

Yuwei Jin

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EDUCATION

- **Rutgers, The State University of New Jersey** Piscataway, NJ
Ph.D. Candidate in Computer Science Sep 2019 - June 2024
- **Rutgers, The State University of New Jersey** Piscataway, NJ
Bachelor in Electrical and Computing Engineering double major in Computer Science Jan 2016 - May 2019
Magna cum laude • GPA: 3.7/4.0

PUBLICATIONS

- **Yuwei Jin, Fei Hua, Yanhao Chen, Ari B. Hayes, Chi Zhang, Eddy Z. Zhang.** Exploiting the Regular Structure of Modern Quantum Architectures for Compiling and Optimizing Programs with Permutable Operators. ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2023F**). Acceptance rate = $50/238 \approx 21.3\%$
- **Yuwei Jin, Zirui Li, Henry Chen, Fei Hua, Yanhao Chen, Eddy Z. Zhang.** Tetris: A Compilation Framework for VQA Applications in Quantum Computing. The International Symposium on Computer Architecture (**ISCA 2024**). Acceptance rate = $73/423 \approx 17\%$
- **Yuwei Jin,** Xiangyu Gao, Minghao Guo, Henry Chen, Fei Hua, Chi Zhang, Eddy Z. Zhang. Quantum Fourier Transformation Circuits Compilation (in submission).
- **Fei Hua, Yuwei Jin, Yanhao Chen, Suhas Vittal, Kevin Krsulich, Lev S. Bishop, John Lapeyre, Ali Javadi-Abhari, Eddy Z. Zhang.** CaQR: A Compiler-Assisted Approach for Qubit Reuse through Dynamic Circuit. ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2023F**). Acceptance rate = $50/238 \approx 21.3\%$
- **Yanhao Chen, Yuwei Jin, Fei Hua, Ari Hayes, Ang Li, Yunong Shi, Eddy Z. Zhang** A Pulse Generation Framework with Augmented Program-aware Basis Gates and Criticality Analysis. IEEE International Symposium on High-Performance Computer Architecture (**HPCA 2023**). Acceptance rate = $91/360 \approx 25.2\%$
- **Fei Hua, Yuwei Jin, Yanhao Chen, Chi Zhang, Ari Hayes, Hang Gao, Eddy Z. Zhang.** CQC: A Crosstalk-Aware Quantum Program Compilation Framework. (in submission)
- **Fei Hua, Yanhao Chen, Yuwei Jin, Chi Zhang, Ari Hayes, Youtao Zhang, Eddy Z. Zhang.** AutoBraid: A Framework for Enabling Efficient Surface Communication in Quantum Computing. IEEE/ACM International Symposium on Microarchitecture (**MICRO 2021**). Acceptance rate = $94/423 \approx 22.2\%$
- **Chi Zhang, Ari B Hayes, Longfei Qiu, Yuwei Jin, Yanhao Chen, Eddy Z. Zhang.** Time-optimal qubit mapping . ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2021**). Acceptance rate = $75/398 \approx 18.8\%$

RESEARCH EXPERIENCE

- **PhD Intern Quantum Computing** Argonne National Laboratory
Mentor: Ji Liu May 2024 - August 2024
 - Exploring objectives and constraints for efficient optimization of circuit cutting partitioning for error mitigation applications.
 - Exploring the opportunity of using the cutting based technique for error characterization.
- **PhD Intern Quantum Computing** Pacific Northwest National Laboratory
Mentor: Ang Li September 2023 - November 2023
 - Developing high-performance simulation environments on classical HPC clusters for efficient quantum simulation.
 - Contributed to the development of a compiler for the Quantum Variational Eigensolver, utilizing XACC as the front-end interface.
- **Mapping and Routing for VQE Applications in Quantum Computing** Rutgers University
Research Assistant; Advisor: Eddy Z. Zhang March 2023 - October 2023
 - Discovered the conflict between gate cancellation and hardware-efficient circuit synthesis in VQE circuit compilation, and proposed a new IR, Tetris to mitigate such conflict.
 - Proposed a new qubit routing method, Fast Bridging to reduce the overhead in conventional SWAP gate insertion method.

- Compared to the state-of-the-art UCCSD compiler, Tetris demonstrates a remarkable reduction up to 20% in CNOT gate counts, and 30% depth reduction.
- **An optimal circuit mapper for QAOA in a large and regular architecture** Rutgers University
Jan 2022 - October 2022
Research Assistant; Advisor: **Eddy Z. Zhang**
 - Built an optimal solver upon an A* framework with an admissible cost function, capable of finding circuit scheduling patterns in small and regular architectures, such as IBM heavy-hex and Google sycamore.
 - Proposed pattern optimization to attain all-to-all interactions in a large and regular architecture, and adapted patterns by taking practical factors into account.
 - Our evaluation presents our method on IBM and Google architecture coupling graphs for up to 1,024 qubits and demonstrates better result in both depth and gate count – by up to 72% reduction in depth, and 66% reduction in gate count.
- **A Compiler-assisted Approach for Qubit Reuse to improve circuit fidelity** Rutgers University
August 2022 - December 2022
Research Assistant; Advisor: **Eddy Z. Zhang**
 - Defined two prerequisites for qubit reuse, enabling us to choose qubit reuse pairs that balance qubit usage and circuit duration for both regular circuits and applications with commutable gates.
 - Optimized SWAP gate insertion by delaying non-critical gates and conserving physical qubits to enhance qubit reuse opportunities for critical gates, potentially minimizing the need for additional SWAP gates.
 - We evaluated our method on a representative set of important applications. We can reduce resource usage by up to 80% and improve circuit fidelity by up to 20%.
- **Time Optimal Qubit Mapping** Rutgers University
September 2019 - August 2020
Research Assistant; Advisor: **Eddy Z. Zhang**
 - Proposed a compiler framework to convert a quantum program to a hardware-compliant circuit by adapting the A-star framework with a theoretically time-optimal SWAP insertion scheme for the small-scale qubit mapping problem and adaptation for large scale qubit mapping problem.
 - discovered an optimal qubit mapping pattern for quantum fourier transformation (QFT) on 2D nearest neighbor architecture.
 - Our practical implementation outperforms state-of-the-art qubit mappers with speedups up to 26%, and on average 17%, over representative benchmarks from RevLib, IBM Qiskit, and ScaffCC.

SERVICE

- Reviewer, IEEE Transactions on Quantum Engineering (TQE). 2024
- Reviewer, Conference on Information and Knowledge Management (CIKM). 2023
- Reviewer, Proceedings of the 2023 International Workshop on Quantum Classical Cooperative Computing. 2023
- Reviewer Assistant, Assisting conference reviewer reviewing plenty of papers including ASPLOS, MICRO, HPCA, etc.

PRESENTATIONS

- **Exploiting the Regular Structure of Modern Quantum Architectures for Compiling and Optimizing Programs with Permutable Operators.** ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2024**).
- **CaQR: A Compiler-Assisted Approach for Qubit Reuse through Dynamic Circuit.** ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2023**).
- **A Pulse Generation Framework with Augmented Program-aware Basis Gates and Criticality Analysis.** IEEE International Symposium on High-Performance Computer Architecture (**HPCA 2023**).

HONORS AND AWARDS

- The Honorable Mention Award (The fifth out of 73 teams). 2023 Quantum Computing for Drug Discovery Challenge at 2023 INTERNATIONAL CONFERENCE ON COMPUTER-AIDED DESIGN (ICCAD) 2023
- Student Travel Grant, ASPLOS 2023

TEACHING

- Teaching assistant, DESIGN AND ANALYSIS OF COMPUTER ALGORITHMS, 2019 Fall
- Teaching assistant, PRINCIPLES OF PROGRAMMING LANGUAGES, 2020 Spring
- Teaching assistant, INTRODUCTION TO DISCRETE STRUCTURES I, 2020 Summer
- Teaching assistant, COMPUTER ARCHITECTURE, 2020 Fall
- Teaching assistant, INTRODUCTION TO DISCRETE STRUCTURES I, 2021 Spring
- Teaching assistant, COMPILERS 2023 Spring

SKILLS

IBM Qiskit, Google Cirq, Python, C, C++, Java, Git, Linux, Flex and Bison