Qipeng Qian

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Objective

Quantum Information Theory, Quantum Machine Learning, Quantum Change Point Detection, Optimization.

EDUCATION

Shanghai Jiao Tong University Sep 2017 - Jun 2021

Mathematics, Bachelor Shanghai, China

GPA: 3.4/4.0

Main Courses: Linear Algebra, Abstract Algebra, Programming, Ordinary Differential Equations, Calculus, Statistical Learning, Mathematical Statistics, Graph theory and networks, Numerical Methods, Differential Geometry, Random Process.

University of Wisconsin-Madison Sep 2021 - Jun 2022

Mathematics, Master Madison, Wisconsin

GPA: 4.0/4.0

Main Courses: Real Analysis, Functional Analysis; Linear and Non-linear Partial Differential Equations; Nonlinear Optimization; Fourier Analysis; Reading course of wavelets.

University of Arizona Aug 2022 - Aug 2026

Applied Mathematics, PhD Program Tucson, Arizona

Main Courses: Quantum Physics; Quantum Information Theory; Stochastic Processes; Reinforcement & Imitation Learning; Optimization & Algorithms.

Research Interest: Quantum Information Theory, Quantum Machine Learning, Quantum Change Point Detection.

SKILLS LIST

- Quantum mechanics, Quantum Information;
- Programming: Python, MatLab, Mathematica, R, C++;
- Math: Numerical computation, Mathematical modeling, Statistic methods, Optimization;
- Machine learning: Diffusion model, Graph neural networks, Generative adversarial network, Reinforcement learning, Imitation learning;
- Language: Chinese (native), English with excellent listening, speaking, reading and writing skills.

RESEARCH EXPERIENCE

"Covert Time-Position Coding with Quickest Quantum Change-Point Decoders", supervised by Prof. Christos Gagatsos and Prof. Boulat Bash in Department of Electrical and Computer Engineering, University of Arizona Aug 2025 - Present

Over bosonic thermal-loss channels, we integrate covert communication/sensing with Quantum change-point detection by using time-position coding and QUSUM decoding, deriving minimum slot-length laws and upper bounds on segment-wise payload under a prescribed covertness budget and false-alarm constraints.

"Best Input State of Estimating Phase Shift under Covariant Measurement", supervised by Prof. Gagatsos Sep 2024 - Aug 2025

We systematically characterize the necessary and sufficient conditions for optimal input states under covariant measurements in phase-shift estimation, and prove that these optimal inputs render the (average) cost asymptotically zero. Moreover, for a specified cost function, we derive an explicit expression for the optimal input state.

"The effect of partial post-selection on quantum discrimination", supervised by Prof. Gagatsos Apr 2025 - Jul 2025

Within a general LOCC framework, we investigate how partial post-selection impacts quantum state discrimination. We rigorously prove that the minimum average error, when averaged across all post-selected branches, cannot surpass the optimum achievable with the original input. At the same time, we exhibit specific branches that deliver strictly better conditional discrimination performance—at the cost of their occurrence probability. These results clarify the distinction between average and conditional performance, and we provide formal proofs and illustrative examples.

Q. Qian, C. N. Gagatsos, "The effect of partial post-selection on quantum discrimination," arXiv. https://arxiv.org/abs/2506.14105

"Lower Bound of Wigner Entropy for Qubit with Non-negative Wigner Function", supervised by Prof. Christos Gagatsos in Department of Electrical and Computer Engineering, University of Arizona Sep 2023 - Nov 2023

Uncertainty relations are of fundamental interest in quantum information theory and are closely related to the wave-particle duality in quantum mechanics and also illustrate one of the essential difference between quantum and classical mechanics. Further-more, uncertainty relations directly put constraints on the precision of measurements and indicates inherent limitations in our understanding of quantum systems. For this particular project, we look into the Wigner entropy conjecture which will induce a tighter uncertainty relation w.r.t classic Shannon entropy. Although we did not completely prove the conjecture, we derived a sufficient condition for it.

Q. Qian, C. N. Gagatsos, "Wigner non-negative states that verify the wigner entropy conjecture," Phys. Rev. A 110, 012228 (2024).

"A Wavelet-Inspired Aggregated Multiscale Graph Convolutional Recurrent Network for Traffic Forecasting", supervised by Tanwi Mallick in Argonne National Lab May 2023 - Jul 2023

This work was completed during the NSF MSGI 2023 Summer Internship, where we proposed a method called Wavelet-Inspired Multiscale Graph Convolutional Recurrent Network (WavGCRN). This approach leverages neural networks to emulate wavelet transforms and integrates multiscale graph learning to effectively capture information from input signals and their underlying graph structures across multiple scales.

Q. Qian, T. Mallick, "Wavelet-Inspired Multiscale Graph Convolutional Recurrent Network for Traffic Forecasting," IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Seoul, Korea, 2024.

"Hyperspectral Image Denoising and Classification", supervised by Prof. Y. Qian in Department of Computer Science, Zhejiang University Sep 2022 - Jul 2023

During the project, my colleagues and I were dedicated to exploring noise-model-free self-supervised techniques based on hierarchical graph relations and diffusion models for hyperspectral image denoising and employing graph convolutional networks and transformers to address hyperspectral image classification challenges in cross-domain scenarios.

K. Deng, Z. Jiang, **Q. Qian**, Y. Qiu, Y. Qian, "A Noise-Model-Free Hyperspectral Image Denoising Method Based on Diffusion Model", IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Pasadena, CA, USA, 2023.

Z. Jiang, **Q. Qian**, Y. Qiu, Y. Qian, "Hierarchical Superpixel Relation Graph Combined with Convolutional Sparse Coding for Self-Supervised Hyperspectral Image Denoising", IGARSS, Pasadena, CA, USA, 2023.

J. Ling, M. Ye, Y. Qian, **Q. Qian**, "Corss-Domain Hyperspectral Imaging Classification Based on Transformer", IGARSS, Pasadena, CA, USA, 2023.

Y. Li, M. Ye, Y. Qian, **Q. Qian**, "Corss-Domain Hyperspectral Imaging Classification Based on Graph Convolutional Networks", IGARSS, Pasadena, CA, USA, 2023.

"Graph Wavelet Transforms and Applications", supervised by Prof. Z. Xu at Shanghai Jiao Tong University Oct 2020 - May 2021

This constitutes my undergraduate thesis project, where I focused on delineating various fundamental approaches to defining wavelet transforms grounded in graph structures. Furthermore, I conducted a thorough analysis of the theoretical underpinnings of widely employed graph neural networks, including Graph Convolutional Networks and Graph Wavelet Neural Networks.

"Machine learning in Hyperspectral remote sensing image processing", supervised by Prof. Y. Qian at Zhejiang University, Prof. M. Ye at China Ji Liang University, and Prof. J. Zhou at Griffith University Sep 2018 - May 2020

Throughout this project, we harnessed the power of deep neural networks and graph wavelet transformations to tackle challenges in hyperspectral unmixing and pixel-level classification. I actively engaged in knowledge exchange and discussions with my supervisors on model construction employing mathematical tools.

Y. Qian, F. Xiong, **Q. Qian**, J, Zhou, "Spectral Mixture Model Inspired Network Architectures for Hyperspectral Unmixing," IEEE Transactions on Geoscience and Remote Sensing, 58(10): 7418-7434, 2020.

Q. Qian, F. Xiong, J. Zhou, "Deep Unfolded Iterative Shrinkage-Thresholding Model for Hyperspectral Unmixing," IGARSS, Yokohama, Japan, 2019.

Q. Qian, X. Fan, M. Ye, "Improving Hyperspectral Image Classification Using Graph Wavelets," IGARSS, Waikoloa, HI, USA, 2020.

Referees

Christos Gagatsos, Assistant Professor of Electrical and Computer Engineering, cgagatsos@arizona.edu;

Chicheng Zhang, Assistant Professor of Department of Conputer Science, chichengz@email.arizona.edu;

Michael Chertkov, Professor of Department of Applied Mathematics, chertkov@math.arizona.edu.