Jixuan Ruan

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Education

University of California, San Diego(UCSD) Sep 2024 – Present
Computer Science and Engineering *Advised by Prof. Yufei Ding*

University of Science and Technology of China(USTC) Sep 2020 – Jun 2024
School of the Gifted Young

Publications

1. **Jixuan Ruan**, Xiang Fang, Hezi Zhang, Ang Li, Travis Humble, Yufei Ding: PowerMove: Optimizing Compilation for Neutral Atom Quantum Computers with Zoned Architecture. [**ASPLOS'25**] **(Major Revision)**
2. Hezi Zhang, **Jixuan Ruan**, Hassan Shapourian, Ramana Rao Kompella and Yufei Ding: OnePerc: A Randomness-aware Compiler for Photonic Quantum Computing.[**ASPLOS'24**][**Distinguished Artifact Award**]
3. Keyi Yin, Xiang Fang, **Jixuan Ruan**, Hezi Zhang, Dean Tullsen, Andrew Sornborger, Chenxu Liu, Ang Li, Travis Humble, Yufei Ding: JazzSplit: Accurate and Fast Decoder for QLDPC-Code-Based QEC Architecture. In submission to ISCA'25
4. Xiang Fan, Keyi Yin, Yuchen Zhu, **Jixuan Ruan**, Dean Tullsen, Zhiding Liang, Andrew Sornborger, Ang Li, Travis Humble, Yufei Ding, Yunong Shi: CaliQEC: In-situ Qubit Calibration for Surface Code Quantum Error Correction. In submission to ISCA'25
5. Hezi Zhang, **Jixuan Ruan**, Yufei Ding, Ang Li, Travis Humble: OneAdapt: Resource-adaptive Compilation of Photonic One-way Quantum Computing. In submission to ISCA'25

Honors And Awards

Outstanding Student Scholarship Silver Award Nov 2023

Outstanding Student Scholarship Gold Award Nov 2022

China Collegiate Programming Contests for Girls Bronze Award Nov 2021

The Second Prize of the Undergraduate Mathematics Contest Dec 2021

Outstanding Student Scholarship Bronze Award Sep 2021

Research Experience

Accurate and Fast Decoder for QLDPC-Code University of California, San Diego
Under the Supervisor of Prof. Yufei Ding *August 2024 – November 2024*

Developed JazzSplit, a novel decoder for quantum low-density parity-check (qLDPC) codes, addressing a critical challenge in quantum error correction. JazzSplit enhances belief propagation (BP) decoders by adaptively modifying the decoding graph to mitigate convergence issues caused by quantum degeneracy. This approach achieves both fast and accurate decoding, outperforming state-of-the-art BP and BP+OSD decoders. JazzSplit reduces logical error rates by up to 16.17× compared to BP and 3.23× compared to BP+OSD, with only an 18.97% time overhead over BP, offering a significant leap in decoding efficiency for qLDPC-based quantum architectures.

In-situ Qubit Calibration for Surface Code QEC University of California, San Diego
Under the Supervisor of Dr. Yunong Shi *August 2024 – November 2024*

Proposed QECali, an innovative framework enabling in-situ calibration for surface codes. By leveraging code deformation, QECali separates qubits under calibration from logical qubit patches, allowing concurrent calibration and computation. Logical code patch enlargement maintains error correction capabilities with minimal qubit overhead. Additionally, QECali optimizes calibration schedules to reduce physical error rates. Evaluations show that QECali achieves practical in-situ calibration with modest resource overhead and minimal impact on execution time, advancing fault-tolerant quantum computing.

NAQC Compiler Optimization with Zoned Architecture University of California, San Diego
Under the Supervisor of Prof. Yufei Ding *August 2024 – October 2024*
In this work, we present PowerMove, an efficient compiler for NAQCs that enhances the qubit movement framework while fully integrating the advantages of ZA. By recognizing and leveraging the interdependencies between these key aspects, PowerMove unlocks new optimization opportunities, significantly enhancing both scalability and fidelity. Our evaluation demonstrates an improvement in fidelity by several orders of magnitude compared to the state-of-the-art methods, with execution time improved by up to 3.46x and compilation time reduced by up to 213.5x. We will open-source our code later to foster further research and collaboration within the community.

Resource-Adaptive Photonic Compiler Design University of California, San Diego
Under the Supervisor of Prof. Yufei Ding *March 2024 – June 2024*
In this work, we propose a novel IR with new optimization passes. Based on this, we realize a resource-adaptive compiler that minimizes the required hardware size and execution time while restricting the requirement for fusion and measurement devices within an adaptive limit.

Randomness-Aware Compilation Framework Design University of California, San Diego
Under the Supervisor of Prof. Yufei Ding *July 2023 – December 2023, Internship*
We introduce a randomness-aware compilation framework designed to concurrently achieve scalability and efficiency. Our approach leverages an innovative combination of offline and online optimization passes, with a novel intermediate representation serving as a crucial bridge between them. Through a comprehensive evaluation, we demonstrate that this framework significantly outperforms the most efficient baseline compiler in a scalable manner, opening up new possibilities for realizing scalable photonic quantum computing.

My work could be checked on https://github.com/Scarlett0815/OnePerc.

USTC Robo Game University of Science and Technology of China
Under the Supervisor of Prof. Yuhu Li *May 2022 – Nov 2022, Part-time*
We have made a curling robot in 6 months, during which I was responsible for the recognition part as well as the tracking part. In this process, I used neural network to realized our recognition part for better robustness.

Our work could be seen on https://github.com/WuTianming/robogame-code.

Build a VR Office system based on Oculus University of Science and Technology of China
Under the Supervisor of Prof. Kai Xing *Jul 2022 – Aug 2022, Part-time*
I took part in a small group consisted of several students interested in VR to build a office system based on Oculus. In this office system, we added the gesture recognition to Oculus and freed customers from the handlers. In addition, we realized 3 basic functions, which are 3D Object Importing, Remote Control as well as Model Plane.

Our work could be seen on https://github.com/OSH-2022/VR-fancy-office.

Research Interest

Quantum System Design

Quantum Error Correction

Teaching Experience

Computer Programming A University of Science and Technology of China
Organized by Prof.Jie Shen *2023 Fall*
Topic: C Programming, Introduction to Basic Programming Techniques

Skills

Programming: C / C++, Python, Verilog, Java, Pascal, Basic, C#

Languages: Chinese, English

Personal Hobbies

Sketching, **Calligraphy**, **Piano**, **Novel Writing**, **Badminton**, **Jane Austen Enthusiast**