

Yuanhang Zhang

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Boosting AI with physics, and understanding physics with AI.

Research Interests

- Unconventional Computing
 - *MemComputing*: Leveraging long-range order in nonlinear dynamical systems for efficient computation.
 - *Neuromorphic computing*: Theoretical modeling and simulation of artificial neurons utilizing resistive switching materials.
- Quantum Machine Learning
 - *Machine learning for quantum systems*: Development of machine learning algorithms to tackle previously intractable quantum problems.
 - *Quantum computing for machine learning*: Accelerating machine learning through quantum computing, and developing machine learning algorithms for quantum computers.

Education

- Ph.D. Physics, University of California, San Diego Jan 2020 - Apr 2024 (expected)
GPA 3.93/4, Advisor: Prof. Massimiliano Di Ventra
- Postbaccalaureate Researcher, Tsinghua University Aug 2019 - Dec 2019
Advisor: Prof. Dong-Ling Deng
- B.Sc. Physics, University of Science and Technology of China Sep 2015 - Jun 2019
GPA 3.91/4.3, with minor in computer science, GPA 4.05/4.3

Publications

- [1] **Zhang, Y. H.**, & Di Ventra, M. (2023). *Collective dynamics and long-range order in thermal neuristor networks*. arXiv preprint arXiv:2312.12899.
- [2] Qiu, E., **Zhang, Y. H.**, Di Ventra, M., & Schuller, I. K. (2023). *Reconfigurable cascaded thermal neuristors for neuromorphic computing*. Advanced Materials, 2306818.
- [3] **Zhang, Y. H.**, & Di Ventra, M. (2023). *Implementation of digital MemComputing using standard electronic components*. arXiv preprint arXiv:2309.12437.
- [4] Primosch, D., **Zhang, Y. H.**, & Di Ventra, M. (2023). *Self-averaging of digital memcomputing machines*. Physical Review E, 108(3), 034306.
- [5] Nguyen, D.C., **Zhang, Y. H.**, Di Ventra, M. & Pershin, Y.V. (2023). *Hardware implementation of digital memcomputing on small-size FPGAs*. arXiv preprint arXiv:2305.01061.
- [6] **Zhang, Y. H.**, & Di Ventra, M. (2023). *Transformer quantum state: A multipurpose model for quantum many-body problems*. Physical Review B, 107(7), 075147.
- [7] **Zhang, Y. H.**, & Di Ventra, M. (2022). *Efficient quantum state tomography with mode-assisted training*. Physical Review A, 106(4), 042420.

- [8] **Zhang, Y. H.**, & Di Ventra, M. (2021). *Directed percolation and numerical stability of simulations of digital memcomputing machines*. Chaos: An Interdisciplinary Journal of Nonlinear Science, 31(6), 063127.
- [9] **Zhang, Y. H.**, Zheng, P. L., Zhang, Y., & Deng, D. L. (2020). *Topological quantum compiling with reinforcement learning*. Physical Review Letters, 125(17), 170501.
- [10] Zhao, J., **Zhang, Y. H.**, Shao, C. P., Wu, Y. C., Guo, G. C., & Guo, G. P. (2019). *Building quantum neural networks based on a swap test*. Physical Review A, 100(1), 012334.
- [11] Jia, Z. A., **Zhang, Y. H.**, Wu, Y. C., Kong, L., Guo, G. C., & Guo, G. P. (2019). *Efficient machine-learning representations of a surface code with boundaries, defects, domain walls, and twists*. Physical Review A, 99(1), 012307.
- [12] **Zhang, Y. H.**, Jia, Z. A., Wu, Y. C., & Guo, G. C. (2018). *An efficient algorithmic way to construct Boltzmann machine representations for arbitrary stabilizer code*. arXiv preprint arXiv:1809.08631.

Talks

- [1] Neuromorphic computing with thermal interactions, invited talk at NIST and at Micius Forum, USTC, 2023
- [2] Collective dynamics and memory-induced long-range order in spiking oscillator arrays, featured student talk, 2023 Annual Meeting of the APS Far West Section
- [3] Towards a general-purpose model for quantum many-body problems, seminar at ByteDance, 2023
- [4] Transformer Quantum State: A Multi-Purpose Model for Quantum Many-Body Problems, APS March Meeting 2023
- [5] Self-Averaging of Digital MemComputing Machines, APS March Meeting 2023
- [6] A brief introduction to MemComputing, seminar at Tsinghua University, 2022
- [7] Towards a general-purpose model for quantum many-body problems, seminar at Tsinghua University, 2022
- [8] Quantum State Tomography with Mode-assisted Training, APS March Meeting 2022
- [9] Topological Quantum Compiling with Reinforcement Learning, seminar at University of Oxford, 2021
- [10] Directed Percolation and Numerical Stability of Simulations of Digital MemComputing Machines, APS March Meeting 2021

Teaching

- Teaching assistant, Phys 1BL, Electricity & Magnetism Lab, UC San Diego, 2020

Skills

- Python and MATLAB programming
- Developing machine learning algorithms with PyTorch and JAX
- Circuit design with LTSpice