# Centre for Power Engineering Seminar

**Chaired by Xu Yan**
(Technically co-sponsored by the IEEE PES Singapore Chapter)

**Date: 5th December 2024 (Thursday)**
**Time: 2:30 pm – 4:00 pm**
**Light refreshment will be provided**

**Venue: Nanyang Technological University**
**School of EEE , LT 29, South Spine**

**Speaker 1**

**Time: 2:30 pm – 3:00 pm**

**Assistant Professor Yue Chen**

Vice-Chancellor
Assistant Professor
Department of Mechanical and Automation Engineering, the Chinese University of Hong Kong

**Title: A Differentially Private Quantum Neural Network for Probabilistic Optimal Power Flow**

***Abstract:***

The stochastic nature of renewable energy and load demand requires efficient and accurate solutions for probabilistic optimal power flow (OPF). Quantum neural networks (QNNs), which combine quantum computing and machine learning, offer computational advantages in approximating OPF by effectively handling high-dimensional data. However, adversaries with access to non-private OPF solutions can potentially infer sensitive load demand patterns, raising significant privacy concerns. To address this issue, we propose a privacy-preserving QNN model for probabilistic OPF approximation. By incorporating Gaussian noise into the training process, the learning algorithm achieves (ε, δ)-differential privacy with theoretical guarantees. Moreover, we develop a strongly entangled quantum state to enhance the nonlinearity expressiveness of the QNN. Experimental results demonstrate that the proposed method successfully prevents privacy leakage without compromising the statistical properties of probabilistic OPF. Moreover, compared to classical private neural networks, the QNN reduces the number of parameters by 90% while achieving significantly higher accuracy and greater stability.

To provide topics for broader research discussions, I will also give an overview of my other research projects related to the optimization and market design of power systems.

***Biography:***

Yue Chen is a Vice-Chancellor Assistant Professor in the Department of Mechanical and Automation Engineering at The Chinese University of Hong Kong (CUHK). Prior to joining CUHK, she received the B.E. and Ph.D. degrees in Electrical Engineering from Tsinghua University in 2015 and 2020, respectively, and the B.S. degree in Economics from Peking University in 2017. Her research interests include optimization and game theory, with applications to electricity markets and cyber-physical-social systems. She received multiple awards, including the Vice-Chancellor Early Career Professorship, the Dean's Exemplary Teaching Award, the Stanford Bits & Watts Postdoc Fellowship, the Excellent Ph.D. Thesis Award of Tsinghua, and the Best Reviewer Award of many international journals. Dr. Chen serves as an Associate Editor for IEEE Transactions on Smart Grid, IEEE Power Engineering Letters, and IET Renewable Power Generation. She is the Hong Kong Chapter Representative of IEEE PES Women in Power.

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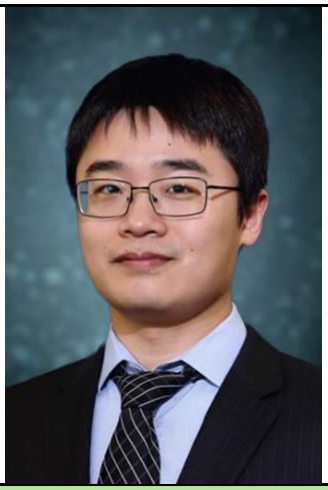
| **Speaker 2**<br><br>**Time: 3:00 pm – 3:30 pm** |  | **Assistant Professor Changhong Zhao**<br><br>Assistant Professor<br>Department of Information Engineering, the Chinese University of Hong Kong |

**Title: Accelerating Large-scale Power Flow Optimization via Distributed Learning and Computing**

***Abstract:***

Optimal power flow (OPF) is a fundamental optimization problem, which aims to minimize the operational cost of a power network subject to its physical laws, resource capacities, and safety limits. The physical laws mainly refer to the nonlinear alternating-current (AC) power flow equations, which make the OPF problems nonconvex and thus hard to solve, especially with a large and ever-increasing number of decision variables for the rapidly growing controllable distributed energy resources.

In this talk, I will introduce a new set of algorithms to solve large-scale nonlinear OPF problems faster than existing methods with improved quality of solutions. To realize this goal, the proposed algorithms will perform learning and computing in a spatially hierarchical and distributed structure on power distribution networks. Particularly, we will learn decentralized neural network models from simulated data to predict the iterative descent directions of decision variables in the hierarchical distributed algorithm. The solution quality and computational efficiency of the proposed algorithms have been verified through software simulations of realistic power distribution network models.

To provide topics for broader research discussions, I will also give an overview of my other research projects related to the control and optimization of power systems.

***Biography:***

Changhong Zhao received BE in Automation from Tsinghua University in 2010, and PhD in Electrical Engineering from Caltech in 2016. He worked at the US National Renewable Energy Laboratory from 2016 to 2019, after which he joined CUHK as an Assistant Professor. His research is in control and optimization for networked systems such as power systems. He received two PhD thesis prizes from Caltech, the Hong Kong RGC Early Career Award, and the IEEE Power and Energy Society Prize Paper Award.

(Please note that photographs and/or videos of you may be taken during the event for the purpose of conducting publicity and developing promotional materials.)