Ruocheng Wang

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EDUCATION

Shanghai Jiao Tong University & Shanghai Innovation Institute (SII) Sept. 2025 – Present
School of Artificial Intelligence (Joint Training Program)

Shanghai Jiao Tong University Sept. 2021 – Sept. 2025
Physics (Zhiyuan Honors program, top 10% in SJTU)

- **Courses Studied:** Mathematical Analysis, Advanced Algebra, Methods of Mathematical Physics, Classical Mechanics, Quantum Mechanics II (**A+**), Thermodynamics and Statistical Physics (**99**), Electrodynamics (**98**), Introduction to Computational Physics (**99**), Introduction to Nanotechnology (by Prof. Nai-Chang Yeh at Caltech), etc.

Institute of Computing Technology, Chinese Academy of Sciences Aug. 2023
Quantum Information (Research Internship)

Harford College, University of Oxford Aug. 2024
Advanced English Language and British Culture Programme

RESEARCH EXPERIENCE

QUANONET: Quantum Neural Operator with Application to Differential Equation Jan. 2024 – Present
Advisor: Prof. Yan Junchi, School of Artificial Intelligence, SJTU

- Proposed QUANONET, a pure quantum neural operator framework tailored for the NISQ era to approximate continuous nonlinear operators.
- Theoretically extended the universal approximation theorem to quantum computing, proving that the architecture constructs an implicit effective frame of size $\mathcal{O}(p^2)$ via the density matrix, strictly exceeding classical capabilities.
- Introduced the Adaptive Trainable-Frequency (TF-QUANONET) strategy to prevent dimensional collapse and unlock the $\mathcal{O}(p^2)$ expressivity.
- Demonstrated superior performance on benchmarks (Antiderivative, Diffusion-Reaction) compared to classical SOTA frameworks (DeepONet, FNO) using significantly fewer parameters.
- Deployed the framework on IBM quantum processors (ibm_fez), validating its functional viability and noise resilience on real hardware.

Design of constrained quantum variational circuits and application to solving complex problem Sept. 2023 – Dec. 2023
Advisor: Prof. Yan Junchi, Dept. of Computer Science & Engineering, SJTU

- Discussed in detail the Hamming Weight (HW) Preserving ansatz under full dimension of dynamic Lie algebras under full join and bow tie conditions, and gave the guiding parameter settings.
- Managed to combine the HW Preserving ansatz and topological-aware parity check on physical qubits to enforce a hard constraint for Quadratic Assignment Problem (QAP).
- Demonstrated its capability on other CO problems e.g. Travelling Salesman Problem (TSP) when it is converted to the QAP form.
- Coded with fewer anyons in topological quantum computing to eliminate the redundant state space.

Quantum Langevin equations of the periodic driven system and frequency locking effect Sept. 2022 – Oct. 2023
Advisor: Prof. Carlos Navarrete-Benlloch, School of Physics and Astronomy, SJTU

- Obtained asymptote solutions and performed stability analysis under the classical limits of the feedback tuned VdP model and DOPO model.
- Simulated and discussed how to qualitatively judge the frequency locking effect by phase analysis of the complex plane.

Non-equilibrium and self-organization phenomena in hot spot ignition models Sep. 2023 – Feb. 2024
Advisor: Prof. Dong Wu (SJTU) & Prof. Jie Zhang (Academician of CAS)

- Studied a non-equilibrium model and extended this model to both isobaric and isochoric conditions, which differ in the hot-spot density and expansion speed.
- Observed the natural phenomenon of self-organization in the bifurcated evolution of ion and electron temperatures in both cases, finding that ion temperature heating outstands in the ignition.

PUBLICATIONS

[1] Yan, G., Ran, M., **Wang, R.**, Pan, K., & Yan, J. *Rethinking Parity Check Enhanced Symmetry-Preserving Ansatz.* In The Thirty-eighth Annual Conference on Neural Information Processing Systems (NeurIPS), 2024.

[2] Yan, G., Wu, W., Yuheng, C., Pan, K., Lu, X., Zixiang, Z., Yuhan, W., **Ruocheng, W.** & Yan, J. (2024). *Quantum circuit synthesis and compilation optimization: overview and prospects*. CORR.

[3] Fu, X. Y., Guo, Z. Y., Wang, Q. H., **Wang, R. C.**, Wu, D., & Zhang, J. (2024). *Non-Equilibrium and Self-Organization Evolution in Hot-Spot Ignition Processes*. Phys. Plasmas 31, 072710 (2024).

[4] **Wang, R.**, Xia, Z, Yan, G., & Yan, J. *QuanONet: Quantum Neural Operator with Application to Differential Equation*. In The Forty-Second International Conference on Machine Learning (ICML), 2025.

SELECTED HONORS & AWARDS

Shanghai Outstanding Graduate	2025
First prize of the Challenge Cup special competition	2024
Rong Chang Science and Technology Innovation Scholarship	2024
National Scholarship	2023
A-class scholarship, SJTU	2023
Zhiyuan Outstanding Leader Scholarship (First prize), SJTU	2021, 2022
Zhiyuan Honors Scholarship, SJTU	2019
Bronze medal for Chinese Physics Olympiad, Chinese Physical Society	2019
1st Prize for Chinese Mathematical Olympiad, Chinese Mathematical Society	2018

ACTIVITIES AND ENGAGEMENT

- Chairman of the Student Union of Zhiyuan College
- Participant in 12-9 Concert representing Zhiyuan College
- Volunteer in welcoming 2020 SJTU graduate freshmen