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Title of the Proposal:

Machine Learning and Distributed Optimization for Cyber-Physical Energy Systems

- Presenter(s):

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- Brief description:

As increasing integration of information and communication technology (ICT) and modern energy systems, the concept of cyber-physical energy systems (CPESs) is presented. By using advanced ICT and energy generation and consumption technologies, CPESs are capable of enhancing system reliability, improving operation security, and reducing failure risk, etc. With the development of diversified energy network architecture, digitalization infrastructure, and e-mobility, there are many unprecedented challenges for smart modelling, operation and control in CPESs.

In this tutorial, we will mainly focus on state-of-the-art machine learning and distributed optimization approaches with application in CPESs. We first will introduce the new concept, features, and challenges of CPESs. Then, we will present several kinds of advanced machine learning methods to tackle the challenges in the aspects of energy management, frequency control, and load monitoring. Next, we will present several kinds of distributed optimization methods to achieve peer-to-peer energy trading and sharing in different physical and communication environments. Finally, we will conclude and point out related open issues.

- Duration: 3 hours

- Outline:

The outline of the Tutorial is summarized as follows:

- Cyber-Physical Energy Systems overview
  - New features, requirements and challenges
  - Key enabling technologies
- Machine Learning for Cyber-Physical Energy Systems
  - Overview, classifications, and advantages
  - Deep reinforcement learning for energy management
  - Transfer learning for non-intrusive load monitoring
  - Multi-agent deep reinforcement learning for frequency control
- Distributed optimization for Cyber-Physical Energy Systems
  - Overview, classifications, and advantages
  - Distributed optimization (ADMM, consensus-based) for energy P2P trading and sharing
  - Privacy-preserving distributed optimization for energy P2P trading and sharing
  - Secure distributed optimization for energy P2P trading and sharing
  - Game theory and auction theory for energy trading
- Conclusion, open issues, and Q&A