CPE-POWERENG 2027
21st International Conference on Compatibility, Power Electronics, and Power Engineering
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CPE-POWERENG 2027 Special Session

Artificial Intelligence and Digital Twins for Power-Electronics-Dominated Energy Systems

- **Abstract:**
  Electrical energy systems are rapidly becoming power-electronics-dominated: solar, wind, batteries, electric-vehicle chargers, electrolysers and fast-growing data-centre loads all connect through converters. This transformation raises new challenges in stability, power quality, electromagnetic compatibility and reliability that conventional model-based tools struggle to address at scale. Artificial intelligence, machine learning and digital twins now offer powerful ways to design, control, monitor and protect these systems. This special session invites original contributions on data-driven, physics-informed and hybrid methods, from device and converter level up to grid scale, with emphasis on experimental validation, real-time implementation and industrial case studies, bringing together the power electronics, power systems and EMC communities.

- **Topics:**
  - Physics-informed and data-driven modelling of converters, machines and grids
  - AI-assisted design of converters, magnetics and wide-bandgap (SiC/GaN) devices
  - Learning-based control of grid-forming and grid-following inverters
  - Digital twins of converters, drives, renewable plants and energy storage
  - Condition monitoring, fault diagnosis and lifetime prediction of power components
  - AI for stability, protection and resilience of inverter-dominated grids
  - Data-driven power-quality analysis and EMI/EMC prediction and mitigation
  - Intelligent energy management for EV charging, hydrogen and data centres
  - Edge AI, real-time embedded implementation and hardware-in-the-loop validation
  - Cybersecurity and explainable, trustworthy AI for power and energy systems

- **Organizer(s):**



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Reader in Electrical Power Engineering. Research interests include power systems, smart grids, energy management, grid reliability, fault detection, condition monitoring and AI/data analytics for modern energy systems.



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Senior Lecturer in Electrical and Electronic Engineering. His research covers power electronics, renewable energy, microgrids, digital twins for smart distribution grids, energy management, and power-system resilience.



Dr. Amira Mohammed
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Lecturer in Electronic Engineering. Her research focuses on grid control and stability, smart grids, renewable-energy integration, microgrid operation, co-simulation, and data analytics for power systems.



Dr. Majdi Mansouri
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Associate Professor in Electrical and Computer Engineering. His research focuses on data-driven and AI-based fault detection and diagnosis, machine/deep learning, statistical signal processing, and applications to energy and industrial systems.



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Assistant Professor at Tarleton State University, holding two Ph.D. degrees in Electronics and Electrical and Computer Engineering. His research focuses on trustworthy AI, cybersecurity, reinforcement learning, and intelligent optimization, stability and control of cyber-physical systems and critical infrastructure.

- **Proposed IEEE IES Technical Committee Sponsorship (subject to confirmation):**
  IEEE IES TC on Power Electronics (PETC)
  IEEE IES TC on Data-Driven Control and Monitoring (DDCM)

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- **Other:**
  A cross-cutting session that links all eight technical tracks (TT01–TT08) through shared AI and digital-twin methods. Contributions from industry and early-career researchers, and papers that share open datasets, benchmarks or tools, are especially welcome.