Dingyi Zhuang

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Education

- **Massachusetts Institute of Technology** — Cambridge, MA
  Ph.D. Candidate in Transportation Engineering — *Sep. 2021 - Now*
  - Thesis proposal: Quantifying Uncertainty: Advancing Robustness, Reliability, and Fairness in AI-Driven Transportation Demand Modeling.
  - Research Interests: Urban Computing, Spatiotemporal Data Mining, Time Series, Economics, Graph Neural Networks, Large Language Model.
  - Advisor: Prof. Jinhua Zhao. GPA: 5.0/5.0.

- **McGill University** — Montreal, Canada
  Master in Transportation Engineering — *Sep. 2019. - May. 2021*
  - Thesis: Spatial Aggregation and Temporal Convolution Graph Neural Network for Kriging.
  - Advisor: Prof. Lijun Sun. GPA: 3.8/4.0.

- **Shanghai Jiao Tong University** — Shanghai, China
  Bachelor of Science in Mechanical Engineering — *Sep. 2015 - Jul. 2019*
  - Graduate with Outstanding Honor (Tsien Hsue-Shen Class, Top 5%)

Internship Experience

- **Morgan Stanley** — New York, USA
  Machine Learning Research Intern (Paid Full-time Internship) — *Jun. 2024 - Aug. 2024*
  - Analyzed and created dashboards to study semi-bipartite graphs in transaction, email, and other financial networks.
  - Designed imbalance-aware heterogeneous graph neural networks on financial transaction data for fraud account detection. Algorithms were implemented into production, helping teams with similar graph structures.
  - Deployed LLM to explore and benchmark the optimization problems.

- **Chicago Transit Authority** — Chicago, IL
  Research Intern (Unpaid Part-time Internship) — *May. 2021 - Sep. 2021*
  - Studied passengers' transaction and trajectory data to understand their spatiotemporal exploratory behavior patterns during different phases of the pandemic. Mixture distributions were used to describe pattern specifics.
  - Analyzed and wrapped up a dashboard to visualize network redundancy and passenger demand change under incidents using disruption logs and smart card data, which helped the agency plan policies for service disruptions.

Selected Publications

1. **Dingyi Zhuang**, Yuheng Bu, Guang Wang, Shenhao Wang, Jinhua Zhao, SAUC: Sparsity-Aware Uncertainty Calibration for Spatiotemporal Prediction with Graph Neural Networks, *Neural Information Processing Systems 2023 (NeurIPS 2023), TGL Workshop.* link

2. Yuankai Wu, **Dingyi Zhuang**, Aurelie Labbe, Lijun Sun, Inductive graph neural networks for spatiotemporal kriging, *Association for the Advancement of Artificial Intelligence 2021 (AAAI 2021).* link

3. **Dingyi Zhuang**, Shenhao Wang, Haris Koutsopoulos, Jinhua Zhao, Uncertainty Quantification of Sparse Trip Demand Prediction with Spatial-Temporal Graph Neural Networks, *The 28th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (SIGKDD 2022).* link

4. Yihong Tang, Zhaokai Wang, Ao Qu, Yihao Yan, Zhaofeng Wu, **Dingyi Zhuang**, Jushi Kai, Kebing Hou, Xiaotong Guo, Jinhua Zhao, Zhan Zhao, Wei Ma, ITINERA: Integrating Spatial Optimization with Large Language Models for Open-domain Urban Itinerary Planning, *EMNLP 2024; SIGKDD Urban Computing Workshop Best Paper* link

5. **Dingyi Zhuang**, Siyu Hao, Lee Der-Horng, Jiangang Jin, From compound word to metropolitan station: Semantic similarity analysis using smart card data, *Transportation Research Part C: Emerging Technology.* link

6. **Dingyi Zhuang**, Jiangang Jin, Yifan Shen, Wei Jiang, Understanding the bike sharing travel demand and cycle lane network: the case of Shanghai, *International Journal of Sustainable Transportation.* link

7. **Dingyi Zhuang**, Yuzhu Huang, Vindula Jayawardana, Jinhua Zhao, Dajiang Suo, Cathy Wu, The Braess Paradox in Dynamic, *Traffic IEEE 25th International Conference on Intelligent Transportation Systems (ITSC 2022*). link

Research Experience

- **Massachusetts Institute of Technology** — Cambridge, MA
  Research Assistant, Urban Mobility Lab — *Sep. 2021 - Now*
  - **Sparsity-Aware Uncertainty Calibration for Spatiotemporal Prediction with Graph Neural Networks**
    - Introduced the Sparsity-aware Uncertainty Calibration (SAUC) method to calibrate uncertainty in both zero and non-zero values in spatiotemporal datasets.
    - Modified state-of-the-art deterministic spatiotemporal GNNs to probabilistic versions for improved pre-calibration.
    - Achieved a 20% reduction in calibration errors for sparse traffic accident and urban crime data, enhancing safety guidance and filling a key gap in uncertainty quantification for sparse data.
  - **Uncertainty Quantification of Sparse Trip Demand Prediction with Spatial-Temporal GNNs**
    - Developed the Spatial-Temporal Zero-Inflated Negative Binomial Graph Neural Network (STZINB-GNN) to address uncertainty and sparsity in fine-grained Origin-Destination (O-D) matrices.
    - Leveraged diffusion and temporal convolution networks to analyze spatial and temporal correlations, enhancing the probabilistic distributions of travel demand.
    - Demonstrated STZINB-GNN's superiority over benchmark models in real-world datasets due to high accuracy, tight confidence intervals, and interpretable parameters beneficial for various transportation applications.
  - **Deep Hybrid Model for Travel Mode Choice Analysis with Graph-embedded Urban Road Network**
    - Proposed Deep Hybrid Model framework that combined graph embedding and choice models to empower the representation ability of choice model using urban road networks.
    - The framework showed strong regression improvement and interpretability potentials that could benefit the theory development in both choice model and deep learning fields.

- **McGill University** — Montreal, Canada
  Research Assistant, Smart Transportation Lab — *Sep. 2019 - May. 2021*
  - **Inductive Graph Neural Networks for Spatiotemporal Kriging**
    - Developed a dynamic sampling based inductive framework of graph neural network to recover data for unsampled sensors on a network/graph structure
    - Learned the spatial message passing mechanism by generating random subgraph samples and adjacency, then reconstructing signals on them.
    - Implemented and outperformed advanced spatial kriging and matrix completion models on various spatiotemporal datasets to test the inductive ability.

- **National University of Singapore** — Singapore
  Research Student — *Apr. 2019 - Sep. 2021*
  - **Understanding Semantic Similarity among Subway Stations Using Smart Card Data**
    - Designed a station2vec approach using the word2vec model in natural language processing and proposed to interpret station vectors as compound words to comprehend their mobility and service semantics.
    - Applied stacked autoencoder on smart card data and topic modeling on Point of Interest data to discover the mobility and service semantics respectively to obtain a deeper similarity between subway stations.

Academic Service

- **Journal Referees**: IEEE Transactions on Neural Networks and Learning Systems; IEEE Transactions on Intelligent Transportation Systems; Transportation Research Part C
- **Conference Referees**: Transportation Research Board Annual Meeting (TRB); IEEE Conference on Intelligent Transportation (IEEE ITSC); COTA International Conference of Transportation Professionals
- **Organizers**: 2nd International Workshop on Socially Interactive Autonomous Mobility (SIAM); Mens, Manus and Machina (M3S) MIT-Singapore AI symposium

Referees

- **Prof. Jinhua Zhao**: jinhua@mit.edu, Professor of Cities and Transportation at the Massachusetts Institute of Technology
- **Prof. Haris N Koutsopoulos**: h.koutsopoulos@northeastern.edu, Professor of Transportation at Northeastern University