

Yifan Zhou

Contact Information

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Address : Department of Electrical and Computer Engineering, Stony Brook University, NY, 11790, USA

Supervisor : Prof. **Peng Zhang**

Research Interests

Microgrid and Networked Microgrids, Formal Analysis, Artificial Intelligence Driven Smart Grid, Quantum Computing

Education and Visiting Experience

Ph.D. of Electrical Engineering, Tsinghua University

Sep. 2014 – Jul. 2019
Beijing, China

- Supervisor: **Yong Min**, Professor
- Thesis: Integrated Power and Heat Dispatch Methodology Based on Operational Flexibility
- GPA: 92.0/100, Rank: **5/58**

Visiting Graduate at SEAS, Harvard University

May. 2018 – Oct. 2018
Boston, MA, USA

- Supervisor: **Na Li**, Gordon McKay Professor

Visiting Graduate at School of EESE, University of Birmingham

Apr. 2016 – Jul. 2016
Birmingham, UK

- Supervisor: **Xiao-Ping Zhang**, Professor

B.S. of Electrical Engineering, Tsinghua University

Sep. 2010 – Jul. 2014
Beijing, China

- GPA: 93.1/100, Rank: **1/132**
- **Excellent Graduate of Tsinghua University (1.5%)**, Excellent Graduate of Beijing, Excellent Thesis Award

Books

- [B1] Peng Zhang, Walter O. Krawec, Zefan Tang, **Yifan Zhou**, "Quantum Grids", Cambridge University Press, to be published in 2022.
- [B2] **Yifan Zhou**, Peng Zhang, "Power System Reachability Analytics", Cambridge University Press, under preparation.

Publications

Highlights: 10 first-author papers in top-tier journals and conferences including TPWRS, TSTE, EGY, PESGM.

Journal Publications

- [J1] **Yifan Zhou**, Peng Zhang, “ *Neuro-Reachability of Networked Microgrids*”, IEEE Transactions on Power Systems (**TPWRS**), accepted, May. 2021.
- [J2] Lizhi Wang, **Yifan Zhou**, Wenfeng Wan, Peng Zhang, “ *Eigenanalysis of delayed networked microgrids*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 36, no. 5, pp. 4860-4863, Sept. 2021.
- [J3] **Yifan Zhou**, Fei Feng, Peng Zhang, “ *Quantum Electromagnetic Transient Program*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 36, no. 4, pp. 3813-3816, Jul. 2021.
- [J4] Fei Feng, **Yifan Zhou**, Peng Zhang, “ *Quantum Power Flow*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 36, no. 4, pp. 3810-3812, Jul. 2021.
- [J5] **Yifan Zhou**, Peng Zhang, “ *Reachable Dynamics of Networked Microgrids with Large Disturbances*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 36, no. 3, pp. 2416-2427, May. 2021.
- [J6] **Yifan Zhou**, Peng Zhang, “ *Reachable Power Flow: Theory to Practice*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 36, no. 3, pp. 2532-2541, May. 2021.
- [J7] **Yifan Zhou**, Peng Zhang, “ *Reachable Eigenanalysis*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 35, no. 6, pp. 4936-4939, Nov. 2020.
- [J8] **Yifan Zhou**, Peng Zhang, “ *Reachable Power Flow*”, IEEE Transactions on Power Systems (**TPWRS**), vol. 35, no. 4, pp. 3290-3293, Jul. 2020.
- [J9] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Power and Energy Flexibility of District Heating System and Its Application in Integrated Power and Heat Dispatch*”, Energy (**EGY**), vol. 190, Jan. 2020.
- [J10] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Integrated Power and Heat Dispatch Considering Available Reserve of Combined Heat and Power Units*”, IEEE Transactions on Sustainable Energy (**TSTE**), vol. 10, no. 3, pp. 1300-1310, Jul. 2019.
- [J11] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Active Splitting Strategy Searching Approach Based on MISOCP with Consideration of Island Stability*”, Journal of Modern Power Systems and Clean Energy, vol. 7, no. 3, pp. 475-490, 2019.
- [J12] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Modeling and Optimization of Multitype Power Sources Stochastic Unit Commitment Using Interval Number Programming*”, Journal of Energy Engineering, vol. 143, no. 5, 2017.
- [J13] Wei Hu, Yong Min, **Yifan Zhou**, *et al* “ *Wind Power Forecasting Errors Modelling Approach Considering Temporal And Spatial Dependence*”, Journal of Modern Power Systems and Clean Energy, vol. 5, no. 3, 2017.
- [J14] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Peak Regulation Compensation Price Decision for Combined Heat and Power Unit and Profit Allocation Method*”, Proceedings of the Chinese Society for Electrical Engineering, vol.39, no.18, pp. 5325-5335+5579, 2019.
- [J15] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Coordinated Power and Heat Dispatch Considering Peak Regulation Initiative of Combined Heat and Power Unit*”, Automation of Electric Power Systems, vol.43, no.19, pp. 42-51, 2019.
- [J16] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “ *Dynamic Comprehensive Evaluation of Chinese Power System Development Level Based on Provincial Data*”, Automation of Electric Power Systems, vol.40, no.18, pp. 76-83, 2016.

Journal Papers Under Review

- [J17] **Yifan Zhou**, Peng Zhang, “*Noisy Intermediate-Scale Quantum Electromagnetic Transients Program*”, IEEE Transactions on Power Systems (**TPWRS**), submitted in Oct. 2021.
- [J18] **Yifan Zhou**, Peng Zhang, “*Stochastic Reachable Dynamics of Microgrids*”, Electric Power Systems Research, submitted in Sep. 2021.
- [J19] Fei Feng, **Yifan Zhou**, Peng Zhang, “*Networked microgrids power flow*”, IEEE Transactions on Power Systems (**TPWRS**), submitted in Sep. 2021.
- [J20] Fei Feng, **Yifan Zhou**, Peng Zhang, “*Authentic microgrids state estimation*”, IEEE PES Letters, submitted in Jun. 2021.
- [J21] **Yifan Zhou**, Peng Zhang, “*Noise-Resilient Quantum Machine Learning for Power System Stability Assessment*”, IEEE Transactions on Power Systems (**TPWRS**), submitted in May. 2021.

Conference Publications

- [C1] **Yifan Zhou**, Peng Zhang, Yue Meng “*An ODE-Enabled Distributed Transient Stability Analysis for Networked Microgrids*”, IEEE Power and Energy Society General Meeting (**PESGM**), 2020.
- [C2] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “*A Semi-Supervised Anomaly Detection Method for Wind Farm Power Data Preprocessing*”, IEEE Power and Energy Society General Meeting (**PESGM**), 2017.
- [C3] Le Zheng, Wei Hu, **Yifan Zhou**, *et al*, “*Deep belief network based nonlinear representation learning for transient stability assessment*”, IEEE Power and Energy Society General Meeting (**PESGM**), 2017.
- [C4] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “*MILP-based Splitting Strategy Searching Considering Island Connectivity and Voltage Stability Margin*”, IEEE Power and Energy Society General Meeting (**PESGM**), 2016.
- [C5] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “*A Novel Active Splitting Strategy Search Method with Modularity-based Network Partition*”, IEEE Innovative Smart Grid Technologies - Asia (ISGT ASIA), 2015.
- [C6] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “*Coherency Feature Extraction based on DFT-based Continuous Wavelet Transform*”, IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), 2015.
- [C7] **Yifan Zhou**, Wei Hu, Yong Min, *et al*, “*Modelization and Optimization of Multi-Type Power Generators Joint Scheduling based on Improved PSO*”, IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), 2014.

Research Experiences

Highlights: Senior personnel of **3 federal projects**; core participant of 10 power system projects focusing on renewable energy, energy decarbonization, AI techniques, formal verification, quantum computing, etc.

AI-Grid: AI-Enabled, Provably Resilient, Programmable Networked Microgrids

Oct. 2021 – Present

Senior Personnel, NSF, \$ 5 M

- Jointly designed the AI-Grid prototype, an AI-enabled platform for modelling, verification and runtime control of networked microgrids towards scalable, self-protecting, autonomic and ultra-resilient smart communities.
- Served as the key personnel for establishing the functionalities of a “resilient” AI-Grid (one of the three modules of AI-Grid), which integrates black-box models, learning-based formal verification and physics-informed stability analysis to enable provable-resilient microgrid operation.
- Partnered with 10+ internationally renowned industry and R&D partners.
- **Highlight:** AI-Grid will be deployed in three highly representative microgrids in the US by Aug. 2023.

**Solar PLUS: Solar Integration through Physics-Aware Learning Based
Ultra-Scalable Modeling and Analytics**

Oct. 2021 – Present

Senior Personnel, DOE SETO, \$ 1.5 M

- Contributed to learning-based dynamic models of solar PVs at all levels (i.e., transmission, distribution, and behind-the-meter).
- Contributed to data-driven dynamic verification of solar PVs under infinitely many solar generation scenarios.

AI-Enabled, Provably Resilient Networked Microgrids (Phase I)

Aug. 2020 – May. 2021

Senior Personnel, NSF, \$ 1 M

- Developed the **Neuro-Reachability** prototype, a data-driven platform for dynamic verification of networked microgrids with unidentified subsystems and heterogeneous uncertainties.
- Designed an **ODE-Net-enabled microgrid model discovery** method to construct nonlinear state-space models of data rich, information poor (DRIP) microgrids.
- Research results led to two following proposals (1 NSF and 1 DOE), one first-author publication and two pending submission.

SBU-UML Collaboration on Energy Resiliency for Navy (Phase II)

Oct. 2021 – Present

ONR, \$ 6 M

- Jointly proposed a three-level cybersecurity architecture for **cyber-physical networked microgrids**.
- A programmable attack-defense platform is under development.

**Practical Quantum Analytics for Ultra-Efficient and Resilient Bulk
Power Systems Operations**

Oct. 2020 – Present

DOE Office of Electricity, \$ 1.2 M

- Pioneered quantum linear solver-based electromagnetic transients program (**QEMTP**) methods for both far-term fault-tolerant quantum era and the near-term noisy-intermediate-scale quantum era.
- Devised a quantum machine learning-based transient stability assessment (**QTSA**) method to unlock quantum potentials in power system stability analysis.
- Led the verification of aforementioned methods on IBM real quantum computers.
- Jointly designed quantum power flow (**QPF**) and quantum state estimation (**QSE**) for power system static analysis.
- An **open-source QGrid Analytics Toolbox** is under development to support future computing needs for fast and resilient bulk power grid operations.
- Research results led to 1 following NSF proposal to be submitted, two three first-author publications and two under review.

**SCC: Empowering Smart and Connected Communities through Programmable
Community Microgrids**

Sep. 2019 – Present

NSF, \$ 0.8 M

- Established scalable and efficient distributed transient stability analytics of networked microgrids.
- Jointly developed a delayed-eigenanalysis method for cyber-physical networked microgrids.
- A **programmable operation platform of networked microgrid** is under development, which incorporates our distributed computation, reachability verification, and delayed-eigenanalysis tools.
- Research results led to three first-author publications.

**Formal Analysis for Dynamic Stability Assessment of Large Interconnected Grids
under Uncertainties**

Aug. 2019 – Nov. 2020

DOE Office of Electricity, \$ 1.05 M

- Designed a series of reachability methods of power systems (i.e., **ReachFlow**, **ReachEigen**, **ReachDyn**, **SReachDyn**) to formally verify the steady-state performance, small-signal stability and large-signal stability of power systems under an infinite number of uncertain/stochastic scenarios in a single run.
- Research results led to 2 following NSF proposal, 5 first-author publications and 1 book under preparation.

Integrated Heat and Power Operation Utilizing Flexibility from District Heating SystemJan. 2017 – Jul. 2019
State Grid Corporation of China (SGCC)

- Derived the **operational flexibility** of combined heat and power (CHP) units as well as that of distinct heating systems based on the polytope projection theory.
- Established a flexibility-driven, hierarchical **optimal energy dispatch** towards energy decarbonization of integrated heat and power systems (IPHS).
- Research results led to my PHD thesis and 5 first-author publications in Chinese and international journals.

Data-driven Renewable Energy Uncertainty FormulationJan. 2016 – Dec. 2016
State Grid Corporation of China (SGCC)

- Designed a semi-supervised anomaly detection method for raw data preprocess of renewable energies.
- Established a wind power uncertainty modelling method by pair-copula theory considering the temporal and spatial dependence.
- Research results led to 2 publications.

Active Splitting Control Decision of Interconnected Power SystemsJun. 2015 – May. 2017
State Grid Corporation of China (SGCC)

- Designed an active splitting control method of bulk power systems incorporating voltage and frequency stability constraints.
- Conducted real-world splitting control analysis of the power system of Hubei province in China.
- Research results led to 4 first-author publications.

Coordinated Control of Multi-FACTSJul. 2014 – Aug. 2015
China Electric Power Research Institute (CEPRI)

- Designed control strategies for multi-FACTS based on various control theories (*i.e.*, optimal control, robust control and game-theoretic control) to enhance the small-signal stability of bulk power systems.

Teaching Experience**Instructor:** ESE586 - Microgrids

Spring 2021

- Graduate Course, Department of Electrical and Computer Engineering, Stony Brook University
- Course Evaluation Grade: **4.7/5.0**

Teaching Assistant: 70220172 - Power System Theory and Analysis

Spring 2017

- Graduate Course, Department of Electrical Engineering, Tsinghua University

Teaching Assistant: 30220343 - Automatic Control Theory

Fall 2015, 2016, 2017

- Undergraduate Course, Department of Electrical Engineering, Tsinghua University

Teaching Assistant: 20220443 - Electric and Electronic Technique (2)

Spring 2014

- Undergraduate Course, Department of Electrical Engineering, Tsinghua University

Services**Invited Research Talk**

- Stony Brook University: Reachability Analysis of Networked Microgrids: Theory and Practice Oct. 2021
- The State University of New York (SUNY) System: Quantum Computing in Power System Analytics Oct. 2021
- New York's Offshore Wind Training Program: Grid Integration of Offshore Wind Energy Systems Jul. 2021

Journal Review

- **Editor of Energy Reports**
- Reviewer of IEEE Transactions on Power Systems, IEEE Transactions on Sustainable Energy, IEEE PES Letters, Applied Energy, Energy

Awards

Reviewer Awards

- Outstanding Reviewer for IEEE Transactions on Power Systems 2020

Student Awards — Tsinghua University

- **Excellent Graduate of Tsinghua University (1.5%)** 2014
- Excellent Graduate of Beijing 2014
- Excellent Thesis Award, Tsinghua University 2014
- Tsinghua First-Class Scholarship for Integrated Excellence 2015,2013,2012