Akash Kumar Singh

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Education

Defence Institute of Advanced Technology (DIAT), Pune *Aug' 23-Jul' 25*

M.Tech in Quantum Computing, CGPA: 8.44/10

Indian Institute of Science Education and Research (IISER), Tirupati *Aug' 18-Jun' 23*

BS-MS in Physics, MS CGPA: 8.1/10

Professional Experience

Centre for Development of Advanced Computing (C-DAC), CINE, India *Jul' 25-Present*

Project Engineer for Quantum Algorithms Research in Computational Fluid Dynamics

QClairvoyance Quantum Labs, Hyderabad, India *Jan' 25-Jun' 25*

Junior Quantum Algorithm Developer Intern

Publications

- **Akash Kumar Singh**, Ashish Kumar Patra, Prof. G. Raghavan, Dr. K. Srinivasan: *"An Efficient Quantum Algorithm for Laplace Transform"*, [In preparation for arXiv submission, 2025].
- **Akash Kumar Singh***, Atharva Manoj Khairnar*, S. Mandal, Dr. A. Raina: *"Creating encoders of CSS codes for Measurement-based Quantum Computing using ZX-Calculus"*, [*Equal contribution, manuscript in preparation].

Research Experience

An Efficient Quantum Algorithm for Laplace Transform *Aug' 24-Jun' 25*

Supervisor: Prof. G. Raghavan and Dr. K. Srinivasan, Defence Institute of Advanced Technology (DIAT), Pune

- Created quantum algorithm for Laplace Transform by encoding the Laplace variable 's' into the eigenvalues of a diagonal matrix. This approach exploited the matrix's arithmetic progression structure and commutativity among its Pauli decompositions, enabling efficient Pauli decomposition and single-step Trotterization resp. , for the Hamiltonian simulation.
- Proved rigorous complexity bounds showing superpolynomial quantum advantage, reducing gate complexity to $O((\log N)^3)$ compared to classical $O(N \log N)$ for an $N \times N$ Laplace transform matrix for specific cases.
- Integrated this into QClair's QForge library (using Pennylane), directly contributing to their quantum drug discovery pipeline.
- Analyzed potential applications in ground state energy calculation using resolvent space and also in pharmacokinetics and pharmacodynamics stage of drug discovery pipeline.
- Conducted as part of the M.Tech dissertation and in collaboration with QClairvoyance Quantum Labs, Hyderabad.

Creating Encoders of CSS Codes for MBQC using ZX-Calculus *May' 22-Jun' 23*

Supervisor: Dr. Ankur Raina, Indian Institute of Science Education and Research (IISER), Bhopal

- Devised a systematic graphical framework using ZX-Calculus to directly translate CSS code stabilizers into optimal MBQC measurement patterns, resolving a longstanding challenge in efficient CSS code encoding.
- Developed the encoding by obtaining CSS code stabilizers, converting them into ZX-diagrams, transforming them into graph-like ZX-diagrams and then measurement fragments, and deriving correction operators using the feed-forward method.
- Provided explicit constructions for repetition code, Steane code, and Shor code within this framework.
- Verified correctness of the scheme via stabilizer evolution techniques of Gottesman.

Awards and Honors

- **Secured highest marks in India in Quantum Computing exam by C-DAC (Scientist 'B' position), 2025.**
- Qualified GATE (2023 and 2024) Physics and awarded AICTE GATE Postgraduate Scholarship.
- Cleared IISER Aptitude Test (IAT) for admission to IISERs, 2018.

Technical Skills

Languages: Python, Fortran, Java, HTML
Libraries: Qiskit, Pennylane, Numpy, Scipy, Matplotlib, Tikzit
Tools: LaTeX, GitHub
Strong background in: Quantum Algorithms, Quantum Error Correction

Relevant Courses

M.Tech (DIAT): Quantum Computing 1 & 2, Digital System Design using FPGA, Advanced Quantum Communication, Nonlinear Optics, Quantum Metrology & Sensing, Machine Learning.

BS-MS (IISER Tirupati): Quantum Mechanics 1 & 2, Quantum Information, Optics & Photonics, Electrodynamics, Statistical Mechanics, Linear Algebra, Probability & Statistics, Structures of Mathematics, Data Science 1 & 2, Operations Research, Discrete Mathematics.

Academic Engagements & Leadership

- Completed WISER Program on Quantum Algorithms for Differential Equations — *Jun' 25-Aug' 25*
- Completed PennyLane LCU Challenge — *Aug' 25*
- Completed PennyLane Trotterization Challenge — *Aug' 25*
- Selected to attend the Fundamental Lecture Series on Theoretical Computer Science at IMSc, Chennai — *Jan' 24*
- Attended International Workshop on *Engineering and Integration Challenges in Quantum Communication and Quantum Computing*, C-DAC Pune — *Mar' 24*
- QWorld QIntern 2023: Diploma + Second Best Project & Presentation Awards — *Jul' 23-Aug' 23*
- IBM Qiskit Global Summer School 2021: Quantum Machine Learning, Certificate of Excellence — *Jul' 21*
- IBM Qiskit Global Summer School 2020: Certificate of Quantum Excellence — *Jul' 20*
- IBM Qiskit Fallfest, DIAT Pune: Led Organizing Team — *Oct' 23*
- Founding member of QUIISER: Quantum Computing & Information Club, IISER Tirupati — *Jan' 21-Jun' 23*
- Core Member of Institute Innovation Council (IIC), IISER Tirupati — *Aug' 20-Jan' 22*
- Institute Rep. : MHRD IC sessions on Promoting Innovation, IPR, Entrepreneurship and Start-ups — *Apr' 20-May' 20*
- Certificate of Excellence: Innovation & Entrepreneurship in Post-COVID World, IIT Kgp — *Jun' 20-Aug' 20*