Mingzhou Yang

Contact Information

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Summary

Ph.D. Candidate specializing in spatio-temporal data science with applications in smart cities and urban intelligence. Expertise in developing novel physics-guided ML models and scalable, multi-objective routing algorithms to solve challenges in transportation systems.

Education

University of Minnesota — Twin Cities, MN
Ph.D. in Computer Science (Expected May 2026)
Advisor: Prof. Shashi Shekhar

Xi'an Jiaotong University — Xi'an, China
M.S. in Control Science and Engineering — May 2020
B.Eng. in Automation — May 2017

Experience

Graduate Research/Teaching Assistant University of Minnesota May 2021 – Present
Advisor: Prof. Shashi Shekhar Sponsors: NSF, USDOE, Volvo Trucks

Project: High Physical Fidelity Trajectory Generation

- Proposed a novel framework, Geo-lucid Conditional Diffusion Models (GCDM), to generate synthetic vehicle trajectories with high physical fidelity, addressing the failure of prior models to capture realistic vehicle dynamics like velocity and acceleration.
- Innovated a two-stage, cascaded architecture that integrates road map attributes into the generative process using novel techniques like map-informed latent variables and a spatial residual diffusion method.
- Demonstrated improved geo-distribution alignment and lower velocity/acceleration/jerk divergence compared with prior generative baselines.

Project: Physics-Informed Neural Network for Vehicle Eco-toll/Energy Estimation

- Developed Eco-PiNN, a novel physics-informed neural network that integrates the physics law of vehicle dynamics for eco-toll estimation.
- Integrated vehicle-physics equations into the estimation framework and added physics-guided regularization to reduce unrealistic acceleration/jerk. Designed an attention-based contextual encoder to capture inter-segment influences along a path.
- Demonstrated SOTA performance on real heavy-duty truck datasets for energy estimation.

Project: Energy-efficient Routing for Heavy-Duty Vehicles

- Built an eco-routing stack coupling Eco-PiNN energy prediction with a physics-informed routing algorithm.
- Field-tested in Texas and Minneapolis with Volvo heavy-duty trucks; observed **15%** range improvement.

Project: Multi-level Bi-objective Routing

- Addressed the high computational cost of the bi-objective routing problem by proposing a novel pre-computation framework, Multi-Level Bi-Objective Routing (MBOR), to find the complete set of Pareto-optimal paths (e.g., balancing travel time vs. energy consumption).
- Demonstrated on real-world road networks that the proposed method achieves over a 10x improvement in online runtime compared to state-of-the-art exact algorithms, while guaranteeing the completeness of the Pareto-optimal solution set.

Teaching Assistant

- Mentored 30+ students in Data Structures & Algorithms (rated 5.4/6.0) and graded for Intro to Programming.

Visiting Student Worcester Polytechnic Institute, Worcester, MA Jul 2019 – Oct 2019
Advisor: Prof. Yanhua Li Project: Transit Passenger Interactive Choice Modeling

- Modeled urban passengers' interactions via Markov Games and developed multi-agent inverse reinforcement learning (IRL)/apprenticeship learning to recover rewards from equilibrium/trajectory data.
- Validated on synthetic and Shenzhen real-world trip datasets.

Selected Publications

** co-first author*

Geo-lucid Conditional Diffusion Models for High Physical Fidelity Trajectory Generation
The 33rd ACM International Conference on Advances in Geographic Information Systems (SIGSPATIAL '25)
Mingzhou Yang, Arun Sharma, Majid Farhadloo, Bharat Jayaprakash, Shashi Shekhar

Eco-PiNN: A Physics-informed Neural Network for Eco-toll Estimation*
The 2023 SIAM International Conference on Data Mining (SDM '23)
Yan Li*, **Mingzhou Yang***, Matthew Eagon, Majid Farhadloo, Yiqun Xie, William F. Northrop, Shashi Shekhar

Inferring Passengers' Interactive Choices on Public Transits via MA-AL: Multi-agent Apprenticeship Learning
The Web Conference 2020 (WWW '20)
Mingzhou Yang, Yanhua Li, Xun Zhou, Hui Lu, Zhihong Tian, Jun Luo

Towards Pareto-optimality with Multi-level Bi-objective Routing: A Summary of Results
The 17th ACM SIGSPATIAL International Workshop on Computational Transportation Science, 2024
Mingzhou Yang, Ruolei Zeng, Arun Sharma, Shunichi Sawamura, William F. Northrop, Shashi Shekhar

Data Mining Challenges and Opportunities to Achieve Net Zero Carbon Emissions: Focus on Electrified Vehicles *(Best Vision Paper Award, runner-up)*
The 2023 SIAM International Conference on Data Mining (SDM '23)
Mingzhou Yang, Bharat Jayaprakash, Matthew Eagon, Hyeonjung Jung, William F. Northrop, Shashi Shekhar

Technical Skills

Languages: Python, C++, Java, R, SQL, Scala
Machine Learning: PyTorch, TensorFlow, Keras, OpenCV
Big Data: Spark, Hadoop, Hive, PySpark
DevOps: Docker, Git, Jira, Tableau

Honors and Achievements

Doctoral Dissertation Fellowship **2024**
University of Minnesota.

Best Vision Paper Award (runner-up) **2023**
SIAM International Conference on Data Mining (SDM'23).

Student Travel Award **2023**
SIAM International Conference on Data Mining (SDM'23).

Professional Activities

Co-organizer, **2022**
Special Data Workshop on Vehicle Data Science, 5th Geoscience Alliance Conference.
Selected Presenter, **2023**
Doctoral Forum, SIAM International Conference on Data Mining (SDM'23).
Excellent Reviewer, **2025**
ACM SIGKDD Int'l Conference on Knowledge Discovery and Data Mining (KDD'25).