Zihan Chen

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Education

Rutgers University — New Brunswick, New Jersey
Ph.D. in Computer Science — *Expected in 2029*
Advised by Dr. Eddy Z. Zhang
M.Sc. in Computer Science — *Sep. 2022 – May 2024*

Nanjing University of Information Science & Technology — Nanjing, China
B.E. in Telecommunication Engineering — *Sep. 2018 – May 2022*
Changwang School of Honors, *joint program with* University of Chinese Academy of Sciences

Selected Publications

[1] **Zihan Chen***, Jiakang Li*, Minghao Guo*, Henry Chen, Zirui Li, Joel Bierman, Yipeng Huang, Huiyang Zhou, Yuan Liu, Eddy Z. Zhang. 2025. *Genesis: A Compiler for Hamiltonian Simulation on Hybrid CV-DV Quantum Computers.* In *Proceedings of the 52nd Annual International Symposium on Computer Architecture (ISCA '25).*

[2] **Zihan Chen**, Henry Chen, Yuwei Jin, Minghao Guo, Enhyeok Jang, Jiakang Li, Caitlin Chan, Won Woo Ro, Eddy Z. Zhang. 2025. *PhasePoly: An Optimization Framework for Phase Polynomials in Quantum Circuits. arXiv preprint arXiv:2506.20624.*

Projects

Compilation for Hamiltonian Simulation on Hybrid CV-DV Quantum Computers

Genesis Compiler: ISCA'25 & Slides & Code — *May 2024 – Present*

Developed **Genesis**, the first end-to-end compiler framework for Hamiltonian simulation on hybrid continuous-variable (CV) and discrete-variable (DV) quantum computers, supporting multi-level compilation and hardware-specific circuit mapping.

- Designed and implemented a hybrid CV-DV domain-specific language (DSL), **CVDV-QASM**, to efficiently encode mathematical Hamiltonian expressions to low-level CV-DV gate sequences.
- Built a robust compiler pipeline using **Python** and **ANTLR**, translating mathematical forms of operators into several intermediate representations (IRs) and ultimately generating optimized quantum assembly code.
- Automated the decomposition of complex Hamiltonian operators using **recursive template rewriting** with product formulas and block encoding as pattern-matching templates, replacing previous manual derivations.
- Addressed hybrid CV-DV compilation challenges via connectivity-aware gate synthesis, including ancilla qumode routing and SWAP insertion for qumode-qumode and qubit-qumode operations.
- Offered and maintained installation and grammar documentation; integrated debugging modes, compilation statistics, and batch-processing features to enhance usability and scalability.

Optimization for Quantum Circuits Compilation

PhasePoly Optimizer: Arxiv & QCE'25 Poster & Available Soon — *Aug. 2024 – Present*

Developed PhasePoly, a quantum circuit optimization framework that systematically reduces and synthesizes phase-polynomial quantum circuits composed of **CNOT and** R_z gates.

- Developed a unified co-optimization strategy that integrates phase rotations and qubit transformations into a single **parity-matrix** representation, achieving holistic optimization, overcoming limitations of previous methods that treated these components separately.
- Implemented a size-bounded **A-star** search algorithm to efficiently explore large solution spaces, achieving up to 50% total gate reduction (avg. 35.83%) and up to 48.57% CNOT gate reduction (avg. 27.9%) on standard benchmark circuits, outperforming state-of-the-art optimizers.
- Demonstrated superior scalability and optimization depth compared to leading subcircuit rewrite quantum circuit optimizers (e.g., QUESO, Quartz), particularly on large circuits (100–400 qubits), via holistic phase-polynomial optimization and multi-block merging techniques.
- Enabled hardware-efficient optimizations by synthesizing subcircuits compatible with linear-connectivity constraints, significantly simplifying physical qubit mapping and reducing the need for SWAP-gate insertions on sparse-connectivity quantum hardware.

Experience

Software Engineer Intern, CARINA AI | Python, C# — Remote, USA

Mentor: Dr. Feng Xue. Contributed to INTContour, DeIdentifier, and AutoBrachy — *May 2023 – May 2024*

Converted products deployed on local GPU server into a cloud solution, adhering to medical privacy standards

- Extracted medical imaging data and diagnostic reports from clinic databases using C# and Python APIs, utilized **DICOM** protocols and **FHIR** standard for querying and retrieval
- Employed cryptographic hashing algorithms for the **deidentification** and subsequent **reidentification** of client local data, establishing an index table that maps original values to their encrypted counterparts
- Optimized cloud-based querying and retrieval of the image segmentation and quality assurance process
- Designed data-forwarding nodes specifically to meet the operational demands of clinics' cloud platforms, ensuring strict data security standards and seamless integration
- Refactored codebases using **MVVM** to enhance modularity, accelerating the development of the following products

Teaching Assistant — New Brunswick, New Jersey

Rutgers University — *Sep. 2023 – Present*

- CS 336: Principles of Information and Data Management (**3 times**)
- ECE 568: Software Engineering of Web Applications (**1 time**)
- ECE 518: Mobile Embedded Systems and On-Device AI (**1 time**)

Academic Service

Co-organizer of Rutgers QEC: Theory and Systems Reading Group

- Organized weekly reading groups discussing Quantum Error Correction (QEC), covering theoretical concepts, compiler optimizations, and AI-driven techniques.
- One group of presenter(s) each week, followed by group discussion and Q&A session.

Conference Subreviewer

- QCE'25

Artifact Evaluation Committee

- SOSP'25
- MICRO'25

Talks and Presentations

[Talk] Compiler framework on hybrid CV-DV quantum computers for Hamiltonian simulation

North Carolina State University CV-DV Group Meeting. — *Remote. May 21, 2025.*

- Slides Available

Selected Patents

- Chinese Patent CN114388129B, *Atherosclerosis Risk Prediction Method Based on Dynamic Information Value Criterion and Ensemble Learning.*
- Chinese Patent CN114550941B, *Low-redundancy Atherosclerosis Risk Prediction Method Based on Dijkstra's Algorithm.*

Skills

Programming: Python, C++, C#, Java, Go, JavaScript, SQL
Libraries: Qiskit, BQSKit, PyTorch, Scikit-learn
Developer Tools: Git, Docker, AWS, Google Cloud
Miscs: Powerlifting, Boxing, Chess, Yo-Yo Ma's Music