Zhen Qin

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RESEARCH INTERESTS

My research focuses on high-dimensional and structured learning at the intersection of **artificial intelligence**, **quantum computing**, and **information processing**. I develop **theoretically grounded, efficient frameworks** for advancing both **next-generation intelligent systems** and **hybrid quantum-classical architectures**, bridging foundational theory with practical implementation.

PROFESSIONAL EXPERIENCE

University of Michigan - Ann Arbor (UMich) **Ann Arbor, America**
Michigan Institute for Computational Discovery and Engineering (MICDE)
Department of Electrical Engineering and Computer Science and Department of Statistics
MICDE Research Fellow ***Aug.2025-Now***

- **Mentors: Prof. *Qing Qu* and Prof. *Yang Chen***

EDUCATION

Ohio State University (OSU) **Columbus, America**
Ph.D. in *Computer Science and Engineering* ***Aug.2022-Jul.2025***

- **Advisor: Prof. *Zhihui Zhu***

University of Denver (DU) **Denver, America**
Ph.D. in *Electrical and Computer Engineering* ***Sep.2021-Jul.2022***

- **Advisor: Prof. *Zhihui Zhu***

Southeast University (SEU) **Nanjing, China**
M.Eng. in *Information and Communication Engineering (Signal Processing)* ***Sep.2017-Jun.2020***

- **Advisor: Prof. *Jun Tao***

Ludong University (LDU) **Yantai, China**
B.Sc. in *Information and Computation Science* (*Computational Mathematics*) ***Sep.2013-Jun.2017***

PUBLICATIONS

Machine Learning Theory

- J. Jiang, **Z. Qin**, and Z. Zhu, "In-Context Learning for Non-Stationary MIMO Equalization", *arXiv preprint arXiv:2510.08711, 2025.*
- **Z. Qin**, J. Zhou and Z. Zhu, "On the Convergence of Gradient Descent on Learning Transformers with Residual Connections", *arXiv preprint arXiv:2506.05249, 2025.*
- **Z. Qin**, X. Tan and Z. Zhu, "Convergence Analysis for Learning Orthonormal Deep Linear Neural Networks", *Signal Processing Letters (**SPL**),* 2024.

Quantum Information Theory and Quantum Tomography

- **Z. Qin** and Z. Zhu, "Quantum State Tomography for Tensor Networks in Two Dimensions", *Physical Review A (**PRA**)*, 2026.
- **Z. Qin**, C. Jameson, Z. Gong, M. B. Wakin and Z. Zhu, "Optimal Allocation of Pauli Measurements for Low-rank Quantum State Tomography", *IEEE Transactions on Quantum Engineering (**TQE**)*, 2026.
- **Z. Qin**, J. Lukens, B. Kirby and Z. Zhu, "Enhancing Quantum State Reconstruction with Structured Classical Shadows", *npj Quantum Information* (***npj QI***), 2025.
- **Z. Qin**, C. Jameson, A. Goldar, M. B. Wakin, Z. Gong and Z. Zhu, "Sample-Efficient Quantum State Tomography for Structured Quantum States in One Dimension", *arXiv preprint arXiv.2410.02583,* 2024.
- C. Jameson, **Z. Qin**, A. Goldar, M. B. Wakin, Z. Zhu, and Z. Gong, "Optimal quantum state tomography with local informationally complete measurements", *arXiv preprint arXiv:2408.07115*, 2024.
- **Z. Qin**, C. Jameson, Z. Gong, M. B. Wakin and Z. Zhu, "Quantum State Tomography for Matrix Product Density Operators", *IEEE Transactions on Information Theory (**TIT**)*, 2024.
- A. Lidiak, C. Jameson, **Z. Qin**, G. Tang, M. B. Wakin, Z. Zhu and Z. Gong, "Quantum state tomography with tensor train cross approximation", *arXiv preprint arXiv:2207.06397,* 2022.

High-Dimensional Tensor Learning and Estimation

- **Z. Qin** and Z. Zhu, "Optimal Error Analysis of Channel Estimation for IRS-assisted MIMO Systems", *IEEE Transactions on Signal Processing (**TSP**)*, 2025.
- X. Liang, **Z. Qin**, Z. Zhu and S. Li, "Landscape Analysis of Simultaneous Blind Deconvolution and Phase Retrieval via Structured Low-Rank Tensor Recovery", *arXiv preprint arXiv:2509.10834, 2025.*
- **Z. Qin** and Z. Zhu, "Computational and Statistical Guarantees for Tensor-on-Tensor Regression with Tensor Train Decomposition", *IEEE Transactions on Pattern Analysis and Machine Intelligence **(TPAMI)***, 2025.
- **Z. Qin**, M. B. Wakin and Z. Zhu, "A Scalable Factorization Approach for High-Order Structured Tensor Recovery", *arXiv preprint arXiv:2506.16032, 2025.*
- **Z. Qin** and Z. Zhu, "Robust Low-rank Tensor Train Recovery", *IEEE Transactions on Signal Processing (**TSP**)*, 2025.
- L. Ding, **Z. Qin**, L. Jiang, J. Zhou and Z. Zhu, "A Validation Approach to Over-parameterized Matrix and Image Recovery", *Conference on Parsimony and Learning (**CPAL**)*, 2025.
- **Z. Qin**, M. B. Wakin and Z. Zhu, "Guaranteed Nonconvex Factorization Approach for Tensor Train Recovery", *Journal of Machine Learning Research (**JMLR**),* 2024.
- **Z. Qin**, X. Tan and Z. Zhu, "Convergence Analysis for Learning Orthonormal Deep Linear Neural Networks", *Signal Processing Letters (**SPL**),* 2024.
- **Z. Qin**, A. Lidiak, Z. Gong, G. Tang, M. B. Wakin, and Z. Zhu, "Error Analysis of Tensor Train Cross Approximation", *Neural Information Processing Systems* (***NeurIPS***), 2022.
- H. Yu, **Z. Qin**, and Z. Zhu, "Learning approach for fast approximate matrix factorizations", *IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP**),* 2022.

Adaptive Signal Processing

- Y. Wang, **Z. Qin**, J. Tao, and Y. Xia, "Variable step-size convex regularized PRLS algorithms", *Signal Processing (**SP**),* 2024.

- Y. Wang, **Z. Qin**, J. Tao and M. Jiang, "A Variable Step-Size l0-PRLS Algorithm and its Application in Sparse Channel Estimations", *IEEE 97th Vehicular Technology Conference (**VTC**)*, 2023.
- **Z. Qin**, J. Tao, L. Yang and M. Jiang, "Proportionate recursive maximum correntropy criterion adaptive filtering algorithms and their performance analysis", *Digital Signal Processing (**DSP**),* 2023.
- Y. Wang, **Z. Qin**, J. Tao and L. Yang, "Performance Analysis of PRLS-based Time-Varying Sparse System Identifications", *IEEE 12th Sensor Array and Multichannel Signal Processing Workshop (**SAM**)*, 2022.
- **Z. Qin**, J. Tao, Y. Xia, and L. Yang, "A proportionate RLS using l_1 norm regularization, performance analysis and its fast implementation", *Digital Signal Processing (**DSP**),* 2022.
- **Z. Qin**, J. Tao, and Y. Xia, "A proportionate recursive least squares algorithm and its performance analysis", *IEEE Transactions on Circuits and Systems II: Express Briefs (**TCASII**)*, 2020.
- **Z. Qin,** J. Tao, L. An, S. Yao, and X. Han, "Fast sparse RLS algorithms", *IEEE 10th International Conference on Wireless Communications and Signal Processing (**WCSP**)*, 2018.

Underwater Acoustic Communications

- **Z. Qin**, "Dynamic Compressive Sensing based on RLS for Underwater Acoustic Communications", arXiv preprint arXiv:2304.11838, 2023.
- Y. Zhuang, J. Tao, **Z. Qin**, and M. Jiang, "Enhanced MSER Adaptive Equalization for Single-Carrier MIMO Underwater Acoustic Communications", *MTS/IEEE OCEANS Conference (**OCEANS**)*, 2022.
- **Z. Qin**, J. Tao, F. Qu and Y. Qiao, "Adaptive equalization based on dynamic compressive sensing for single-carrier multiple-input multiple-output underwater acoustic communications" , *The Journal of the Acoustical Society of America (**JASA**), 2022.*
- Y. Wang, **Z. Qin**, J. Tao, F. Tong and Y. Qiao, "Sparse Adaptive Channel Estimation based on l0-PRLS Algorithm for Underwater Acoustic Communications", *MTS/IEEE OCEANS Conference (**OCEANS**)*, 2022.
- **Z. Qin**, J. Tao, and X. Han, "Sparse direct adaptive equalization based on proportionate recursive least squares algorithm for multiple-input multiple-output underwater acoustic communications", *The Journal of the Acoustical Society of America (**JASA**)*, 2020.
- **Z. Qin**, J. Tao, and X. Han, "Dynamic compressive sensing based adaptive equalization for underwater acoustic communications", *MTS/IEEE Global OCEANS Conference (**OCEANS**)*, 2020.
- **Z. Qin**, J. Tao, F. Tong, H. Zhang, and F. Qu, "A fast proportionate RLS adaptive equalization for underwater acoustic communications", *MTS/IEEE OCEANS Conference (**OCEANS**)*, 2019.
- **Z. Qin**, J. Tao, X. Wang, X. Luo, and X. Han, "Direct adaptive equalization based on fast sparse recursive least squares algorithms for multiple-input multiple-output underwater acoustic communications", *The Journal of the Acoustical Society of America (**JASA**)*, 2019.

HONOR & AWARDS

- **MICDE Postdoctoral Fellowship,** University of Michigan ***May. 2025***
- **CSE Graduate Research Award,** Ohio State University ***Apr. 2025***
- **Excellent Academic Master's Thesis (1%),** Southeast University ***May. 2021***
- **Outstanding Graduate Award (10%),** Southeast University ***Jun. 2020***

PROFESSIONAL ACTIVITIES

- **Reviewer for the Following Journals**

IEEE Transactions on Information Theory
IEEE Transactions on Signal Processing
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Journal of Selected Topics in Signal Processing
Transactions on Machine Learning Research
npj Quantum Information

- **Reviewer for the Following Conferences**

IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)
IEEE International Workshop on Machine Learning for Signal Processing (MLSP)
Neural Information Processing Systems (NeurIPS)
Conference on Parsimony and Learning (CPAL)
International Conference on Learning Representations (ICLR)
International Conference on Machine Learning (ICML)
Annual AAAI Conference on Artificial Intelligence (AAAI)