Chuxiangbo Wang

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EDUCATION

University of North Carolina at Chapel Hill Expected May 2027
Ph.D. in Applied Mathematics
Research Assistant, Teaching Assistant

University of North Carolina at Chapel Hill Aug 2022 – May 2024
Master of Science, Applied Mathematics

University of California, Irvine Sep 2018 – Jun 2022
Bachelor of Science, Mathematics, Honors Program

SKILLS

Featured Skills: Data Analysis, Machine Learning, Mathematical Problem Solving, Geometric Analysis
Programming languages: Python, Matlab, Julia, Mathematica, SQL, C++
Python Libraries: Pytorch, Tensorflow, Keras, Scikit-learn, OT, Matplotlib, Math, SciPy, NumPy, Pandas

RESEARCH PROJECTS

Independent Component Analysis with Optimal Transport Aug 2023 – Present
This method enhances Independent Component Analysis by integrating optimal transport theory, allowing for more effective analysis of high-dimensional data. It is used in fields such as machine learning, signal & image processing, data compression, and manifold learning.
- Extended unsupervised learning method (ICA) to the Wasserstein space, leveraging optimal transport theory for analyzing probability measures and point clouds in high-dimensional space.
- Developed and implemented algorithm that employs the 2-Wasserstein distance to construct graph Laplacian, bridging optimal transport theory with graph-based machine learning methods.
- Recovered independent components from up to 2000 point clouds under linear and non-linear transformations.

Carbon Monoxide Diffusion Across Human Placenta Jan 2024 – May 2024
This model simulates the diffusion of carbon monoxide across the human placenta, providing insights into substance transfer between mother and fetus. It is used in biomedical simulation, computational biology, toxicology, and maternal-fetal health studies.
- Developed a spatial-temporal model to simulate carbon monoxide (CO) diffusion using the finite difference method with 0.02 micrometers spatial step size over a time span of 1,440 minutes, capturing diffusion dynamics across maternal blood, placental tissue, and fetal blood.
- Implemented an iterative time-stepping approach with a time step of 0.1 seconds and integrated with an ODE model, achieving accurate modeling of CO concentrations with real-time boundary condition updates.
- Achieved detailed data visualization of CO diffusion patterns, demonstrating that fetal CO concentrations reached up to 30% higher than maternal levels, highlighting significant retention effects due to maternal smoking.

Robust Face Recognition via Sparse Representation Aug 2023 – Dec 2023
This system improves face recognition speed and accuracy and can handle image imperfections. It is used in computer vision, image processing, pattern recognition, feature extraction, and security systems.
- Developed a robust face recognition system leveraging sparse representation techniques to improve accuracy and resilience against data imperfections. Achieved 96.6% accuracy using ℓ_1-minimization (ADMM) on a dataset of 594 images across 11 classes.
- Enhanced model robustness by applying the Sparsity Concentration Index (SCI), successfully detecting and rejecting invalid samples.
- Improved computational efficiency, reducing the recognition time to 1.2 seconds per image using the ℓ_0-minimization (OMP) method.
- Implemented facial features extraction algorithm to identify key facial components even in the presence of occlusions or variations, ensuring accurate recognition by focusing on the most discriminative features across different face images.

Point Cloud Data Recovery with Diffusion Maps Aug 2023 – Dec 2023
This method recovers original data structures of transformed point clouds data, it can be used in signal processing, image recovery, dimension & noise reduction, autonomous systems, manifold learning.
- Recovered original data structure of non-linearly transformed point clouds using manifold learning technique (diffusion maps), achieving a one-to-one correspondence with up to 500 point clouds.
- Simulated Ito process with 1000 bursts per point within 0.001 time step to accurately estimate the local geometric structure of the point cloud data, enhancing the recovery of original structures through feature exraction & dimension reduction technique (diffusion maps).

CONFERENCE & WORKSHOPS

- **Data Science Day 2023 & 2024**, UNC Chapel Hill September 2023 & 2024
- **Triangle Computational and Applied Mathematics Symposium (TriCAMS) 2023 & 2024**, Duke University & UNC Chapel Hill October 2023 & 2024
- **Algorithms & PDE Conference/Workshop**, UT Austin & Texas State University May 2024
- **Optimal Transport Through the Midwest**, University of Wisconsin-Madison July 2024

HONORS & AWARDS

- Honors in Mathematics & Pi Mu Epsilon, UC Irvine

PUBLICATION

[1] Li, S., Moosmueller, C., & Wang, C. (2024). *Linear independent component analysis in Wasserstein space*. Submitted. 2024