

Han Wang

Ph.D. in Autonomous Driving and Generative AI at Berkeley Artificial Intelligence Research

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Profile and Objective

Ph.D. candidate at the Berkeley Artificial Intelligence Research group with a focus on Autonomous Driving and Generative AI. Seeking a postdoctoral position to further explore intelligent transportation systems and vehicular automation technologies.

Education

University of California, Berkeley	<i>GPA 3.93/4.0</i>	CA, United States
Ph.D. in Transportation Engineering	<i>Advisor: Maria Laura Delle Monache</i>	08/2021 – 12/2024(Exp.)
M.S. in Electrical Engineering and Computer Science	<i>Advisor: Alexandre Bayen</i>	08/2023 – 12/2024(Exp.)
M.Eng. in Transportation Engineering	<i>Advisor: Alexander Skabardonis</i>	08/2020 – 05/2021
Relevant Courses: Deep Reinforcement Learning / Responsible GenAI and Decentralized Intelligence / Advanced Control System / Reproducible and Collaborative Statistical Data Science / Computer Vision / Immersive Computing and Virtual Reality / Foundations of Computer Graphics / Intelligent Transportation Systems / Data Driven Control Methods for Civil Systems / Highway Traffic Operations / Operation of Transportation Facilities / Systems Analysis in Transportation / Public Transportation Systems / Traffic Safety and Injury Control		
Southeast University	<i>GPA 85.75/100</i>	Nanjing, China
M.Eng. in Transportation Engineering	<i>Advisor: Jian Zhang, Bin Ran</i>	09/2017 – 05/2020
Southwest Jiaotong University	<i>GPA 80.27/100</i>	Chengdu, China
B.S. in Transportation Engineering		09/2013 – 06/2017

Research Experience

Congestion Impacts Reduction via CAV-in-the-loop Lagrangian Energy Smoothing (CIRCLES) **03/2022-12/2024**
World's largest open-track fieldtest, sending 100 auto-vehicle(AV)s to I-24 during the morning peak to improve traffic. Funded by Toyota, Nissan, and General Motors. Supported by Tennessee Department of Transportation

- **Role:** Led the centralized speed planner to publish the optimized speed for all 100 AVs in real-time during the experiment.
- **Tools:** RL Speed Planner: PyTorch, Ray, Gym | Backend: MySQL, Python | API: PHP
- **Outcome:** From the field test data, we observed an 8% improvement overall, with 7% and 10% improvements upstream and downstream, respectively, and a 52% improvement during congestion formation at the bottleneck.

Collision Indeterminacy Prediction via Stochastic Trajectory Generation **06/2023-06/2024**
Predicting the motion of AV with the pre-trained image generative model. Funded by Berkeley Deep Drive and Allstate

- **Role:** Lead the occupancy image dataset collecting, generative decoder pre-training, end-to-end training with perception encoder, the building of the simulation platform, and the design & training of the AV controller in the simulator.
- **Tools:** ML Model Design & Training: PyTorch, Ray | Simulation: SUMO | Dataset: Argoverse
- **Outcome:** Developed a probabilistic occupancy risk assessment (PORA) metric, validated through a scenario-generation-based microsimulation platform, demonstrated to be effective in predicting 87% of the conflicts that could not be predicted by TTC-2.

Creating an Inclusive Bicycle Level of Service: Virtual Bicycle Simulator study **01/2021-08/2023**
Gather user feedback on biking environments with VR simulator survey. Funded by California Department of Transportation

- **Role:** Built the VR biking simulator, including hardware & software integration. Rebuilt the California streets in 3D scenarios.
- **Tools:** Simulator Development: Unity, C#, SteamVR | Modeling: Blender
- **Outcome:** The feedback from the survey proved the VR simulator provided a more realistic and engaging experience for participants, which enhanced their ability to make informed decisions about their route preferences.

Opportunities and Challenges for Runtime Behavior Generation in Games and Simulations **09/2023-06/2024**
Runtime behavior generation using large language models in game/simulation development. Personal Project

- **Role:** Developed the runtime code compile module. Implemented the semantic search and prompt engineering of the agent. Develop the element tree system of test scenarios. Conducted generalization tests in various scenarios.
- **Tools:** System Development: Unity, C# | LLM: OpenAI API
- **Outcome:** The pressure test demonstrated the system in various game scenarios, achieving an 85% success rate. Thematic analysis of developer feedback indicates the improved dynamic game experience by integrating real-time behavior generation.

V2X-based Driving Perception Assistance System

09/2023-12/2024

Integration of foundation models and AR to enhance driving assistance systems via real-time visual aids Personal Project

• **Role:** Designed and implemented a system integrating multimodal data (Lidar, cameras, maps, traffic updates) for real-time driving assistance. Developed AR visual aids for 3D object tracking and scene reconstruction. Utilized specialized LLMs for script generation and natural language interaction.

• **Tools:** System Development: Unity, C#, OpenCV | LLM: Ollama, LiteLLM

• **Outcome:** Achieved accurate 3D object tracking and reconstruction, enhancing driver situational awareness and safety through real-time AR visualizations. Refined functionality through human-in-loop interactions and driver feedback. Integrated foundation models for natural language command interpretation and script generation, improving adaptability and usability.

Vision-based Browser Automation using GenAI

01/2024-12/2024

Automating browser workflows using multimodal LLM agents. Personal Project

• **Role:** Finetuned open-source LLMs with RAG for browser operation subtasks. Developed vision + HTML webpage scraper. Defined and implemented multi-agent workflow. Develop the browser operation API kit for LLM. Developed the Chrome extension for human-in-loop expert data collecting. Created the open dataset on HuggingFace.

• **Tools:** Finetune: Unsloth | Agent: Ollama, LangChain, LiteLLM

• **Outcome:** Enhanced automation stability and adaptability to website layout changes, enabling complex workflow automation across multiple sites. Integrated real-time debugging and visualization of automation steps, facilitating efficient troubleshooting.

Crowdsourcing Perceived Hazardous Pedestrian Locations

09/2020-05/2021

SafeTport: An IOS App allowing users to report and view traffic hazards and crashes.

Funded by SafeTREC

• **Role:** Developed the front-end and back-end of the system independently.

• **Tools:** IOS APP: Swift, Google Map Platform | Backend: MySQL, AWS, Restful API

• **Outcome:** Created a functional application, identified marketing strategy in user engagement and data collection.

Research on Multi-junction Energy-saving Access Control of Intelligent Electric Vehicles

07/2017-12/2020

Developed control models and simulations for energy-saving access control in intelligent electric vehicles. Funded by SEU

• **Role:** Established a multi-agent control model using improved MADDPG algorithm for multi-intersections urban arterial in a connected environment. Designed traffic and communication network simulations using SUMO, OMNET++.

• **Tools:** Controller: TensorFlow | Simulation: SUMO, OMNET++

Resilience Research for Extremely Surging Traffic of Huning (Shanghai-Nanjing) Highway

03/2017-12/2019

Analyze and improve the resilience of the Huning Highway system under extremely large traffic flow

Funded by Joint Research Institute on Internet of Mobility: Southeast University and University of Wisconsin

• **Role:** Led the establishment of the SUMO micro-simulation scenario for the entire Huning Highway. Designed the ramp control algorithm based on deep reinforcement learning.

• **Tools:** Simulation: SUMO | Ramp Controller: keras

Course Design of the Traffic Analysis I Driven by Big Data

01/2019-12/2019

Enhanced traditional traffic analysis course content with data mining skills.

Funded by Didi Chuxing Technology Co.

• **Role:** Added data mining related skills to the traditional traffic analysis course content. Designed course paper requirements integrating data of the GAIA Initiative from Didi.

Skills

Programming Languages:

Python, C#

Backends:

MySQL, AWS

Frameworks and Libraries:

PyTorch, Ray, Ollama, LiteLLM, Unsloth, OpenCV

Simulation and Modeling:

Unity, SteamVR, Blender, SUMO

Publications

- Lee, J. W., **Wang, H.**, Jang, K., Hayat, A., Bunting, M., Alanqary, A., ... (64 authors) & Bayen, A. M. (2024). Traffic control via connected and automated vehicles: An open-road field experiment with 100 cavs. Accepted by IEEE CSM Special Issue Sept. 2024. arXiv preprint arXiv:2402.17043.
- **Wang, H.**, Fu, Z., Lee, J., Matin, H. N. Z., Alanqary, A., Urieli, D., ... (17 authors) & Monache, M. L. D. (2024). Hierarchical speed planner for automated vehicles: A framework for lagrangian variable speed limit in mixed autonomy traffic. Accepted by IEEE CSM Special Issue Sept. 2024. arXiv preprint arXiv:2402.16993.
- **Wang, H.**, Nick Zinat Matin, H., & Delle Monache, M. L. (2024, June). Reinforcement learning-based adaptive speed controllers in mixed autonomy condition. In 2024 European Control Conference (ECC) (pp. 01-06). IEEE.
- Chekroun, R., **Wang, H.**, Lee, J., Toromanoff, M., Hornauer, S., Moutarde, F., & Monache, M. L. D. (2024). Mesoscale

Traffic Forecasting for Real-Time Bottleneck and Shockwave Prediction. arXiv preprint arXiv:2402.05663.

- Fu, Z., Kreidieh, A. R., **Wang, H.**, Lee, J. W., Delle Monache, M. L., & Bayen, A. M. (2023, June). Cooperative driving for speed harmonization in mixed-traffic environments. In 2023 IEEE Intelligent Vehicles Symposium (IV) (pp. 1-8). IEEE.
- **Wang, H.**, Wu, H., Lu, J., Tang, F., & Delle Monache, M. L. (2023, September). Communication Optimization for Multi-agent Reinforcement Learning-based Traffic Control System with Explainable Protocol. In 2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC) (pp. 6068-6073). IEEE.
- **Wang, H.**, & Delle Monache, M. L. (2022, July). Urban network resilience analysis and equity emphasized recovery based on reinforcement learning. In 2022 European Control Conference (ECC) (pp. 01-06). IEEE.
- Zhang, J., Dong, S., Li, Z., Ran, B., Li, R., & **Wang, H.** (2019). An eco-driving signal control model for divisible electric platoons in cooperative vehicle-infrastructure systems. IEEE Access, 7, 83277-83285.
- Tang, F., Cheng, L., **Wang, H.**, Mao, P., & Jiang, J. (2019). Research on the Impact of Car-Hailing on Travel Mode Choice: Evidence from Chengdu, China. In CICTP 2019 (pp. 6134-6145).
- Dong, S. Y., Zhang, J., **Wang, H.**, Ran, B., & Tan, H. C. (2018, July). A speed guidance-based signal control method for divisible platoon in CVIS. In 2018 IEEE 8th Annual International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (CYBER) (pp. 1403-1408). IEEE.
- Dong, S. Y., Zhang, J., Chen, T. Y., **Wang, H.**, & Ran, B. (2018, July). CVIS-Based Intersection Signal Control Model for Indivisible Platoons. In 18th COTA International Conference of Transportation Professionals (pp. 359-368). Reston, VA: American Society of Civil Engineers.

Thesis

Thesis Title: *Scalable Distributed Control for Large-Scale Multi-Agent Systems*

December 2024

Degree: Ph.D. in Transportation Engineering

University of California, Berkeley, CA

Objective: To develop and validate a scalable distributed control framework that employs hierarchical and distributed control to optimize operation efficiency in large-scale multi-agent systems. The application goal is to integrate real-time data and machine learning algorithms to control the speed limits system, enhancing traffic efficiency and reducing fuel consumption.

Thesis Title: *Multi-Agent Reinforcement Learning Method for Arterial Traffic Signal Control*

May 2020

Degree: M.Eng. in Transportation Engineering

Southeast University, Nanjing, China

Objective: To address the complexity of coordinating multi-intersection arterial traffic signal control systems by implementing a reinforcement learning approach that effectively manages the delayed reward dynamics inherent in such environments.

Professional Service & Teaching

• Member and Reviewer of:

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| - IEEE Membership | - Reviewer for |
| - Intelligent Transportation Systems Society | - Transportation Research |
| - Control Systems Society | - Transactions on Intelligent Transportation Systems |
| - Robotics and Automation Society | - European Control Conference |

• Teaching Assistant of:

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| - CE265 Traffic Safety at UCB | - Advanced Mathematics I&II at SEU | - Traffic Analysis I at SEU |
| - Assisted in designing course material | - Conducted weekly recitation sessions | - Assisted in preparing lecture |
| - Led lab sessions and discussions about VR and crowdsourcing | - Provided one-on-one tutoring | - Facilitated student group projects |
| - Graded assignments and exams | - Developed supplementary learning materials | - Evaluated student performance through quizzes and exams |

Honors

- 2nd Prize Scholarship of Southeast University - 3 times (2017-2019)
- 3rd Prize of the National Cup Graduate Mathematical Contest in Modeling (2017)
- 3rd Prize of the Undergraduate Transportation Science and Technology Competition, SWJTU (2016)
- 1st Prize of the National Higher Education Association Cup Mathematical Contest in Modeling, Sichuan Province (2015)
- 3rd Prize Scholarship of Southwest Jiaotong University (2014)