

## **Call for Letters - Special Section on AI-Enhanced Power Electronic Systems: Design, Control, and Maintenance**

**Scheduled Publication Time: November 2025**

### **Brief description**

Power electronic systems (PESs) are vital for smart grid, energy storage, transportation electrification, and industrial automation. The fast development of PESs inspires optimized energy use, green technology integration, improved control and efficiency, and supports the shift towards more sustainable and flexible power systems. In recent years, Artificial Intelligence (AI) is increasingly providing transformative information and technology to PESs, throughout three distinctive life-cycle phases: design, control, and maintenance. Based on the powerful nonlinear learning capabilities, AI is making a significant impact on multiple aspects of PESs, for example, design and optimization, adaptive control, smart grid management, predictive maintenance, fault detection and diagnosis, etc. However, there are still challenges and hindrances for the real application of AI in PESs, which include high real-time requirements, substantial data demands, integration issue with existing systems, risks of cyber-attack, and limited model interpretability. And the models and requirements would vary for different life-cycle phases. Tackling these challenges requires the efficient real-time AI algorithms tailored for practical systems in low-data environments. These endeavors are crucial for meeting the demands of AI-enhanced PESs and achieving enhanced efficiency, adaptivity, and stability, in a complete cycle of system design, control, and maintenance.

### **Objective**

This Special Section aims to provide a platform for worldwide researchers in academia and industry to share their contributions in the subject of AI-enhanced power electronic systems during three life-cycle phases: design, control, and maintenance, which could unlock the AI potential of integrated studies on three phases, and also encourage international collaborations between academia and industry for the AI applications in both transportation and energy sectors.

### **Subtopics**

Prospective authors are invited to submit original contributions and industry-focused papers on related topics of interest including, but are not limited to, the following:

- Design and optimization of power electronic systems
- Data-model-hybrid-driven control of power converters
- Adaptive control of power electronic systems
- AI-enhanced fault detection and diagnostics of power converters
- Predictive maintenance of power electronic systems
- Supervised learning-aided design and control of power converters
- Reinforcement learning for the control of power converters
- Emerging machine learning techniques (e.g., federated learning, transfer learning) for power electronics

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### **Proposed timeline**

- December 1, 2024 – Open to Manuscript Submissions
- June 1, 2025 – Manuscript Submissions Deadline
- August 30, 2025 – Final Decision Notification
- September 15, 2025 – Manuscripts Forwarded to IEEE for Publication
- October 1, 2025 – Manuscripts Published Online as Early Access
- November 15, 2025 – Special Section Published in an IEEE TPEL Issue