated PV
- Calculation and evaluation of carbon emission
- Energy Internet
- Microgrid, smart grid and smart energy
- AC/DC transmission devices and systems
- Digitalization technologies for renewable energy

SS DC-DC Power Converters: Novel Topologies, Advanced Control and its Applications in Electric Vehicles

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Description:
In the realm of Electric Vehicle (EV) technology, contemporary advancements in renewable resources and power converters play a pivotal role in effectively managing voltage and current for power distribution. This is particularly significant across diverse EV applications, including Distribution Generators, Hybrid Vehicles, Satellites, Aerospace, and Microgrid Applications. The integration of innovative control and modeling methodologies, along with specialized DC-DC converter circuitry tailored for the unique demands of electric vehicles, has propelled the rise of intelligent and modern DC-DC converter technologies.

This specialized session seeks to bring together insights from experts and research communities in the EV domain on a standardized platform. It aims to drive continuous advancements in power converter technologies tailored for EV applications, focusing on power circuits, synthesis, mathematical modeling, design, cost optimization, control mechanisms, techno-economic considerations, and more. The session will concentrate on novel developments in DC-DC converters, control strategies, and applications, with the ultimate goal of providing effective and energy-efficient solutions aligned with the sustainable development of electric mobility.

Technical Outline of the Session and Topics:

- Isolated and Non-isolated DC-DC Converters for EV Battery Charging
- Various converter types including multiport, multilevel, switched inductor, and switched capacitor converters for EV Battery Charging.
- Development of new control strategies or algorithms for DC-DC converters for EV Battery Charging.
- Exploration of Z Source-based DC-DC converters, hybrid converters, and other innovative designs.
- DC-DC Resonant Converters for Wired/Wireless charging.
- Power loss calculations and thermal analysis for DC-DC converters.
- Analysis of cost, reliability, and stress in DC-DC converter systems.
- Design and development of high-power density and voltage DC-DC converters for EV Battery Charging.
- Survey and analysis of different topologies in DC-DC converters for EV Battery Charging.
- Optimization of DC-DC converter design and control.

SS Topology Design and Advanced Control Strategy of Hybrid Energy Storage System for Clean Distribution Network and Green Transportation

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Description:

Hybrid energy systems are increasingly recognized as a pivotal solution for sustainable power generation, serving both green transportation and the establishment of clean distribution network. Central to their efficacy is the design of the system's topology, which dictates how different energy storage components interact and perform. The optimization of these hybrid systems, including their topology structure design, is critical yet demanding, given the need to carefully weigh techno-economic factors against environmental impacts. To ensure optimal system configuration, operation, real-time energy management, control mechanisms, and predictive optimization, it is indispensable to utilize sophisticated methodologies and techniques that accurately reflect the actual behavior of these systems in operation. Expanding the research frontiers in hybrid energy systems is crucial to meeting technical, economic, and design objectives. This special session is tailored to present the latest advancements in the field, focusing on the design, modeling, and optimization of hybrid energy systems' topology structures, as well as their environmental and techno-economic assessment. It also aims to provide guidance on future research directions and practical recommendations to enhance the performance and commercial viability of hybrid energy systems in both green transportation and clean distribution network applications.

SS Next-Generation Powertrains for Electric Vehicles: High-Efficiency Machines, Intelligent Integration and Advanced Automated Control

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Description:
This special session brings together experts and researchers who are pushing the boundaries in electric powertrain design - from next-generation electric machines, through ultra-fast charging solutions, to advanced motion control methods.

A prominent topic is the development of new radial and axial flux electric motors, characterized by high power density, superior efficiency, and reduced reliance on rare earth materials. Contributions will explore novel design concepts, integration of digital twins for multi-physics analysis, and innovative manufacturing approaches aimed at enhanced performance and improved circularity.

In parallel, the Special Session will highlight the emerging high-voltage power electronics solutions that enable ultra-fast charging and higher operating voltages, while ensuring backward compatibility with established 400V and 800V charging infrastructures. Presentations will address the challenges of modular component use, integrated axle solutions, thermal management, and partial-load efficiency optimization - supported by novel digital twins and life-cycle analyses.

Finally, the session will showcase advanced vehicle motion control frameworks tailored for multi-actuated electric platforms. These control strategies rely on robust, predictive, and data-driven methods, offering enhanced energy efficiency, driving safety, and comfort under uncertain road and environmental conditions. Attendees will learn about cutting-edge solutions for road condition estimation, real-time software validation, and hardware-in-the-loop demonstrations.

SS Security Communication and Control of Distributed Networked Systems under Malicious Cyber-Attacks

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Description:
Distributed networked systems have been used in various applications including smart grids, unmanned marine vehicles, intelligent transportation systems, sensor networks, and so on. Due to its scalability, reliability, and performance advantages over centralized systems, various techniques have recently been proposed for studying distributed networked systems in the literature. Moreover, the reliance on open communication networks exposes them to escalating cyber-physical threats, including false data injection, denial-of-service (DoS) attacks, and so on. This special session aims to disseminate and highlight new research findings in the security communication and control of distributed networked systems under malicious cyber-attacks. Prospective authors are invited to submit original contributions to the related research topics.

Topics of interest include, but are not limited to:

- Modelling of cyber-attacks in communication networks
- Resilient control of networked systems against attacks
- Event-triggered distributed control of networked systems
- Event-triggered distributed filtering of networked systems
- Stability and stabilization analysis of distributed networked systems
- Cooperative control of intelligent transportation systems
- Attack detection, identification and isolation
- Data-Driven Detection and Mitigation
- Scalability of distributed networked systems
- Distributed control and filtering with various communication scheduling

SS Battery Energy Storage Systems in Microgrids – Design, control, and reliability

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Description:
Battery Energy Storage Systems (BESS) are pivotal in modern electrical infrastructures, and power electronics converters within microgrids, where they perform critical functions such as energy storage, load levelling, frequency regulation, and the integration of renewable energy sources. The effective operation and integration of BESS hinge on optimizing design, employing advanced strategies, and developing innovative techniques to enhance efficiency, power density, reliability, and cost-effectiveness. Multi-objective optimization plays a key role in achieving these goals by advancing battery technologies, power electronics interfaces, and integration strategies that maximize performance while minimizing costs and environmental impact. Cutting-edge strategies, including predictive algorithms, adaptive methods, and AI-based techniques, are essential for improving the dynamic performance and stability of BESS, enabling precise regulation of power flow, state of charge, and grid support functions to ensure robust operation under varying load conditions and grid disturbances. Additionally, the development of comprehensive frameworks for real-time diagnostics and predictive maintenance is crucial for detecting anomalies, predicting failures, optimizing maintenance schedules, and enhancing cybersecurity measures, thereby reducing downtime and improving reliability and safety.

SS High Power Hybrid and Electric Vehicles: Advances in Design, Operation and Charging

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Description:
The hybrid and electric vehicles technology is gaining importance in heavy vehicle industry. Operation and charging of high power hybrid and EVs require integration of internal combustion, battery energy storage and grid/hydrogen/renewable sources. There has been a tremendous growth in the high power EVs design, operation and charging methods, over past few years. It involves drive trains, high power electronics, smart and wireless EV charging, high density battery packs, integration of renewables, fuel cell etc. Nevertheless, need of much innovations in this technology is required to profligate the high power hybrid and electric vehicles such as cars, buses, trucks, tractors etc. This special session intends to collect scientific and technical papers dealing with advances in high power hybrid and EVs.

Topics of the SS but not limited to
- Medium to high power Hybrid and EVs operation.
- High power drive trains
- High density battery packs
- Smart and fast charging stations
- Multiport EV chargers
- High power electronics
- Multilevel and Special converter topologies
- Hydrogen powered vehicles and fuel cells
- Renewable sources and energy storage in EVs
- Wired and wireless charging

SS Future MVDC & LVDC Networks: Architecture, Topology, Control, Protection & Applications

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Description:
The use of DC technology in modern power systems has experienced rapid growth in recent years, and DC transmission has experienced increased application globally. Thanks to progress in electrification and digitalization, more implementation of DC technology at the distribution level is expected. Compared to the traditional AC distribution network, the MVDC & LVDC can offer flexible topology and controllable power flow, with potential for off-grid operation. However, the widespread adoption of MVDC & LVDC is heavily dependent on the future technical breakthroughs, including system protection and reliability of power electronic devices, and consensus on network topologies, voltage levels, and associated aspects.

This special session invites papers on architecture, topology, control, applications and standardization of future MVDC & LVDC networks, as well as the conversion stage and efficiency analysis of connection between distributed DC power sources and local loads.

Topics of the Session
- MVDC
- LVDC
- Network architecture
- DC and AC/DC circuit topology
- Converters & enabling technologies
- Control of MVDC, LVDC
- Protection of MVDC, LVDC network
- Transition from AC to DC
- Electric Vehicle(EV) integration
- DC datacenter application
- DC in homes

SS Revolutionizing Electric Mobility: Advancements in Wide Bandgap Power Electronics for the Next Generation of EV Powertrains and Charging Infrastructure

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Description:
The rapid evolution of electric mobility is driving significant advancements in power electronics, with wide bandgap (WBG) semiconductors emerging as a key enabler of next-generation electric vehicle (EV) powertrains and charging systems. Materials such as silicon carbide (SiC) and gallium nitride (GaN) offer substantial advantages over traditional silicon-based semiconductors, including higher efficiency, faster switching speeds, and improved thermal management. In EV powertrains, WBG power electronics enhance energy conversion efficiency, support higher voltage levels, and minimize system losses, resulting in extended driving range, improved battery performance, and reduced energy consumption. This leads to a more efficient and sustainable EV ecosystem. Similarly, in EV charging infrastructure, WBG semiconductors enable faster charging speeds and reduced charging times, addressing a critical barrier to widespread EV adoption. As the EV market expands, the integration of WBG technology in powertrains and charging infrastructure is set to revolutionize electric mobility. The ongoing advancements in WBG semiconductors will play a pivotal role in shaping the future of sustainable and cost-effective electric transportation.

Topics of interest include, but are not limited to:
- Challenges in Mass Adoption of WBG Semiconductors in EVs
- High power density batteries for EV system
- EV Powertrain and Energy Efficiency
- Thermal Management in EV Power Electronics
- Standardization and Regulatory Challenges for WBG-Based EV Components
- Fast Charging Infrastructure for EVs
- Battery Management systems for EVs
- Role of Artificial Intelligence (AI) in smart grid and EV
- Enhancing Regenerative Braking Efficiency Using WBG Power Electronics
- High-Frequency Power Converters in EV Applications for WBG Semiconductors

SS Data-Driven Fault Diagnosis and Fault-Tolerant Control for Industrial Systems

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Description:
Enhancing the safety and reliability of modern industrial and intelligent systems—where control systems are pivotal—has driven significant interest in data-driven methodologies. With vast amounts of process data generated daily, the failure to efficiently analyze and leverage this information risks squandering invaluable insights. Simultaneously, the rise of industrial big data presents persistent challenges: theoretical gaps and complex application scenarios continue to hinder the design of effective fault diagnosis systems and fault-tolerant control strategies. Against this backdrop, this special session emphasizes cutting-edge data-driven and machine learning approaches for fault diagnosis and fault-tolerant control in complex industrial systems. We aim to create a collaborative platform for researchers and industry professionals to share groundbreaking advancements, including theoretical breakthroughs, algorithmic innovations, and successful real-world applications. By fostering dialogue between academia and industry, the session seeks to bridge the gap between emerging methodologies and their practical implementation, ultimately advancing the resilience and intelligence of next-generation industrial systems.

Topics of the Session
- Data-driven and intelligent algorithms for fault diagnosis
- Data-driven monitoring of performance degradation
- Intelligent learning methods for system monitoring
- Data-driven modelling of complex faults and failures
- Data-driven design of fault-tolerant controllers
- Data-driven residual generation and evaluation
- Applications to complex industrial systems
- Other topics that are closely relevant to the theme

SS Learning-Based Energy Management for Sustainable Energy Systems

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Description:
As global energy systems are shifting rapidly towards sustainability, renewable energy sources will eventually dominate the power supplies. However, the variability and unpredictability of renewable energy sources, such as solar and wind, pose significant challenges in maintaining the stability, efficiency, and resilience of sustainable energy systems (SESs). To tackle these challenges resulted from renewable energy sources, energy management systems play a critical role in optimizing energy utilization, enabling demand-side management, and enhancing grid resilience. Designing the optimal energy management system indispensably involves timely acquiring and processing tremendous amount of data. Conventional model-based methods themselves may have difficulty in meeting these data-heavy involved demands. Machine learning (ML) and its emerging algorithms offer the potential of dealing with large-scale data analysis and decision-making in the energy management of sustainable energy systems. In turn, these ML based applications in SESs can also promote the development of ML, such as approximation theory, physics-informed learning, deep learning algorithms, and optimization approaches. This special session solicits the latest advancements in learning-based energy management technologies that support the transition towards sustainable energy systems. This special section aim to bring experts and researchers in IES communities together to share and discuss the latest advancements and challenges in the AI and their applications in energy management fields.

SS Advanced Power Electronics and Control for Efficient Renewable Integration in Low-Carbon Microgrids

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Description:
Power electronics plays a crucial role in renewable energy integration, microgrid stability, and smart grid advancements. This session explores emerging converter technologies, including hybrid multilevel, switched-capacitor, and Z-source converters, along with wide-bandgap semiconductors (SiC/GaN) for improved efficiency and thermal performance.

AI-driven control strategies—such as genetic algorithms, artificial neural networks (ANN), and predictive optimization—will be highlighted for enhancing fault tolerance, dynamic response, and energy management. Special focus will be given to bidirectional power converters, essential for EV charging (V2G/G2V), energy storage, and microgrid applications.

The session will also cover advanced inverter-based microgrid controls, grid-supportive storage technologies, and hybrid renewable energy systems. Additionally, the role of power electronics in space applications, industrial automation, and electrified transportation will be discussed. These innovations drive the development of low-carbon energy systems, addressing the growing need for efficient and sustainable power conversion.

- Hybrid multilevel, switched-capacitor, and Z-source converters
- Wide-bandgap (SiC/GaN) semiconductor applications
- AI-driven control in power converters
- Bidirectional converters for EVs and energy storage
- Microgrid stability and fault-tolerant inverter control
- Smart grids, sustainable electrification, and low-carbon energy systems

SS Advances in Energy Management for Sustainable Energy Systems

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Description:
The global energy landscape is undergoing a transformative shift driven by the rapid integration of renewable sources, decarbonization of industries, and the electrification of various sectors. Energy management is the key to optimize the energy use. Traditional energy management systems face challenges in dealing with high uncertainties from renewables and loads, as well as complexity of various components. Advanced control/optimization methods, artificial intelligence and machine learning techniques, together with IoT technologies, provide opportunities to advance energy management systems. This special session will bring together researchers from both industry and academia to share the latest research and the newest ideas in energy management systems, for various sustainable energy systems, from buildings, industrial power parks, microgrids, to large scale power grids.

SS Advanced Control Techniques for Power Electronics Converters

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Description:
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

SS Novel Developments for Special Robots and Vehicles in Complex Scenarios

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Description:
Complex application scenarios, including multi-obstacle unknown spatial environments, deserts and water surfaces characterized by weak reference features, rugged terrains, extraterrestrial landscapes, and games subject to multi-agent communication constraints, pose ongoing challenges for innovative and intelligent solutions aimed at novel specialized robots and unmanned vehicles. Traditional methods of robotic dynamics modeling, control, and navigation decision-making face difficulties in being directly applicable to these scenarios. This special topic focuses on research achievements tailored for these complex scenarios, encompassing new-concept robots, key components, mechanical modeling and simulation, intelligent perception and decision-making, and other related areas.

The topics of this special issue include, but are not limited to, the following:

- New concepts and key component for the complex scenarios
- Modelling, dynamics and simulation for the novel robots
- Recent development of guidance, navigation and control for special vehicles
- Large Language Model application for the special robot and complex situations
- Planning， Co-operation, and Co-perception for Multi-agents
- Safe, reliable and low-cost intelligent computation and engineering applications for robots and unmanned vehicles

SS Advances in Electrical Energy Systems: Markets, Digitalization and IA in Electrical Grids with Renewable Energies

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Description:
The transition to renewable energy aims to reduce dependency on fossil fuels and mitigate the effects of climate change. The integration of renewable energy sources in the electrical grid is becoming a key focus in international energy policies, thanks to their reduced environmental impact and economic viability. Despite these advancements, significant challenges remain, namely: the integration of these energy sources in the electrical grids, flexibility planning of the generated renewable energy in a dynamic market, digitalization of the energy systems, etc…

Therefore, this session provides an insight on the latest trends in local energy systems and future scenarios in distributed generation in electrical grids.

Topics of the Session include, but are not limited to:

- Monitoring and energy management in electrical grids.
- Integration of policy, regulation, and technical aspects for effective local market operation.
- Tools for electrical market participation: forecasting, scheduling, bidding, and resource control.
- Leveraging Digital Twins and Virtual Power Plants (VPPs) to virtualize electrical systems.
- Role of IoT, Edge Computing, and Blockchain in enabling efficient data handling and management.
- AI-driven techniques for predictive modeling of renewable energy production and market dynamics.
- AI-powered Anomaly Detection and Fault Prediction in Smart Grids.
- AI for Demand Response and Consumer Behaviour Modeling
- Generative AI for Energy Scenario Forecasting
- Mult-Agent AI systems for Decentralized Energy Trading
- Strategies for enhancing grid performance with distributed renewable energy resources.
- AI-based approaches for element placement and sizing in distribution grids.
- Challenges posed by electric vehicles and electrolyzers.
- Application of advanced algorithms and optimization techniques for flexible and resilient grid.
- Creating adaptive, flexible solutions for future grid needs.
- Electrification Scenarios and Future Challenges.

SS Smart Sensors, Sensor Networks, and Standards for IoT Applications

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Description:
A smart sensor consists of a set of sensors and/or actuators with metadata and some capabilities, including signal conditioning and conversion, sensor data processing with artificial intelligent (AI), timing synchronization, and secure network communications. Standardized smart sensor interfaces and data formats based on IEEE 1451 standards will help to achieve sensor data interoperability. Smart sensors and sensor networks can play a critical role in the IoT applications by providing real-time data to improve efficiency, and reliability.

Topics of the Session:
- Smart sensors and actuators
- AI-enabled smart sensors and actuators
- Digital twin for smart sensors and actuators
- Security and privacy, and timing synchronization for smart sensors and actuators
- Reference implementations of IEEE 1451-based smart sensors and actuators
- Conformance and interoperability testing methods of IEEE 1451-based smart sensors and actuators
- Smart sensor ontology modeling and semantic Web applications
- Ontology-based semantic communication and interoperability
- Interactions harmonization among IoT sensors, devices, and systems
- Smart sensors and sensor networks for the following IoT applications:
- Smart homes/buildings
- Smart agriculture
- Smart grid
- Smart manufacturing
- Intelligent transportation system
- Smart city
- Cyber-physical system
- Industrial automation

SS AI-Driven Strategies for Power and Energy Systems Condition Monitoring: Advances in Fault Diagnosis, Prognosis, Predictive Maintenance, Cyberphysical Security, and Privacy

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Description:
In today's rapidly evolving industrial context, integrating cutting-edge technologies is essential to ensuring optimal performance, reliability, and security. This special session will explore the latest advancements in fault diagnosis, prognosis, predictive maintenance, security, and privacy in power and energy systems. From AI-driven real-time fault detection to predictive analytics for proactive maintenance, the session will highlight innovative strategies aimed at enhancing operational efficiency and reducing system downtime. Additionally, it will expand its focus to cybersecurity, addressing cyberattack detection and privacy challenges, emphasizing the importance of protecting sensitive infrastructure and data in an increasingly interconnected power and energy systems.

SS Advanced Multilevel Converters for Green Energy Integration: Topology, Modulation, Control Strategies, and Applications

Organizers:
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Hani Vahedi, Netherlands, h.vahedi@tudelft.nl

Hamza Makhamreh, Turkey, hamza.makhamreh@ozyegin.edu.tr

Description:
With the increasing demand for green energy solutions, multilevel converters (MLCs) play a crucial role in improving energy efficiency and grid integration of renewable energy sources. The transition from isolated DC sources to voltage-controlled capacitors reduces cost and enhances system reliability. Furthermore, novel modulation and control techniques enable superior energy management for electrified transportation and energy storage applications.

This special session will cover recent advancements in:

- Multilevel converters for renewable energy integration and grid stability
- High-efficiency converter topologies for energy storage systems (ESS) and electric vehicles (EVs)
- Advanced modulation and control techniques for balancing auxiliary capacitors in MLCs
- Hybrid AC/DC microgrids utilizing advanced MLCs
- Electrified transportation applications including traction inverters and onboard chargers
- Multilevel rectifier technologies with improved power quality
- DC-link voltage regulation strategies for floating capacitor-based MLCs
- Multiport converter solutions for hybrid energy sources (solar, wind, battery, and hydrogen systems)
- AI-based control and fault diagnostics in MLCs
- Emerging trends in solid-state transformer-based multilevel converters

SS Advanced Motor Drive and Control for High-Performance Robotic Joints

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Description:
This Special Session focuses on the latest advancements in motor drive and control technologies for robotic joints, which are critical for achieving high-precision motion, high efficiency, and intelligent adaptability in modern robotic applications. With the increasing demand for high-performance joint actuators in industrial automation, humanoid robotics, and medical robotics, innovative motor control strategies, advanced power electronics, and high-efficiency drive systems are essential to improving system performance and reliability.

Key topics include model-based and AI-driven motor control, sensor fusion for precise current and position estimation, high-efficiency torque and impedance control, and advanced power electronics for compact and lightweight motor drives. Additionally, this session will explore fault-tolerant motor drive strategies and predictive maintenance techniques to enhance the reliability, thermal stability, and longevity of robotic joint actuators.

This session bridges the gap between motor drive technology, power electronics, and real-world robotic applications. By gathering experts from academia and industry, the session aims to foster discussions on next-generation motor drive and control systems, paving the way for more precise, energy-efficient, and intelligent robotic solutions.

SS Advancements in Power Electronics for Hydrogen Systems and Beyond

Organizers:
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Hady Habib Fayek, Egypt, hadyhabib@hotmail.com

Description:
In 2023, global hydrogen demand reached approximately 97 million metric tons (Mt), marking a 2.5% increase from 2022., highlighting its pivotal role as a versatile energy carrier across multiple sectors such as transportation, industry, and electricity generation. With its abundance and clean-burning properties, hydrogen presents a promising solution for reducing reliance on fossil fuels and mitigating greenhouse gas emissions, particularly in fuel cell (FC) vehicles where it generates only water as a byproduct. Its efficient storage and transport capabilities facilitate its widespread adoption, enabling flexible energy distribution. However, realizing the full potential of hydrogen requires robust power electronics converters for electrolysis-based hydrogen production and fuel cell electricity generation. Addressing the associated challenges is crucial to harnessing the evolving landscape of power electronics systems for hydrogen applications, both now and in the future.

Topics of the Session
- Next-generation power converters for hydrogen production and fuel cell applications
- Advanced controllers for converters and energy management in hydrogen systems
- Advanced theoretical or data-driven electrical modeling of electrolyzers
- digital twin of hydrogen-based energy systems
- hybrid energy storage systems, including hydrogen (HESS)
- Power quality issues in hydrogen systems
- Grid integration strategies for large-scale deployment of hydrogen systems
- Reliability and Safety Considerations in Power Electronics for Hydrogen-Based Energy Systems
- Advanced energy hub architectures to integrate hydrogen production and utilization through FC
- Power electronics applications in FC hybrid electric vehicles and e-mobility

SS AI based Grid Integration of DERs and EVs

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Description:

The rapid expansion of distributed energy resources (DERs) and electric vehicles (EVs) presents both opportunities and challenges for modern power grids. This special session at IEEE IECON 2025 will explore how artificial intelligence (AI), machine learning (ML), and digital twins can optimize grid integration, stability, and real-time energy management.

Key topics include AI-driven predictive analytics for grid balancing, reinforcement learning for adaptive energy dispatch, federated learning for decentralized control, and digital twin simulations for real-time optimization. Additionally, this session will address cybersecurity challenges in AI-enabled grid systems and the role of blockchain for secure energy transactions.

Aligned with IECON Green Tech, this session bridges power electronics, smart grids, and AI for industrial automation, fostering collaboration between researchers, industry leaders, and policymakers. Special emphasis will be placed on scalable AI models for dynamic grid conditions, vehicle-to-grid (V2G) optimization, and proactive demand-side management.

Attendees will gain insights into the latest breakthroughs in AI-driven decision-making, resilient grid architectures, and next-generation energy management systems, making this session essential for those shaping the future of intelligent, decentralized, and carbon-neutral power networks.

SS Advanced Technologies for Battery Management Systems

Organizers:
Heng Li, China,
Weihan Li, Germany
Zhongwei Deng, China

Description:
Battery-powered systems continue to proliferate across industries from electric vehicles and renewable energy storage to portable electronics. There is a growing need for innovative and reliable battery management solutions. This special session aims to bring together researchers, engineers, and practitioners from academia and industry to present and discuss recent advances in Battery Management Systems (BMS), focusing on intelligent algorithms, sensing technologies, communication strategies, control systems, and real-time data analytics.

We welcome original research papers, case studies, and industrial applications that address (but are not limited to) the following topics:

- State estimation techniques (SoC, SoH, SoP)
- Machine learning and AI applications in BMS
- Fault diagnosis and safety mechanisms
- Battery modeling and simulation
- Thermal management and control
- Power electronics and control strategies for BMS
- Wireless and cloud-connected BMS architectures
- Energy balancing and optimization algorithms
- Cybersecurity in BMS
- Standards and compliance for advanced battery systems
- BMS in electric vehicles, renewable energy systems, robotics

SS Advanced Modeling and Control of Grid-Connected Converters for Distributed Generation and Power Quality

Organizers:
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Description:
Renewable sources, such as photovoltaic panels, wind generators and fuel cells, are usually connected directly to the grid for cogeneration. This connection is made through power electronics interfaces that should ensure high stability, voltage regulation, power flow control, and low electromagnetic emission, along with high power density, low cost and high reliability. In some applications where high power level is required, the switching frequency of the power semiconductors is limited and the use of multilevel or interleaved converters becomes mandatory in order to get an acceptable power quality. This session addresses the issues of advanced modeling techniques applied to such converters for real-time simulations and control design in order to improve their performance, efficiency, reliability and cost-effectiveness.

Topics of interest include, but are not limited to:

- Advanced control of multilevel inverters
- Real-time control and simulations of high-power converters
- Grid-connectivity control requirements
- Control of parallel or interleaved topologies
- Modeling and model-based control of switch-mode power converters
- Optimal control in hybrid cogeneration systems
- Predictive control of power converters
- Intelligent control of power converters
- Power quality control in renewable energy systems
- Digital twin modelling of power electronics devices

SS Design, Control and Fault Detection of Power Converters for Energy Storage and EV Charging Systems

Organizers:
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Description:
Electric storage devices, like batteries, supercapacitors, and electric vehicles, are usually connected to the grid for cogeneration or energy conservation for future use. This connection is made through power electronics interfaces that should guarantee high stability, voltage regulation, power flow control, and low electromagnetic emission, along with high power density, low cost, and high reliability. To increase the power density, passive devices that are considered the bulkiest components in these systems should be reduced or avoided. This can be achieved by considering multilevel topologies that would comply with power quality requirements without the need for passive filters.

This session is dedicated to the various solutions adopted for high quality energy management at the storage or EV charging levels. More specifically, it will present advanced power electronics topologies used for power quality enhancement in such applications. Model-based or intelligent control algorithms ensuring a compliance with grid requirements, especially regarding power quality and V2G connectivity, and EV-related standards are also considered as major topics in this session. In addition, fault detection techniques dedicated to the diagnosis of power converters for electric vehicles and energy storage devices are also covered.

Topics of the Session
- Multilevel converters in grid-connected storage devices
- Fuel cells for EV drives
- Battery charging systems
- PV-assisted charging systems
- Power quality in V2G systems
- Model-based control design
- Artificial-intelligence-based control
- Energy management in V2G systems
- Open-winding motor drives
- Current and voltage signature-based fault diagnosis methods for chargers

SS Developing Durable and Reliable Hydrogen and Energy Storage Systems Towards Real-World Applications

Organizers:
Xin Wang, France
Jian Zuo, France
Liming Jin, China

Description:
Hydrogen systems include water electrolyzers and hydrogen fuel cells for hydrogen production and utilization. Lithium-ion batteries and flow batteries are commonly used for energy storage. These systems are indispensable for real-world applications in transportation and smart grid fields, particularly, to achieve the decarbonization goal. Nonetheless, durability and reliability remain core challenges that hinder their full commercialization.

Joint efforts spread from material design, system monitoring and analysis, control design, and decision-making optimization are required to address the above challenges. Material design lies at the basis of developing hydrogen and energy storage systems. For instance, cost-effective and efficient electrode designs are critical to reduce the reliance on noble metals in water electrolyzers and hydrogen fuel cells. System monitoring and analysis apply advanced characterization and modeling techniques to acquire internal health states, diagnose potential operational faults, and predict their future health states. Proper converter and controller designs are proposed to support the integration of multiple energy networking systems, ensuring stability and efficiency. Finally, decision-making strategies are developed to minimize the overall degradation and reduce operational costs. This session aims to bring together researchers working at the intersection of these fields to drive innovation and accelerate the commercialization of hydrogen and energy storage technologies.

SS Advanced Network Automation in 5G and Beyond for Industry 5.0

Organizers:
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Description:
The rise of 5G and the anticipated arrival of 6G are key drivers of Industry 5.0, where humans and machines collaborate seamlessly. At the heart of this transformation lies network automation, enabling real-time communication, intelligent decision-making, and adaptive manufacturing. These advancements enhance efficiency, flexibility, and customization in production systems.

However, realizing Industry 5.0's full potential comes with challenges. The growing number of interconnected devices increases cybersecurity risks, necessitating robust protection measures. Deploying edge computing for real-time data processing requires overcoming infrastructure hurdles and ensuring interoperability. Additionally, effective human-machine synergy demands intuitive interfaces and adaptive systems that balance automation with human input.

This Special Session brings together researchers to tackle these challenges and advance network automation for Industry 5.0. By sharing insights, methodologies, and case studies, we aim to contribute to developing resilient, adaptive, and intelligent networks.

Topics of interest include:
- Zero-touch network management in 5G/6G
- Edge computing and IoT for real-time data processing
- AI/ML for network optimization and predictive maintenance
- Security, privacy, and blockchain in industrial networks
- Energy efficiency of network automation
- Human-machine collaboration via advanced infrastructures
- Case studies in various Industry 5.0 sectors (e.g., healthcare, agriculture, supply chain, smart grid, manufacturing)

SS Advanced control and image processing technology for robots

Organizers:
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Description:
Robotics technology is rapidly evolving, driven by advancements in control algorithms and image processing capabilities. The integration of high-precision control systems with real-time vision-based perception is critical for applications such as industrial automation, autonomous navigation, and human-robot collaboration. However, the adaptability to execute autonomous navigation, exploration, and other complex tasks in uncertain environments is still a key issue to be solved urgently. Moreover, since the rapid advancement of robot techniques, autonomous robots still face several challenges, including advanced control technology, human-computer interaction, and perception and motion planning, which will allow robots to operate autonomously and effectively in complex environments.

Therefore, advanced control theory and sensing technology for intelligent robot systems are inspiring and promising topics. This special session aims to bring world-class researchers to present state-of-the-art research achievements and advances that contribute to autonomous robots in terms of control theory, image processing, and environment perception.

The session will cover (but is not limited to):

- Disturbance prediction and rejection control for robots
- AI-based control
- Structural design and optimization of new configuration robots
- Real-time object detection and tracking
- Deep learning for robotic vision
- Aerial-aquatic robots, agricultural robotics and mobile robots
- Energy management for robots

SS Physics-Informed Learning for Modeling, Monitoring, and Control in Industrial Systems

Organizers:
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Description:
This Special Session focuses on recent advances in physics-informed learning methods for modeling, monitoring, and control of complex industrial systems. In practical industrial environments, purely data-driven methods often suffer from limited generalization due to data sparsity, noise, and lack of interpretability. Meanwhile, physical principles and system structures are often well understood but difficult to incorporate into standard machine learning models.

Physics-informed learning addresses this gap by embedding physical laws, constraints, and domain knowledge into the learning process, resulting in more robust, interpretable, and reliable models for industrial applications. This session aims to gather researchers working at the intersection of machine learning, system dynamics, and industrial control.

Topics of the Session
- Physics-informed neural networks (PINNs)
- Data-driven control and reinforcement learning
- Learning-based monitoring and fault detection
- Robust and safe control under uncertainty
- Real-time optimization with physical constraints
- Hybrid modeling and digital twins
- Applications to complex industrial systems
- Other topics closely related to the theme

SS Advanced Control and Optimization for Power Converter Systems in Electrified Transportation

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Description:
Transportation electrification is the most effective innovation technology for solving the global energy crisis and alleviating environmental pollution. As the core bridge, the efficient control and optimization of power converter systems are critical for improving the performance, reliability, and sustainability of electric vehicles, charging stations, electric ships, and more/all-electric aircrafts. This special session focuses on innovative solutions for controlling and optimizing power converter systems in electrified transportation to address challenges related to efficiency, stability, and fault tolerance. In addition, the topic of artificial intelligence integration in the power electronic-based transportation electrification system is also of interest.

Detailed topics include, but are not limited to, the following:

- Advanced control strategies for power converter systems in electrified transportation;
- Condition monitoring and diagnostics, fault detection, protection, and EMI/EMC mitigation techniques for power converter systems in electrified transportation;
- Optimization techniques in power converter systems for topology design, efficiency improvement, component parameter tuning in electrified transportation;
- Machine learning-assisted design for power converter systems in electrified transportation;
- Machine learning-based modeling and control for power converter systems in electrified transportation;
- Digital twin models for power converter systems in electrified transportation;
- Digital twin applications in power converter systems in electrified transportation.

SS Transforming the Energy Landscape with Hydrogen Based Solutions

Organizers:
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Description:
Green Hydrogen integration into power systems is rapidly emerging as a transformative solution for the global energy transition. As nations accelerate their decarbonization efforts, hydrogen is gaining prominence as a versatile energy carrier. Projections indicate that hydrogen could meet a significant share of global energy demand by 2050, revolutionizing power generation, storage, and industrial applications. This special session will explore cutting-edge advancements in hydrogen production, storage, and distribution, along with its seamless integration into renewable energy systems. Key focus areas of this special session will include AI-driven optimization, hybrid energy networks, digital twin technology for real-time hydrogen infrastructure management, and hydrogen's role in power electronics, smart/micro grids, and global hydrogen roadmaps & policies. Additionally, the session will highlight hydrogen's impact on Industry 5.0, emphasizing smart manufacturing, industrial automation, and cybersecurity in hydrogen-based energy systems.

For the IEEE IECON 2025 audience, this session offers significant research opportunities in hydrogen-powered industrial processes, smart grid resilience, and sustainable mobility solutions. It provides a platform for networking and collaboration among global researchers, enabling interdisciplinary discussions that drive innovation in hydrogen applications across power electronics, automation, and digital transformation. By fostering cross-sectoral partnerships, this session will accelerate the adoption of hydrogen in next-generation industrial and energy systems.

SS Aerial Manipulation Systems in Dynamic Environments: Intelligent Modeling, Planning, and Control

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Description:
Aerial Manipulation Systems (AMS) have revolutionized industries such as disaster response and industrial inspection by integrating multirotor UAVs with multi-modal robotic manipulators, enabling operations in dynamic and hazardous environments. Despite their significant potential, AMS face critical technical challenges along two primary research axes: single-UAV optimization involves developing vectoring propulsion systems for agile maneuverability, variable-morphology manipulators for hybrid force-position control, and adaptive frameworks to interact with unstructured environments. Meanwhile, multi-UAV collaboration requires swarm intelligence algorithms for dynamic load sharing, decentralized fault-tolerant coordination under communication constraints, and real-time motion planning with obstacle avoidance. Addressing these challenges is essential to unlock the full operational capabilities of AMS in emerging applications like precision agriculture and autonomous logistics.

This special session directly aligns with IECON's focus on industrial automation, control systems, and intelligent robotics. Aerial manipulation systems address critical industrial needs such as: (1) Hazardous environment operations requiring advanced robotic solutions; (2) Precision manufacturing through aerial manipulation in constrained factory spaces; (3) Logistics optimization via autonomous aerial delivery systems.

Topics of interest include (but are not limited to):

- Novel aerial manipulator architectures and morphing mechanisms
- Robust control algorithms
- Distributed coordination in multi-robot manipulation
- Human-robot interaction in aerial manipulations
- Real-world applications

SS Solar Photovoltaic Frontiers: Design, Deployment, Reliability, and Global Policies

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Description:
Solar photovoltaic (PV) technology is a cornerstone of the global energy transition, driving advancements in sustainable power generation. This special session, "Solar Photovoltaic Frontiers: Design, Deployment, Reliability, and Global Policies," will explore state-of-the-art innovations in PV systems, addressing key challenges, barriers, and solutions for large-scale deployment. A significant focus will be on power electronics for PV applications, AI-driven power stabilization, and real-time analytics, including anomaly detection for enhanced efficiency and operational resilience. Emerging applications such as agrivoltaics, aquavoltaics, floating PV, canal-top PV, and building-integrated PV (BIPV) will be examined for their role in optimizing land and infrastructure utilization. Additionally, hybrid PV systems, including photovoltaic-thermal (PVT) technologies, will be discussed for their potential in dual-energy generation. Beyond technological advancements, the session will provide critical insights into global policies, regulatory frameworks, and economic strategies shaping the future of solar deployment. This session will try to highlight incentives, tariffs, investment models, and renewable energy standards that drive PV adoption through global research submissions.

It will offer a multidisciplinary platform for researchers, industry professionals, and policymakers to engage in high-impact discussions on the evolving global solar PV landscape.

SS Model-Based Control Techniques for Three-Phase Systems

Organizers:

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Description:
This session aims to introduce different model-based control techniques for modern power systems, particularly in power converters and microgrids. In recent years, the energy landscape has undergone significant transformations, characterized by the increasing penetration of distributed energy resources and the transition towards more sustainable power generation methods. However, this transition presents unique operational complexities, including intermittency, voltage fluctuations, and power quality issues. In this context, the effective management and control of converters and microgrids are paramount to ensure grid stability, reliability, and efficiency. Different model-based control techniques stand out as a promising approach to tackle these challenges by using advanced mathematical models to anticipate system behavior, and optimize control actions in real-time. Also, the introduction of Kalman filtering or other state observers to predict the system dynamics, optimal control techniques, and sliding mode control based on the model of the system are different topics to be presented in this special session.

Topics of the Session
- Model predictive control for three-phase systems.
- Model-based control applied to different control techniques.
- Kalman filtering in model-based controllers.
- Active damping techniques using the model of the system.
- Design of control systems using state observers.
- Application of model-based control for in microgrids systems.
- Optimal control for three-phase systems.

SS AI-driven Optimization, Control and Management for Economical Operation of Renewable Energy Power Systems

Organizers:
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Description:
The modern power grid systems are changing rapidly, driven by a societal and environmental push towards use of clean and renewable energy technologies. However, the intermittency of renewable power generation sources and dynamic load demands has raised a significant challenge relating to their operation optimization. Managing strong source-grid-load-storage interactions in the power grids in turn increases complex and high-dimensional optimization problems. Therefore, a flexible and intelligent approach is required to economically adapt to the changing behavior of both consumers and renewable power generators. This paradigm shift will enable power delivery by actively and proactively managing the system performance to any dynamic situations in an optimal, controllable and economic manner. This special session will address and disseminate the state-of-the-art ongoing research and development results on optimization, control and management of renewable energy power systems for a sustainable and economical operation, aided by emerging artificial intelligence-enabled technologies.

Topics of the Session (but are not limited to)
- Smart grids/microgrids with renewable energy sources
- Power prediction and forecasting
- Power flow optimization
- Real-time energy management
- Demand-side response and management
- AI-empowered control including reinforcement learning
- Data-driven machine learning approaches and physical modelling approaches
- Energy cost modelling
- Economic power dispatch
- AI and digital twin-enabled solutions and applications

SS Data-Based Intelligent Sensing and its Application to System Integration Technology

Organizers:
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Description:
Data measured by sensing technologies, such as innovative vision and cameras, as well as 3D and 2D LiDAR, are crucial for designing systems based on current machine learning and artificial intelligence technologies. Artificial Intelligence and machine learning techniques are used effectively for system integration based on this data. System integration that effectively connects data-based systems has also been proposed. Recent advances in sensing technology are expected to contribute to the development of intelligent systems in future human assistance applications. Therefore, this session aims to discuss new trends in sensing and their applications, focusing on the wide range of applications of the fusion of intelligent sensors and control.

SS Theory and Technologies on Human Factors in Advanced Human-System Environment

Organizers:
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Description:
Human Factors/ergonomics is a key concept to modeling, analyzing, and designing human-machine systems, in which human factors includes not only physical but also psychology aspects. A well-designed system not only has a good combination of sensing, decision-making, and control technologies, but also makes the best use of AI in human-machine interactions. We organize this special session to discuss resent studies and development in this field. Contributors are encouraged to submit their papers including modelling and methods from mechanical, electrical, environmental, biomedical, chemical, and physical aspects with a special focus on the effect of human factors.

SS Advanced Technologies of Motion Control for Robotic Applications

Organizers:
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Description:

This special session offers a unique opportunity to explore cutting-edge advancements in motion control that are revolutionizing the robotics industry. The session will focus on emerging technologies, such as AI-driven control systems, reinforcement learning, and force feedback, which are enabling robots to perform tasks with unprecedented precision and adaptability. These innovations directly impact industries such as manufacturing, healthcare, and autonomous systems, where precise and efficient motion control is essential for improving productivity, safety, and overall performance.

This session is highly relevant for an industrial electronics society audience, as it bridges the gap between advanced research and real-world applications. Discussions will highlight how the latest motion control techniques are integrated into robotic systems, enhancing automation and human-robot collaboration. The session will also address the challenges and opportunities in implementing these technologies in industrial settings, such as optimizing manufacturing workflows, increasing production efficiency, and ensuring seamless integration with existing systems. Attendees will gain valuable insights into how these innovations are shaping the future of robotics and driving the next wave of industrial automation.

SS Advanced Applications and Topics in Model Predictive Control In Microgrids, Drives, Converters and Renewable Energy

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Description:
Recently, Model Predictive Control (MPC) methods have gained considerable attention due to their straightforward design, simple inclusion of different objectives, and their discrete nature. Therefore, it has been designed for a lot of different converter topologies targeting a wide range of applications. However, MPC's design and implementation can impose some limitations due to the high computational burden, variable switching frequency operation, and/or the design of weighting factors. Improvements to MPC algorithms and their combination with intelligent controllers have been proposed. Therefore, this special session focuses on the latest advancements in model predictive control algorithm design.

Topics of the Session
- Latest advances in predictive control algorithms.
- Recent solutions for eliminating weighting factors.
- New model predictive control methods for reducing switching frequency and reducing computation burden.
- Model-free predictive control solutions.
- Model Predictive Control Designs for Power Converters: Multilevel Converters, Matrix Converters, DC-DC, DC/AC, and AC/DC, etc.
- Model Predictive Control Algorithms for Grid Connected Applications: Grid-Tied Converters, Active Front-End Rectifiers, etc.
- Model Predictive Control for Power Quality Applications: Active Filters, STATCOM, etc.
- Model Predictive Control for Drive Applications: Induction Motors, PMSM Machines, etc.
- Machine learning with model predictive control

SS Innovation in Power Electronics and Intelligent Energy Systems for Sustainable Industrial Transformation

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Description:
This Special Session examines cutting-edge innovations in power electronics, control systems, and smart energy technologies pivotal for sustainable industrial transformation. As industries shift toward cleaner, efficient energy paradigms, it focuses on breakthroughs enhancing renewable integration, energy efficiency, and optimized industrial systems. Key topics include wide-bandgap semiconductors (SiC, GaN) for high-efficiency converters, multilevel inverters for renewable energy systems (solar, wind), and advanced control strategies ensuring grid stability.

The session will showcase diverse contributions, from AI-driven predictive control and real-time monitoring systems to energy storage solutions bolstering grid resilience. It also covers IoT-based automation for energy management, fault detection via digital signal processing, and VLSI technologies for precise power regulation in industrial settings. Further exploration includes hybrid energy systems and electric vehicles' role in future energy networks.

This session aligns with 'IECON Green Tech,' providing a platform for researchers, engineers, and industry experts across these fields to exchange knowledge. By integrating power electronics, intelligent control, and sustainable energy systems, it offers scalable, practical solutions for efficient, reliable industrial ecosystems.

SS Advanced Control and its Application in Complex Industrial Systems

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Description:
Most systems in complex industrial Electronics are inherently nonlinear. Therefore, the study of nonlinear dynamic systems has attracted attention in engineering and academic fields in recent years. In today's highly competitive industrial landscape, the need for precise, efficient, and reliable control mechanisms has never been more crucial. However, traditional linear methods are no longer capable of accomplishing such a task under the influence of various uncertainties and disturbances. Therefore, it is important to adopt advanced control methods to control complex industrial electronic systems to improve system performance. Advanced control strategies encompass a wide array of techniques, ranging from model predictive control that anticipates system behavior based on predictive models, to robust control which ensures stability and performance even in the face of uncertainties. These methodologies are not only theoretically profound but also practically significant. When applied to complex industrial systems such as large-scale chemical plants, automotive manufacturing lines, or smart power grids, advanced control can optimize production processes, enhance product quality, reduce energy consumption, and improve overall system reliability. It enables industries to meet stringent environmental regulations, respond swiftly to market demands, and gain a competitive edge.

This proposed Special Session aims to provide a platform for researchers to share and exchange original research about this topic in IECON 2025. We sincerely hope that researchers in relevant fields can report the recent results to the scientific community.

The list of possible topics includes, but is not limited to:

- Sliding mode control
- Model predictive control
- Data-driven based control
- Optimization in complex industrial systems
- Fault diagnosis of complex industrial systems
- Smart grid
- Robotic system
- Unmanned system
- Multi-agent systems
- Intelligent vehicles

SS Multiphase technology - a solution for high-performance electric drives

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Description:
The current state of our planet demands optimized energy consumption and reduced greenhouse gas emissions. In this critical scenario, the use of electric drives emerges as a powerful solution. The growing need for more competitive electric drives has sparked interest in multiphase systems due to their advantages over conventional three-phase drives. These benefits include greater fault tolerance, improved power distribution and integration, reduced torque ripple thanks to a higher degree of freedom. Such capabilities are particularly valuable in industrial applications, where reliability and efficiency are critical requirements. Multiphase technology has already been implemented in various commercial electric vehicles, including cars, trucks, ships, and more-electric aircraft, enhancing the competitiveness of their propulsion systems. Its effectiveness has also been confirmed in electrical generation based on multiphase wind energy conversion systems. Despite significant advancements in multiphase electric drives over recent decades, further efforts are needed to fully exploit their potential. Key areas for improvement include but are not restricted to the integration of multiphase drives with high-frequency semiconductors, the development of new multiphase topologies, and the design of multiphase machines based on axial flux — all of which are currently among the hottest topics in the field.

SS Interoperability Frameworks for Smart Transducers in Intelligent Systems

Organizers:
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Description:
This Special Session will explore the crucial role of interoperability in enhancing the integration and functionality of smart transducers within interconnected Intelligent Systems. This session will cover the development and application of vocabularies, ontologies, standards, and protocols that ensure seamless communication and data exchange between diverse smart transducers integrated or not with Artificial Intelligence (AI). Intelligent systems are found in areas, such as Transportation, Waste Management, Grid Platforms, Predictive Maintenance, Digital Twins, Quality Control, Robotic Process Automation, Supply Chain Management, and AI-powered infrastructures.

The purpose of this Special Session is to gather researchers, practitioners, and industry experts to discuss and share advancements in these interoperability frameworks. By focusing on interoperability, the session aims to highlight the importance of seamless data integration and communication for efficient resource management.

The significance of this Special Session lies in its potential to drive innovation and collaboration in smart transducer technology. Participants will gain valuable insights into how these frameworks can enhance decision-making and improve resource management. This session will also provide a platform for networking and knowledge exchange, fostering the development of new standards and best practices in the industry.

SS Power Converters and Control for Electric Vehicle Charging Infrastructure

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Description:
The electrification of transportation is one of the key actions for energy transition to reduce CO_2 emissions and mitigate the effects of climate change. One of the most relevant aspects to accelerate the adoption of electric vehicles is to improve and expand the charging infrastructure, particularly fast charging technologies. Power electronics plays a critical role in EV charging infrastructure, not only adapting and controlling the power flow from grid to battery but also enabling new grid integration solutions that can unlock new possibilities in distributed generation, energy storage and complementary cervices to enable a more reliable and flexible smart grid.

This special session aims to gather the latest contributions on EV charging infrastructure to provide a fertile ground for researchers and practicing engineers to discuss and share experiences to advance this technology and tackle existing challenges and embrace existing opportunities.

The Special Session topics include but are not limited to:
- On-board, off-board and integrated charger topologies
- Reliability in EV charging infrastructure
- Heavy duty vehicle charging infrastructure (Megawatt Charging System - MCS)
- Gird integration and smart charging (Vehicle to everything - V2X)
- Battery management systems (BMS)
- Battery charging profiles
- EV fast charging station architectures (split chargers, AC-bus, DC-bus)
- Wireless charging technologies
- AI and machine learning applied to EV charging technologies
- Advanced control methods for EV charging
- Modular, reconfigurable, and scalable power converter architectures
- Solid-state transformers (SSTs) for EV charging applications
- Galvanic isolation requirements
- Battery powered chargers

SS The Responsible Practice of Generative Artificial Intelligence for Industrial Applications and Systems

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Description:
Generative Artificial Intelligence (AI) is transforming the way we live and work through numerous practical applications of intelligence, insights and decision-making. These generative intelligence capabilities have expanded into industrial applications and systems, leading to diverse opportunities for innovation in research, development, practice, as well as training and education. For instance, in energy systems, Generative AI can be used to inform decisions on renewables integration, energy conservation measures, energy optimization and predictive maintenance, while in robotics, it is contributing to trajectory planning, state estimation, adaptive vision and human interaction. In parallel to these rapid technical innovations, the risks of AI are also growing. AI that is poorly designed, developed and evaluated without consideration of the broader socio-technical landscape of operation, can result in system failures, service disruptions, security violations and even human casualties. This special session invites novel research articles in the theory, application and evaluation of Responsible AI and Generative AI for industrial applications and systems.