HAOWEI DENG

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EDUCATION

University of Maryland, college park: Ph.D. student in Computer Science Aug-2020 to now
Advisor: Xiaodi Wu **Research Area**: Quantum Computing, Programming Language, Compiler Optimization

University of Science and Technology of China Sep-2016 to Jul-2020
Bachelor of Engineer (B.E.) in Computer Science and Technology.

PUBLICATION

- A Case for Synthesis of Recursive Quantum Unitary Programs.
  Haowei Deng, Runzhou Tao, Yuxiang Peng, Xiaodi Wu*. Appeared in POPL 2024.
- Automating NISQ Application Design with Meta Quantum Circuits with Constraints (MQCC).
  Haowei Deng, Yuxiang Peng, Michael Hicks, Xiaodi Wu*. Appeared in ACM Transactions on Quantum Computing.
- Context-Sensitive and Duration-Aware Qubit Mapping for Various NISQ Devices.
  Haowei Deng, Yu Zhang*, Quanxi Li. Accepted by Design Automation Conference 2020.
- Optimizing Quantum Programs Against Decoherence: Delaying Qubits into Quantum Superposition.
  Yu Zhang*, **Haowei Deng**, Quanxi Li, Haoze Song, Leihai Nie. Accepted by TASE 2019.

RESEARCH EXPERIENCE

In CTO Infrastructure of Bloomberg Research Assistant
with Julio Auto De Medeiros—Team Leader of Services Security Architecture at Bloomberg *2024-now*

- Contributed to Minorminer, the most common used open-source tool developed by D-wave for embedding combinatorial optimization problems into quantum annealing machines. We reduce Minorminer's execution time by 50% on average given random problem instances and improve its probability to find a valid solution when the problem's density is close to the hardware's limitation. Going to write a paper for this contribution.

In University of Maryland, College Park Research Assistant
with Professor Xiaodi Wu—University of Maryland, College Park *June 2019 - Now*

- Designed and Implemented *QSynth*, a quantum unitary program synthesis framework. By leveraging existing SMT solvers, QSynth successfully synthesizes quantum unitary programs for state preparation, quantum adder circuits, and quantum Fourier transformation, which can be readily transpiled to executable programs on major quantum platforms, e.g., Q#, IBM Qiskit, and AWS Braket. Appeared in POPL 2024. Github Link
- Designed and implemented *Meta Quantum Circuits with Constraints (MQCC)*, a meta-programming framework for quantum programs. MQCC is the first general-purpose approximate computing framework for quantum programs. MQCC makes it easy to design, implement, and experiment quantum program optimizations. Appeared in ACM Transactions on Quantum Computing. Github Link.
- Neuro-symbolic Quantum Error Correction (QEC) Code Search. Finding good and large-size QEC codes is non-trivial due to its exponentially large search space. We utilize the Large Language Model to generate good heuristic functions to guide the search over large-size code space. We have found LDPC codes with lower logical error rates and higher error thresholds than the best BB code proposed recently by IBM on Nature. The paper is still under the writing

In University of Science and Technology of China Research Assistant
with Professor Yu Zhang—University of Science and Technology of China *2018-2020*

- Designed CODAR, a Context-Sensitive and Duration-Aware Qubit Mapping algorithm for Various NISQ Devices. CODAR is aware of gate duration difference and program context, which bring it abilities to extract more programs parallelism and reduce program execution time. Appeared in DAC 2020.

LEADERSHIP/TEAMWORK EXPERIENCE

- As a reviewer in the quantum coding contest committee of ICCAD 2023. 2023
- As a reviewer in the ASPLOS'21 artifact evaluation committee. 2022
- Lead the implementation and code maintainance of MQCC and QSynth. 2020-2023
- Code contribution to CODAR and SQIR & VOQC, a Verified Optimizer for Quantum Circuits. 2020-2021

RELEVANT SKILL

Proficient in Domain Specific Programming Language design and compiler implementations.
Programming Language: C, C++, Python, Julia, Racket, Coq, Ocaml
Tools: LLVM, Linux, SMT solver, Rosette, OpenMPI.