Hao Zheng

Phone: +86 157 1112 0980 GitHub: scholarhaozheng

Email: zhengh22@mails.tsinghua.edu.cn / scholarhaozheng@gmail.com Website: scholarhaozheng.github.io

Education

- **Tsinghua University**, School of Civil Engineering, Master of Science, GPA: 3.86 09/2022 - 06/2025
- **Beijing Jiaotong University**, School of Traffic and Transportation, Bachelor of Engineering, GPA: 3.80 09/2018 - 06/2022

Manuscripts Under Review

- **Hao Zheng**, Han Zheng*, George Giannopoulos. KNOWCAST: Domain-Knowledge-Integrated Deep Learning for Metro OD and Path Flow Joint Forecasting. (Code repository) ***(Under Major Revision at Transportation Research Part C)*** *(Revision Received: 09/2025)*
  - **Paper's Contribution:** Proposed a novel deep learning framework that embeds transportation models (trip generation, distribution, assignment) to jointly forecast metro OD and path flows, leveraging intermediate path-level features to ensure their mathematical consistency and improve accuracy.
  - **My Contribution:** Conceptualized the domain-knowledge-integrated framework, implemented the deep learning model, and served as the lead author of the manuscript.
- **Hao Zheng**, Yian Zhao, Jiantao Li, Xi Zhu, Runhua Guo*. An End-to-End Framework for Pavement Maintenance Scheduling: From Rule-Based Planning to Optimized Vehicle Routing. (Code repository) *(Submitted to International Journal of Sustainable Transportation) (Under Review, 10/2025)*
  - **Paper's Contribution:** Developed an integrated framework for maintenance-vehicle route planning that addresses the challenge of representing linear road segments within a node-based network graph. The method first introduces a novel topology reconstruction technique, using a three-node (entry, virtual, exit) structure to model maintenance tasks. It then formulates the scheduling challenge as a Vehicle Routing Problem with Time Windows (VRPTW) and solves it efficiently using a custom Branch-and-Price algorithm.
  - **My Contribution:** Led model development, coding, experimental validation, and manuscript writing.

Manuscripts in Preparation

- **Hao Zheng**, Han Zheng*, George A. Giannopoulos. DISCERN: Discrete Choice with Embedded Representation Networks. *(To be submitted to Transportation Research Part C, 12/2025)*
  - **Paper's Contribution:** Proposed DISCERN, a novel framework that calibrates the behavioral parameters of traditional Discrete Choice Models (DCMs) using large-scale, macroscopic data. This is achieved by embedding a theory-driven DCM within a deep learning architecture, using backpropagation on a macro-level predictive task to infer latent micro-level parameters.
  - **My Contribution:** Led model development, coding, experimental validation, and manuscript writing.
- **Hao Zheng**, Runhua Guo*. An Intelligent Data-Driven Framework for Multi-Indicator Pavement Performance Prediction via Progressive Multi-Task Learning. (Code repository) *(To be submitted to IEEE Transactions on Intelligent Transportation Systems, 12/2025)*
  - **Paper's Contribution:** Proposed a multi-staged, multi-task learning framework to overcome data scarcity in pavement performance prediction. The approach involves pre-training a deep learning model on a large-scale public dataset (LTPP) and then progressively adapting it to a smaller, local dataset (Fuzhou) through a phased training strategy with parameter freezing, enabling reliable prediction of multiple performance indicators (IRI, RD, and PCI).
  - **My Contribution:** Designed and implemented the multi-stage, multi-task learning framework to jointly forecast multiple pavement performance time-series.

Publications

- **Hao Zheng**, Han Zheng*, George Giannopoulos. Integrated Routing of Trucks and Robots for Multi-Modal Urban Express Logistics. (Code repository) *(Accepted by the TRB 105th Annual Meeting, 2026)* *(Accepted: 09/2025)*
  - **Paper's Contribution:** Proposed LT-ADR, a novel logistic system for multi-modal urban delivery that jointly optimizes truck and robot routes for both regular and instant express services. The system is modeled on a multilayer space-time network and solved by a Branch-and-Price algorithm, demonstrating significant improvements in efficiency and computational speed over commercial solvers.
  - **My Contribution:** Formulated the multi-modal routing problem on a multilayer space-time network and developed the Branch-and-Price algorithm to solve it efficiently.
- **Hao Zheng**, Xingchen Zhang, Junhua Chen. Study on Customized Shuttle Transit Mode Responding to Spatiotemporal Inhomogeneous Demand in Super-Peak[J]. Inf. 2021, 12:429. DOI:10.3390/info12100429. (Code repository) 2021
  - **Paper's Contribution:** Proposed a customized shuttle bus transportation model to address instantaneous mega-traffic flows with uneven demand. The problem is formulated as a Pickup and Delivery Problem with Time Windows and Transfers (PDPTWT) and solved by a novel heuristic algorithm combining Tabu Search and ALNS. The method demonstrated significant computational speedup over commercial solvers and achieved substantial reductions in fleet cost, vehicle waiting time, and passenger waiting time in reality-based case studies.
  - **My Contribution:** Formulated the PDPTWT model and developed the hybrid ALNS-TS heuristic algorithm to solve it.
- **Hao Zheng**, Yun Wang*, Xuedong Yan, Yunwei Li. Dynamic Planning Model and Solution Algorithm for the Demand-responsive Customized Bus Route. World Transport Convention (WTC) Proceedings, 2021. (Code repository) 2021
  - **Paper's Contribution:** Developed a two-stage planning model and solution algorithm for customized bus services, enabling dynamic route adjustments to accommodate real-time passenger demands on top of existing static reservations.
  - **My Contribution:** Modified the core algorithm, implemented the solution in code, conducted computational case studies for validation, and was the primary author of the manuscript.

- Jiantao Li, Yian Zhao, **Hao Zheng**, Runhua Guo. Vehicle Vibration Modeling via Road profile Reconstruction and Simulation: Coupled Analysis of IRI, Speed, and Ride Comfort for Driving Assistance. Road Materials and Pavement Design. 2025
- Yuyan Tan, Yibo Li, Ruxin Wang, Xiwei Mi, Yaxuan Li, **Hao Zheng**, Yu Ke, Yan Wang. Improving Synchronization in High-Speed Railway and Air Intermodality: Integrated Train Timetable Rescheduling and Passenger Flow Forecasting. IEEE Transactions on Intelligent Transportation Systems. PP. 1-17. 10.1109/TITS.2021.3137410. 2022

- **Book**:
  - Huapu Lu, Fang Wang, et al., and **Hao Zheng**. *Green Development Strategies for Comprehensive Transportation in Ningxia.* 2024

Theses

- **Master Thesis:** A Comprehensive Full-Process Planning Model for Pavement Performance Forecasting and Maintenance Strategy Implementation under Missing Data Conditions. 06/2025
- **Undergraduate Thesis:** Customized Bus Planning Method Responding to Spatiotemporal Concentrated Demand in Super-peak. 06/2022

Skills

- **Programming Skills**: Proficient in MATLAB, C#, Python; Experienced with C++/CUDA and GAMS.
- **English Proficiency**: TOEFL: 112 (Reading: 30, Listening: 30, Speaking: 25, Writing: 27) 01/2025

Research Experience

- **A Bilevel Optimization Framework for Tolling Strategy in Autonomous Networks (Code Contribution)**: 06/2025 – 10/2025
  MIT-UF-NEU Summer Research Camp | Supervisor: Prof. Jinhua Zhao, Mentor: Dr. Xuan Jiang
  - Project: Understanding different cooperation patterns between AV companies and road infrastructure companies;
  - Designed and implemented an end-to-end bi-level optimization framework to find optimal tolling strategies by modeling the interaction between infrastructure operators and autonomous vehicle fleets;
  - Developed the upper-level model using Python to create an automated optimization loop that configures and executes a traffic simulator, processes results, and iteratively updates tolling policies based on revenue and congestion feedback;
  - Re-engineered a high-performance C++/CUDA traffic simulator to serve as the lower-level model, implementing toll-responsive logic and a cost-benefit analysis for agent lane-changing behavior;
  - Verified the framework's effectiveness while generating substantial revenue across various tested scenarios.

- **Digital Platform for Intelligent Road Asset Management (Code Writing: Prediction & Decision Models)**: 2023–2025
  Project: Research on Integration and Application of Intelligent Air-Ground Equipment in Digital Transportation Management
  - Developed the core algorithms for a comprehensive digital road asset management platform, built on a SpringBoot + VUE framework.
  - Designed and implemented the road performance prediction module, creating a deep learning model using GRU and Attention mechanisms that incorporates climate, traffic, and material data. Trained the model on the LTPP dataset.
  - Built the maintenance optimization module, which uses a mathematical model under dual budget and performance constraints to generate optimal, fine-grained maintenance strategies.

- **Strategic Framework for Green Transportation & Infrastructure Management (Researcher & Contributing Author)**: 2022–2024
  Project: Coordinating Ecological Protection with Carbon Peaking and Neutrality Goals in the Yellow River Basin | Supervisor: Prof. Runhua Guo
  - Analyzed infrastructure lifecycle management strategies, including intelligent inspection methods, pavement performance prediction, and maintenance decision-making models;
  - Under the primary guidance of Prof. Guo, authored two key chapters (Chapter 3: Green Construction; Chapter 4: Green Operations & Maintenance) of the project's resulting book, published by the China Communications Press.

- **Comparative Analysis of Road Design Standards for Belt and Road Projects (Research Analyst)**:
  Project: Differentiated Research on Engineering Projects along the Belt and Road: Sri Lanka | Supervisor: Prof. Runhua Guo *2023*
  - Conducted a comparative analysis of the standards for highway construction and acceptance between China and Sri Lanka to provide technical guidance for international projects;
  - Authored a technical report identifying critical differences in design parameters (e.g., standard axle loads, material specifications, reliability levels) to facilitate the adaptation of Chinese engineering practices abroad.

- **Optimizing Air-Rail Intermodal Transport: A Case Study of Daxing Airport (Project Leader)**:
  National University Student Innovation & Entrepreneurship Development Program | Supervisor: Prof. Yuyan Tan *2020 – 2022*
  - Led a student team to design a two-stage optimization framework aimed at improving the end-to-end efficiency of air-rail passenger transfers.
  - Formulated a multi-objective optimization model to adjust high-speed rail timetables, maximizing flight connection opportunities while minimizing schedule disruptions.
  - Designed a Customized Bus routing solution for the airport-station connection, modeling it as a VRPTWTS and developing a hybrid Adaptive Large Neighborhood Search and Tabu Search (ALNS-TS) algorithm to solve it.
  - Implemented the solution as the Multi-Type Customized Shuttle Bus Route Planning Software, for which I was granted a national software copyright as the sole holder (Reg. No. 2021SR1289113).
  - The project received a national-level award, and the research was accepted for publication in the World Transport Convention (WTC) proceedings.

Awards & Honors

- Second-Class Academic Excellence Scholarship, Tsinghua University 2024
- National Level Award, National University Student Innovation & Entrepreneurship Program 2022
- Outstanding Graduate of Beijing Municipality (Top 5%, 19/380) 06/2022
- National Software Copyright (Sole Holder), Reg. No. 2021SR1289113 2021
- Wu Fu-Zhenhua Transportation Education Excellent Student Award (Top 0.1%, 1/1520) 12/2021
- "Outstanding Student in Transportation", China Institute of Communications Education 11/2021
- Zhan Tianyou Scholarship (Top 0.2%, 2/1520) (Awarded Twice) 12/2021, 12/2020
- Zhixing Scholarship (President's Scholarship) (Top 0.1%, 10/16800) 12/2020
- University-Level Merit Student (Awarded Twice) 12/2021, 12/2020
- Excellent Academic Scholarship (Awarded Three Times) 12/2021, 12/2020, 12/2019