Hao Zheng

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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 in Progress

- **Accepted & Under Revision (1 Accepted, 2 Under Revision)**:
  - **Hao Zheng**, Han Zheng*, George Giannopoulos. KNOWCAST: Domain-Knowledge-Integrated Deep Learning for Metro OD and Path Flow Joint Forecasting. (Code repository) ***(Submitted to Transportation Research Part C)*** *(Major Revision: 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:** Led model development, coding, experimental validation, and manuscript writing.
  - **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 bespoke column-generation algorithm, demonstrating significant improvements in efficiency and computational speed over commercial solvers.
    - **My Contribution:** Led model development, coding, experimental validation, and manuscript writing.
  - Jiantao Li, Yian Zhao, **Hao Zheng**, Runhua Guo. Vehicle Vibration Modeling via Road Profile Reconstruction and Simulation. *(Submitted to Road Materials and Pavement Design)* *(Revised Manuscript submitted: 09/2025)*
- **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, thus bridging the gap between micro-behavioral theory and macro-empirical validity.
    - **My Contribution:** Led model development, coding, experimental validation, and manuscript writing.
  - **Hao Zheng**, Runhua Guo*. Multi-Staged Multi-Task Learning for Reliable Pavement Time-Series Prediction with Data Supplementation. (Working Title). (Code repository) *(To be submitted to Road Materials and Pavement Design, 10/2025)*
    - **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:** Led model development, coding, experimental validation, and manuscript writing.
  - **Hao Zheng**, Jiantao Li, Yian Zhao, Runhua Guo* , An Integrated Topology Reconstruction and Branch-and-Price Method for Maintenance-Vehicle Route Planning. (Code repository) *(To be submitted to International Journal of Pavement Engineering, 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.

Publications

- **Book**:
  - Huapu Lu, Fang Wang, Runhua Guo, Sa Xu, et al., and **Hao Zheng**. *Green Development Paths and Strategies for Comprehensive Transportation in Ningxia.* 2024
- **Published Journal & Conference Papers (3 Papers)**:
  - 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
  - **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:** Led model development, coding, experimental validation, and manuscript writing.
- **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. 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.

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

Open Source Projects

- **Projects continually updated on github.com/scholarhaozheng**:
    - **Python**: Pave-ML-Multi-Task Learning for Pavement Performance Indicators — Continuously maintained. Initial release: 2025
    - **Python**: Pavement Maintenance Decision-Making and a VRP Model for Execution — Continuously maintained. Initial release: 2025
    - **Python**: Dynamic Short-Term Prediction of Urban Rail Origin-Destination Flow — Continuously maintained. Initial release: 2024
    - **C#**: Hybrid Route Planning of Same-Day and Regular Deliveries in Space-Time Networks — Continuously maintained. Initial release: 2023
    - **MATLAB**: A Multi-Type Customized Shuttle Bus Route Planning Software — Continuously maintained. Initial release: 2021

Skills

- **Programming Skills**: Proficient in MATLAB, C#, Python; Experienced with C++ 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 (Student Researcher)**: 06/2025 – 10/2025
  MIT-UF-NEU Summer Research Camp | Supervisor: Prof. Jinhua Zhao, 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
    - Researched and formulated technical roadmaps for the resource utilization of solid waste in highway construction, focusing on recycled asphalt and industrial by-products;
    - 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 highway design standards between China and key Belt and Road countries (e.g., Sri Lanka, Pakistan) to provide technical guidance for international projects;
- Conducted a comparative analysis of the standards for highway construction and acceptance between China and Sri Lanka, with a focus on asphalt pavement design philosophies, to formulate conversion methods and investigate universal acceptance criteria;
- 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 upon completion, and the research was accepted for publication in the World Transport Convention (WTC) proceedings.