IEEE Canada

IEEE Canadian Journal
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CALL FOR PAPERS

Special Issue on

Power Electronics-Dominated Power System Dynamics, Stability, and Control (PEDSC)

A foundational transformation has occurred in electric power infrastructures over the past decade: a systemic shift from rotor-based electromechanical architectures to converter-interfaced fast-switching paradigms. Driven by decarbonization imperatives, utility-scale photovoltaics (PV) power plants, battery storage systems, inland and offshore wind farms, fast-charging electric vehicles, high-voltage direct current (HVDC) corridors, and widely deployed Flexible AC transmission systems (FACTS) devices are displacing synchronous generators and their physical inertia, inner electromotive force, fault currents, and governor responses. This technological transition, while environmentally essential, has exposed unforeseen stability challenges. Recent events, such as the 2025 Iberian Peninsula blackout, underscore that contemporary Power Electronics-Dominated Power Systems exhibit novel dynamics confounding conventional stability analysis, protection coordination, and control frameworks. NERC's 2024 Inverter-Based Resource Model Quality Deficiencies Alert mandates higher-fidelity EMT models and coordinated validations. The emerging grid-forming technologies (virtual synchronous generator, matching control, virtual oscillators) show promise to restore system inertia, damping, and fault ride-through. However, critical research gaps persist, such as multi-timescale interactions, wide-spectrum oscillations, sequential switching dynamics, scalable system-wide coordination, and adaptive protection philosophies. Therefore, understanding power electronics-dominated dynamics at the system level, inventing new stability analysis tools, and proposing adequate control architectures and protection paradigms is a significant and timely topic.

The guest editorial board of this special issue solicits original research papers with novel contributions to the dynamics, stability, and control of power electronics-dominated power systems. Topics of interest include, but are not limited to

1. Fundamental Dynamics and Modeling

- **Novel Instability Mechanisms**
  - Sub-synchronous oscillations
  - Ultra-high-frequency resonance and harmonics
  - Transient voltage instability
  - Synthetic inertia and high Rate of Change of Frequency (RoCoF) dynamics
  - Sequential switching transients
- **Multi-fidelity Modeling**

- Scalable reduced-order models for large-signal and small-signal studies
- EMT-RMS co-simulation interoperability, Hardware-in-the-Loop (HIL) testbeds
- Digital twins for Inverter-Based Resource (IBR)-dominated grids
- Artificial Intelligence (AI)-accelerated electromagnetic transient solvers

2. Stability Analysis and Control

- **Advanced Stability Criteria**
  - Stability regions of hybrid AC/DC grids
  - Passivity-based stability margins
  - Coupled oscillation mode analysis
  - Linear Time Variant (LTV) grids stability
- **Grid-Forming Control**
  - Virtual synchronous generator control
  - Matching control
  - Virtual oscillator control
  - Field validation case studies

3. Protection and Resilience

- **Adaptive Protection Schemes**
  - Solid-state circuit breaker coordination
  - Dynamic zone-of-protection adjustment
  - Fault-current characterization and protection adaptation
  - Machine learning-assisted fault detection
- **Black-Start and Recovery**
  - Converter-based system restoration
  - Sequential energization protocols
  - Robust synchronization and adaptive phase-locking under extreme disturbances

4. System Integration and Standards

- **Wide-Area Coordination**
  - TSO-DSO (Transmission System Operator-Distribution System Operator) interoperability frameworks
  - Multi-converter stability coordination
- **Standardization Gaps**
  - IEEE/CIGRE/IEC model validation benchmarks
  - NERC/FERC compliance roadmap analysis

5. Cross-Disciplinary Frontiers

- **Physics-Informed Machine Learning (ML)**
  - Physics-informed neural networks for parameter estimation and model validation

  - Fast stability screening, oscillation source location, and predictive control via ML
  - Digital twin-to-hardware transfer learning
- **Cyber-Physical Security**
  - Latency-impacted control stability
  - Resilient communication architectures
  - Cyber-physical resilience and coordinated remedial action schemes

Timeline and Important Dates (Extended)

- Dec. 1, 2025 (extended to Feb. 24, 2026): Deadline of the extended abstract submission
- Jan. 15, 2026 (extended to Mar. 5, 2026): Deadline of notifications/invitations of the full paper submission
- Mar. 5, 2026 (extended to Apr. 20): Deadline of the full paper submission through the Author Portal
- Oct. 15, 2026: Deadline of the final decision of the papers
- Oct. 31, 2026: Deadline of the submission of final files through the Author Portal.
- Dec. 15, 2026: Publication in the IEEE Canadian Journal of Electrical and Computer Engineering.

Submission Guidelines

Authors must submit an extended abstract (2-page, free format of A4 or US letter, font size of 11 pts, PDF version) to Prof. Dan Wu (danwuhust@hust.edu.cn). Authors with accepted abstracts will receive a formal invitation with detailed instructions for submission of the complete manuscript to the Author Portal of the IEEE Canadian Journal of Electrical and Computer Engineering. Manuscripts submitted for this Special Issue will be reviewed separately and will be handled by the guest editorial board identified below.

Guest Editorial Board

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