Title: AI-Empowered Scientific Computing for Analysis, Planning and Operation of Power and Energy Systems

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Brief Description of the Session Thematic:

The power system the largest and most complex machine ever devised by mankind, which represents large-scale complex engineered systems. Power and energy systems are characterized by nonlinearities, randomness, heterogeneity, interactions, connected multiscale components, sensitivity to initial conditions, and emergent behaviors, etc. The integration of huge amounts of inverter-based stochastic renewable energy sources has dramatically increased the complexity of power and energy systems. In this context, physics-based mathematical models, time-domain simulation tools, and deterministic optimization methods may no longer suffice for the analysis, planning and operation of power and energy systems. AI-empowered scientific computing paradigms are believed to help to augment and improve workflows (e.g., analysis, planning and operation) in complex power and energy systems. Unlike general AI and generative AI, which falls short in solving problems governed by rigorous mathematical principles and physical rules, AI-empowered scientific computing is designed to perform extremely well on specified tasks, e.g., solving a system of nonlinear equations, a nonconvex or combinatorial optimization problem, and a differential-algebraic system of equations, etc. Encouraged by the emerging advanced research directions on AI for science, we set up this Special Issue on AI4PES to collect recent advances and applications of AI-empowered scientific computing in the analysis, planning and operation of power and energy systems with a focus on analytic, optimization and control methods.

Topics and Keywords:

1. Pretrained AI models for power and energy systems
2. Physics-informed surrogate models for scientific computing in power system analysis
3. AI-empowered optimal planning and/or operation of renewable power and energy systems
4. AI-empowered stability and control of renewable power and energy systems
5. Quantum machine learning in power and energy systems
6. AI-driven studies in characterization, forecasting, and knowledge extraction of complex power and energy systems

Keywords: Pretrained AI models, power system analysis, renewables, quantum machine learning, complex systems.