Lei Zhang

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Research Interests

Quantum Information, Quantum Computation, Quantum Communication, Machine Learning, Optimization, Quantum Software, Quantum Metrology.

Work Experience

Institute for Quantum Computing, Baidu Research   *Beijing, CN*

Intern for Research and Development. Supervisor: Xin Wang.   *Dec 2021 - May 2023*

- Responsible for designing and maintaining functionalities of Paddle Quantum - a quantum machine learning platform based on Python (see GitHub page underline here). Individually develop the modules *qsvt*, *qpp* and *model* for Paddle Quantum. Take the lead and work with developers to publish the version update of Paddle Quantum v2.4.0, reinforcing the stability and improving the computation efficiency over 200%.
- Collaborate with researchers to demonstrate the expressiveness of quantum circuits and examine the properties of non-local operations. Review and give oral presentations on quantum Gibbs sampling and related quantum MCMC techniques.
- Investigate and write reports on prompt technologies and services in quantum industries. Design and prepare commercial materials for business activities of Baidu Quantum.

Origin Quantum   *Hefei, CN*

Intern for Quantum Algorithm Engineer.   *Apr 2021 - Aug 2021*

- Reproduce the results of Shor's algorithm on breaking RSA and ECC using QPanda - a quantum computing programming framework based on C++ (see GitHub page here), according to papers published by Microsoft and Google.
- Survey and write detailed reports on quantum attacks on mainstream crypotosystems.

Education

Hong Kong University of Science and Technology (Guangzhou).   *Guangzhou, CN*

Doctor of Philosophy in Artificial Intelligence.   *Sept 2023 - present*

- Supervisor: Xin Wang.

University of Waterloo   *Waterloo, CA*

Bachelor of Mathematics   *Sept 2017 - Jun 2022*

- Applied Mathematics - physics specialization, Honours.
- Combinatorics and Optimization, Honours.
- Pure Mathematics, joint Honours.

Skills

Research	QSP & QSVT, Quantum non-local simulation, Quantum modular arithmetic units.
Technical	Python (with *Paddle Paddle*, Numpy and Matplotlib), C++, MatLab, Overleaf (LaTex), Git, PowerPoint.
Soft	Logical thinking and Academic writing, Teamwork and Leadership, Communication, Presentation skills, Time management.

Publications

- Wang, Y., **Zhang, L.**, Yu, Z.,& Wang, X. (2023). Quantum Phase Processing and its Applications in Estimating Phase and Entropies. arXiv preprint arXiv:2209.14278. **Accepted as a short talk at AQIS 2023**.

Research highlights: Based on the ability of quantum computing, we develop a new algorithmic toolbox "Quantum phase processing" that can directly apply arbitrary trigonometric transformations to eigenphases of a unitary operator. We further exploit the power of QPP by investigating a plethora of applications in quantum phase estimation, Hamiltonian simulation, entanglement spectroscopy, and quantum entropies estimation, demonstrating improvements or optimality for almost all cases.

Professional Service

Invited Referee   Quantum.

Patents

During my work in Baidu Quantum, I collaborated with my colleagues to develop technologies and make innovations to overcome science and engineering difficulties on quantum information processing and quantum circuit design. Currently I have 9 patents under reviewed.

- Wang, X., **Zhang, L.**, & Yu, Z. Quantum simulation method, device, equipment and storage medium, CN115456189A, Under review, 2022.

- Wang, Y., **Zhang, L.**, Yu, Z., & Wang, X. A method, device, equipment and storage medium for measuring ground state energy, CN115577776A, Under review, 2023.

- Yu, Z., **Zhang, L.**, Wang, Y., & Wang, X. Quantum relative entropy determination method, device, equipment and storage medium, CN115577781A, Under review, 2023.

- Wang, Y., **Zhang, L.**, Yu, Z., & Wang, X. Quantum data processing method, device, apparatus and storage medium, CN115577783A, Under review, 2023.

- Yu, Z., Wang Z., **Zhang, L.**, & Wang, X. Quantum channel noise estimation method and device, electronic device, and medium, CN115577785A, Under review, 2023.

- Yu, Z., Wang, Y., **Zhang, L.**, & Wang, X. Quantum amplitude estimation method, device, equipment and storage medium, CN115577787A, Under review, 2023.

- Yu, Z., **Zhang, L.**, Wang, Y., & Wang, X. Quantum entropy determination method, device, equipment and storage medium, CN115577788A, Under review, 2023.

- Yu, Z., **Zhang, L.**, & Wang, X. Quantum entanglement degree determining method, device, equipment and storage medium, CN115577789A, Under review, 2023.

- Wang, Y., Yu, Z., **Zhang, L.**, & Wang, X. Hamiltonian simulation method, Hamiltonian simulation device, Hamiltonian simulation equipment and storage medium, CN115577790A, Under review, 2023.

Reference

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Relationship: Research supervisor at Baidu Research and HKUST(GZ).

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References available upon request.