



2021 PSERC Summer Tutorial

Physics and Risk-Aware Machine Learning for Power Systems Operations

Hao Zhu

University of Texas

Recent years have witnessed rapid transformations of advances in machine learning (ML) and data science to aid the transition of energy systems into a truly sustainable, resilient, and distributed infrastructure. A blind application of the latest-and-greatest ML algorithms to solve stylized grid operation problems, however, may fail to recognize the underlying physics models or safety constraint requirements. This talk will introduce three examples of bridging physics and risk-aware ML advances into efficient and reliable grid operations.

First, we develop a topology-aware approach using graph neural networks (GNNs) to predict the price and line congestion as the outputs of real-time optimal power flow problem. This proposed solution significantly reduces the model complexity of existing end-to-end ML methods while efficiently adapting to varying grid topology. Second, we put forth a risk-aware ML method to ensure the safety guarantees of data-driven, scalable reactive power dispatch policies in distribution grids. Last, we consider a reinforcement learning framework for managing a large number of dynamical, flexible energy resources such as electrical vehicles, and demonstrate the need to simplify the system representation through physics-aware state/action aggregation.

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3:00-4:30 P.M. EDT

[LINK TO TUTORIAL REGISTRATION](#)

(12:00-1:30 P.M. PDT)

Hao Zhu is an Assistant Professor of Electrical and Computer Engineering (ECE) at The University of Texas at Austin. She received the B.S. degree from Tsinghua University in 2006, and the M.S. and Ph.D. degrees from the University of Minnesota in 2009 and 2012, all in electrical engineering. From 2012 to 2017, she was a Postdoctoral Research Associate and then an Assistant Professor at the University of Illinois at Urbana-Champaign. Her research focuses on developing innovative algorithmic solutions in the optimization for future energy systems. Her current interests include physics and risk-aware machine learning for power systems, and the design of energy management system under the cyber-physical coupling. Dr. Zhu is a recipient of the NSF CAREER Award and the Siebel Energy Institute Seed Grant Award. She is currently a member of the IEEE Power & Energy Society (PES) Long Range Planning (LRP) Committee and an Associate Editor for the IEEE Transactions on Smart Grid.

