Wang Fang | Research Associate

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Research Interests

Quantum Programming Languages, including verification and analysis

Techniques for Classical Simulation of Quantum Circuits

Quantum Applications in Simulation, Optimization and Machine Learning

Research Positions

School of Informatics, University of Edinburgh **Edinburgh, UK**
Research Associate *07/2024-present*
Advisor (PI): Chris Heunen and Robin Kaarsgaard

Education

Institute of Software, Chinese Academy of Sciences **Beijing, China**
Ph.D. in Computer Science, GPA: 3.67/4 *09/2018-06/2024*
Thesis title: Automation Techniques for Quantum Programming: Symbolic Execution and Automatic Differentiation.
Supervisor: Prof. Mingsheng Ying

Department of Mathematics, Nanjing University **Nanjing, China**
B.S. in Mathematics, GPA: 4.621/5 *09/2014-07/2018*
Thesis title : Quantum Perceptron Models.

School of Geography and Ocean Science, Nanjing University **Nanjing, China**
Undergraduate *09/2013-08/2014*

Publications

Peer-Reviewed Publications

[1] **Wang Fang**, Chris Heunen, and Robin Kaarsgaard. Hadamard-Pi: Equational quantum programming. *Proceedings of the ACM on Programming Languages* **(POPL 2026)**, 10(POPL):117–143, 2026.

[2] Mingyu Huang, Ji Guan, **Wang Fang**, and Mingsheng Ying. Approximation methods for simulation and equivalence checking of noisy quantum circuits. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (Early Access)*, 2025.

[3] **Wang Fang** and Qisheng Wang. Optimal quantum algorithm for estimating fidelity to a pure state. In *Proceedings of the 33rd Annual European Symposium on Algorithms* **(ESA 2025)**, pages 4:1–4:12, 2025.

[4] Kean Chen, Yuhao Liu, **Wang Fang**, Jennifer Paykin, Xin-Chuan Wu, Albert Schmitz, Steve Zdancewic, and Gushu Li. Verifying fault-tolerance of quantum error correction codes. In *International Conference on Computer Aided Verification* **(CAV 2025)**, pages 3–27, 2025.

[5] Qifan Huang, Li Zhou, **Wang Fang**, Mengyu Zhao, and Mingsheng Ying. Efficient formal verification

of quantum error correcting programs. *Proceedings of the ACM on Programming Languages* **(PLDI 2025)**, 9(PLDI):1068–1093, 2025.

[6] Yanling Lin, Ji Guan, **Wang Fang**, Mingsheng Ying, and Zhaofeng Su. VeriQR: A robustness verification tool for quantum machine learning models. In *Proceedings of the 26th International Symposium on Formal Methods* **(FM 2024)**, pages 403–421, 2024.

[7] **Wang Fang** and Mingsheng Ying. SymPhase: Phase symbolization for fast simulation of stabilizer circuits. In *Proceedings of the 61st ACM/IEEE Design Automation Conference* **(DAC 2024)**, pages 32:1–32:6, 2024.

[8] **Wang Fang** and Mingsheng Ying. Symbolic execution for quantum error correction programs. *Proceedings of the ACM on Programming Languages* **(PLDI 2024)**, 8(PLDI):1040–1065, 2024.

[9] Mingyu Huang, Ji Guan, **Wang Fang**, and Mingsheng Ying. Approximation algorithm for noisy quantum circuit simulation. In *2024 Design, Automation & Test in Europe Conference & Exhibition* **(DATE 2024)**, pages 1–6, 2024.

[10] **Wang Fang**, Mingsheng Ying, and Xiaodi Wu. Differentiable quantum programming with unbounded loops. *ACM Transactions on Software Engineering and Methodology*, 33(1):1–63, 2023.

[11] Ji Guan, **Wang Fang**, Mingyu Huang, and Mingsheng Ying. Detecting violations of differential privacy for quantum algorithms. In *Proceedings of the 2023 ACM SIGSAC Conference on Computer and Communications Security* **(CCS 2023)**, pages 2277–2291, 2023.

[12] Jingzhe Guo, Huazhe Lou, Jintao Yu, Riling Li, **Wang Fang**, Junyi Liu, Peixun Long, Shenggang Ying, and Mingsheng Ying. isQ: An integrated software stack for quantum programming. *IEEE Transactions on Quantum Engineering*, 4:1–16, 2023.

[13] Qisheng Wang, Zhicheng Zhang, Kean Chen, Ji Guan, **Wang Fang**, Junyi Liu, and Mingsheng Ying. Quantum algorithm for fidelity estimation. *IEEE Transactions on Information Theory*, 69(1):273–282, 2022.

[14] Ji Guan, **Wang Fang**, and Mingsheng Ying. Verifying fairness in quantum machine learning. In *International Conference on Computer Aided Verification* **(CAV 2022)**, pages 408–429, 2022.

[15] Ji Guan, **Wang Fang**, and Mingsheng Ying. Robustness verification of quantum classifiers. In *International Conference on Computer Aided Verification* **(CAV 2021)**, pages 151–174, 2021.

Manuscripts

[1] **Wang Fang**, Chris Heunen, and Qisheng Wang. Unitary synthesis with near-optimal T-count for near-Clifford unitaries, 2025. Under review.

[2] Kean Chen, **Wang Fang**, Ji Guan, Xin Hong, Mingyu Huang, Junyi Liu, Qisheng Wang, and Mingsheng Ying. VeriQBench: A benchmark for multiple types of quantum circuits. ArXiv preprints ArXiv:2206.10880, 2022.

Supervising Experience

Master's dissertation: Quantum Low-density Parity-check Codes under Product Construction and ZX Calculus, Boren Gu, MSc in Mathematical Physics, University of Edinburgh, 2025 (co-supervised with Prof. Dr Chris Heunen and Dr Robert Booth).

Presentations

- **Differentiable quantum programming with unbounded loops**.
  07/2023 An invited talk at 2023 CCF Forum for Distinguished Ph.D. Candidates in Theoretical Computer Science at Hong Kong Polytechnic University, Hong Kong.
- **Symbolic execution for quantum error correction programs**.
  04/2025 An online talk invited by Yuan Feng at the Department of Computer Science and Technology, Tsinghua University, China.
- **Verifying fault-tolerance of quantum error correction codes**.
  02/2025 An invited talk at Quantum Error Correction Journal Club, Quantum Software Lab, University of Edinburgh, UK.
  07/2025 A contributed talk at CAV 2025 in Zagreb, Croatia.
  08/2025 An online talk invited by Yu-Fang Chen at Academia Sinica, Taiwan.
- **Hadamard-Pi: Equational Quantum Programming**.
  01/2026 A contributed talk at POPL 2026 in Rennes, France.

Professional Service

Program Committee: ECOOP 2026 Artifact Evaluation.

Reviewer (Journals): ACM Transactions on Quantum Computing, Information and Software Technology.

Reviewer (Conferences): PLDI 2026, QCNC 2026, PlanQC 2026, LICS 2025, QCE 2025, QCNC 2025, QCE 2024, AQIS 2023, QPL 2021, CAV 2021.

Misc

Hobbies: Badminton, harmonica.