ZHIXIN SONG

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EDUCATION

Georgia Institute of Technology, Atlanta Georgia	August 2021 - Present
Ph.D. in Physics with research focus on quantum algorithms	GPA: 4.00/4.00
The Ohio State University, Columbus Ohio	January 2016 - December 2019
B.S. Major in Physics, Minor in Mathematics and Philosophy	Major GPA: 3.87/4.00

WORK EXPERIENCE

Research Assistant at Georgia Tech — August 2022 - Present

Research with Prof. Spencer Bryngelson — *School of Computational Science & Engineering, GaTech*

Benchmark various Variational Quantum Algorithms for solving partial differential equations (PDEs) on IBM superconducting quantum processors and adopt error mitigation methods. Develop novel variational algorithms for nonlinear PDEs and apply them to computational fluid dynamics (CFD). Simulate large-scale (>40 qubits) quantum algorithms on GPU and HPC system.

Global Technology Research Associate Intern, New York — June 2023 - August 2023

Research with Dr. Changhao Li — *JPMorgan Chase & Co.*

Design quantum communication protocols to enhance privacy in quantum federated learning (QFL). Study user-level data privacy with quantum information theory.

Research Development at Baidu Inc., Beijing China — April 2020 - July 2021

Research with Dr. Xin Wang — *Institute for Quantum Computing, Baidu Research*

Develop a Python-based quantum machine learning (QML) toolkit called **Paddle Quantum**. Design novel quantum algorithms for singular value decomposition (SVD), fidelity estimation between arbitrary mixed states, classification based on classical shadows, and entanglement detection.
GitHub Link: https://github.com/PaddlePaddle/Quantum

RESEARCH EXPERIENCE & PROJECT

(i) Variational Quantum Entanglement Detection — December 2020 - April 2021

Research Project — *Quantum Information*

- Develop a framework for entanglement detection based on the positive map criterion. The algorithm decomposes a positive map into a combination of quantum operations implementable on near-term quantum devices. I conduct experiment on ibmq-santiago 5-qubit superconducting quantum processor and verify the detection result on the Bell states and isotropic states with the reduction map.
- Link: Wang, K., **Song, Z.**, Zhao, X., Wang, Z., & Wang, X. (2022). Detecting and quantifying entanglement on near-term quantum devices. https://www.nature.com/articles/s41534-022-00556-w

(ii) Machine Learning for Distributed Quantum Information Processing — Aug. - Dec. 2020

Research Project — *Quantum Information & Machine Learning*

- Develop a machine learning framework for designing novel quantum information processing protocols such as entanglement distillation, quantum state discrimination, and quantum channel simulation under the assumption of Local Operations and Classical Communication (LOCC).
- Link: Zhao, X., Zhao, B., Wang, Z., **Song, Z.**, & Wang, X. (2021). Practical distributed quantum information processing with LOCCNet. https://www.nature.com/articles/s41534-021-00496-x

(iii) Quantum Classifier based on Classical Shadows
Research Project

June 2020 - September 2020

Quantum Algorithm

· Develop a variational quantum algorithm for classification tasks based on classical shadows of quantum data. These shadows are extracted with parametrized local observables and represent side information.
· AAAI 2021 Conference Link: Li, G., **Song, Z.**, & Wang, X. (2021). VSQL: Variational Shadow Quantum Learning for Classification. https://ojs.aaai.org/index.php/AAAI/article/view/17016

(iv) Quantum Singular Value Decomposition
Research Project

April 2020 - July 2020

Quantum Algorithm

· Develop a variational quantum algorithm for singular value decomposition (VQSVD) based on the Ky Fan Theorem. I conduct the numerical simulation and application on image compression.
· Journal Link: Wang, X., **Song, Z.**, & Wang, Y. (2021). Variational quantum singular value decomposition. Quantum, 5, 483. https://quantum-journal.org/papers/q-2021-06-29-483/
· Short talk on the 20th Asian Quantum Information Science Conference (AQIS 2020), Sydney Australia

PATENT

Xin Wang, Xuanqiang Zhao, Benchi Zhao, Zihe Wang, **Zhixin Song**, Renyu Liu (2021). Design protocol of entanglement processing framework based on machine learning (CN112529198A).

Xin Wang, Yiliu Chenran, Xuanqiang Zhao, **Zhixin Song** (2020). Determine distance between quantum data with trace distance (CN112633509B).

SKILLS

Programming Languages	Python, Julia, C++, MATLAB, LaTex.
Specific Interests	Hybrid classical-quantum programming using Qiskit and IBMQ,
	Genetic Algorithm and Annealing for optimization problem,
	Finite Element Analysis with ANSYS and Abaqus,
	Object detection with CNN based YOLO model,
	DL frameworks such as TensorFlow, PyTorch, and PaddlePaddle.
Software & Tools	Mathematica, ANSYS, Abaqus, Blender, Adobe Illustrator.

AWARDS & HONORS

CRNCH Ph.D. Fellowships, GaTech	*Autumn 2022*
Project Outstanding Contribution Award, IQC Baidu Research	*Autumn 2020*
Achieved **Deans List** and in the **Honors List** every semester at OSU	*Spring 2016 - Autumn 2019*
Smith Sophomore Award for Undergraduate Physics Majors, OSU	*Spring 2017*
The Captain Forrest R. Biard Undergraduate Research Scholarship, OSU	*Summer 2017*

ACTIVITIES

Quantum Computing Association (Vice President), GaTech	*Spring 2022 - present*
Qiskit Advocate, IBM	*Summer 2021 - present*
AI Club member, OSU	*Autumn 2018 - Autumn 2019*
Society of Physics Students (SPS) , OSU	*Autumn 2017 - Autumn 2019*
Buck-I-SERV: Habitat for Humanity, Lafayette LA	*Spring 2017*
Buck-I-SERV: Community Servings, Boston MA	*December 2018*