Special Session on

High-Performance Electrical Drives: Physics-Based Modeling, Advanced Model-Based Control and Physics-Informed AI Operation

Organized and co-chaired by:

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Abstract

High-performance electrical drives convert electrical energy into mechanical motion or vice versa with special requirements in, e.g., adaptability, efficiency, fault-tolerance, functionality, power/torque density, and precision for demanding applications such as electric vehicles, robotics, high-precision machining, aerospace, aviation or marine propulsion and even certain renewable energy systems. This special session brings together the recent advances in precise physics-based modeling, advanced model-based control and physics-informed AI operation of high-performance electrical drive systems. The session particularly wants to shed light on physics-based modeling, model-based control and physics-informed AI operation of realistic (i.e., nonlinear) electrical drives covering all dominant physical effects such as angle, current, temperature and frequency-dependent flux linkages and resistances, overcoming common over-simplifications such as constant parameters (of, e.g., resistances, apparent or differential inductances) or symmetric machine behavior.

Topics of interest include but are not limited to:

- Precise physics-based modeling of:
  - Thermal and electro-magnetic effects (e.g., nonlinear dependencies of flux linkages or resistances on currents, angle or temperature).
  - Losses (e.g., iron losses in stator and rotor).

  - Faults or aging.
- Advanced model-based control (based on the developed models above) of:
  - Optimal control (e.g., time-optimal).
  - Optimal operation (e.g., efficiency maximization).
  - Fault-tolerant control.
  - Active noise cancellation/suppression.
  - Torque ripple minimization.
- Physics-informed AI operation (exploiting engineering knowledge):
  - Neuro-adaptive control.
  - Operating point and pulse pattern optimization.
  - State estimation, model identification and the combination of both (electrical, thermal and mechanical domains).
  - Fault detection and diagnosis (FDD).
  - Prognostics & remaining useful life predictions.

Important dates

- Full Paper Submission: February 1, 2026
- Full Paper Notification: May 1, 2026
- Final Paper Upload: June 1, 2026

Submission of papers

Paper submission follows the rules of regular papers. All the instructions for paper submission are included in the conference website:
https://icem2026.ubi.pt/submission.html