SAI ANURUDH REDDY PEDURI

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EDUCATION

Ruhr University Bochum (RUB)

Doctor of Philosophy (PhD) In Computer Science

Aug 2022 - Ongoing (expected Jan 2026)

Title: Quantum Programming Languages and Formal Methods.
Supervised by: Prof. Dr. Michael Walter, Prof. Dr. Gilles Barthe.

IIIT Hyderabad

Masters by Research in Computer Science & Engineering

2019-2022 | 9.75/10

B. Tech with Honors in Computer Science & Engineering

2015-2019 | 8.09/10

RESEARCH PROJECTS

Traq

- Designed a formal framework for **reasoning about quantum complexity** of high-level classical programs with quantum primitives, providing **formal cost guarantees**. Systematized prior ad-hoc quantum analyses, enabling rigorous evaluation of quantum speedups on practical problem sizes.
- Implemented a **Haskell** tool to estimate quantum costs and compile annotated programs into low-level quantum circuits. [github]
- Enabled scalable cost estimation via source-level analysis, avoiding the need to compile or execute quantum programs, and supporting large input instances.

Qubrabench

- Developed a Python framework for **estimating quantum complexity** of algorithms using classical code execution, avoiding the need for quantum hardware or quantum simulation. Released open-source implementation: [github]
- Enabled users to annotate Python code to estimate classical and quantum complexity metrics, facilitating analysis of **quantum speedups on real-world instances**.

QbC: Quantum Correctness by Construction

- Developed a methodology for **correct-by-construction quantum programming** given a specification. Gave sound and complete **refinement rules** for the quantum while-language.
- Validated the approach by constructing quantum programs for canonical problems like Grover and QFT, showcasing the method's ability to illuminate design decisions and derivation choices. [doi]

Quantum Regularized Least Squares

- Designed the first quantum algorithms for ordinary, weighted, and generalized least squares with general ℓ_2-regularization, extending the capabilities of quantum linear regression.
- Leveraged **block-encoding** and **Quantum Singular Value Transformation (QSVT)** techniques to build accurate and efficient quantum algorithms for linear algebraic computations. [doi]

QSSA

- Implemented an **intermediate representation** for quantum programs in **LLVM/MLIR**, along with analysis passes to verify quantum constraints. This leverages state-of-the-art classical compiler technology to analyze and optimize hybrid classical-quantum programs. [github]

EXPERIENCE

Google Quantum AI — Jun '24 – Sep '24

Student Researcher Intern

- Implemented quantum primitives in the Qualtran library for analysis and resource-estimation of fault-tolerant quantum algorithms. [github]
- Implemented the paper "Generalized Quantum Signal Processing", which is used in Hamiltonian simulation and quantum machine learning.
- Implemented algorithm and various subroutines from the paper "Quartic speed-ups for planted inference", which provides a near quartic speedup over classical methods.

Ruhr University Bochum — Aug '22 – Jan '26

Research Assistant

- Co-supervised one masters thesis and three bachelors theses.
- Teaching assistant for 6 courses.
- Reviewed research papers for OOPSLA 2025 STOC 2025, QIP 2024, ICALP 2023, iFM 2023, QIP 2023.

University of Edinburgh — Jun '20 – Jun '21

Research Intern

- Worked on the QSSA project, at the Compilers and Runtime Systems Lab at UoE, supervised by Prof. Tobias Grosser.

IIIT-H — Aug '17 – Dec '19

Teaching and Research Assistant

- Teaching assistant for 5 courses.
- Coordinator for Theory Reading Group and Programming Club.

PUBLICATIONS

- **A. Peduri**, G. Barthe, M. Walter, "Traq: Estimating Quantum Cost of Classical Programs". Preprint. [github]
- M.P. Harrigan, T. Khattar, C. Yuan, **A. Peduri**, et. al., "Expressing and Analyzing Quantum Algorithms with Qualtran". Poster at PlanQC 2025. [doi] [github]
- **A. Peduri**, I. Schaefer, M. Walter, "QbC: Quantum Correctness by Construction". Accepted at OOPSLA 2025. [doi]
- S. Chakraborty, A. Morolia, **A. Peduri**, "Quantum Regularized Least Squares". Accepted in Quantum Journal 2023. [doi]
- **A. Peduri**, S. Bhat, T. Grosser, "QSSA: An SSA-based IR for Quantum Computing". Accepted at CC 2022. [doi] [github]

ACHIEVEMENTS

ICPC 2020 World Finalist

Member of team **tesla_protocol** which placed **46th** at the 44th Annual ICPC World Finals, held at Moscow, Russia.

Codeforces

Handle: **codelegend**. Peak rating: **2475** (Grandmaster).

SKILLS

Programming: C/C++, Python, Haskell, Rust.
Quantum Frameworks: Cirq, Qualtran, Quipper, Q#.
Compiler Frameworks: LLVM, MLIR.
Theorem Provers: Coq, Lean.