

# Han Wang

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## Profile

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Ph.D. candidate at the Berkeley Artificial Intelligence Research(BAIR) and Berkeley Deep Drive(BDD), focusing on Self-Driving, Human-AI Interaction, and Multi-Agent Reinforcement Learning. Personal hobby projects involve AR/VR + GenAI.

## Education

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<b>University of California, Berkeley</b>	<i>GPA 3.93/4.0</i>	<b>CA, United States</b>
Ph.D. in Transportation Engineering	<i>Advisor: Maria Laura Delle Monache</i>	08/2021 – Present
M.S. in Electrical Engineering and Computer Science	<i>Advisor: Alexandre Bayen</i>	08/2023 – Present
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		
<b>Southeast University</b>	<i>GPA 85.75/100</i>	<b>Nanjing, China</b>
M.Eng. in Transportation Engineering	<i>Advisor: Jian Zhang, Bin Ran</i>	09/2017 – 05/2020
<b>Southwest Jiaotong University</b>	<i>GPA 80.27/100</i>	<b>Chengdu, China</b>
B.S. in Transportation Engineering		09/2013 – 06/2017

## Research Experience

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### **Perception, Prediction and Control of Collision Indeterminacy via Stochastic Generation** **06/2023-Present**

*Predicting the motion of AV with the **pre-trained image generative model**. Funded by Berkeley Deep Drive and Allstate*

- **Role:** Data fusion and comprehensive perception based on the onboard sensor array. 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.

### **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:** Reinforcement Learning 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.

### **Understanding Resilience and Equity of Transportation System During Hazardous Events** **07/2021-12/2024**

*An **equity-focused resilience framework** for urban transportation. Funded by California Department of Transportation*

- **Role:** Designed a social-physical integrated evaluation index to quantify resilience and equity, integrating social equity considerations with system resilience to ensure equitable recovery for underserved communities. Formulated recovery strategies as a Markov Decision Process (MDP) and implemented reinforcement learning (RL) algorithms using Actor-Critic methods. Conducted large-scale simulations of the San Francisco Bay Area transportation network, leveraging GMNS and OpenStreetMap data to validate the framework's scalability and effectiveness.
- **Tools:** Network Modeling: GMNS, OpenStreetMap | Simulation: Python, TensorFlow | RL Algorithm: Actor-Critic
- **Outcome:** Achieved a significant reduction in inequity penalties, enhancing recovery performance by 13.8% over capacity-based strategies and 26.3% over population-based strategies. Results demonstrated effective prioritization and equitable recovery under various hazard scenarios.

- 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.

# Publications

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## Peer-reviewed Journal Articles

- Lee, J. W., **Wang, H.(co-first)**, Jang, K., Hayat, A., Bunting, M., Alanqary, A., ... (64 authors) & Bayen, A. M. (2025). Traffic control via connected and automated vehicles: An open-road field experiment with 100 cavs. *IEEE Control Systems*, 45(1), 28-60.
- **Wang, H.**, Fu, Z., Lee, J., Matin, H. N. Z., Alanqary, A., Urieli, D., ... (17 authors) & Monache, M. L. D. (2025). Hierarchical speed planner for automated vehicles: A framework for lagrangian variable speed limit in mixed autonomy traffic. *IEEE Control Systems*, 45(1), 111-138.
- Ameli, M., McQuade, S., Lee, J. W., Bunting, M., Nice, M., **Wang, H.**, ... & Bayen, A. M. (2025). Designing, simulating, and performing the 100-av field test for the circles consortium: Methodology and implementation of the largest mobile traffic control experiment to date. *IEEE Control Systems*, 45(1), 139-155.
- 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.

## Conference Papers

- (Best Paper Award) Jennings, N., **Wang, H.**, Li, I., Smith, J., & Hartmann, B. (2024, October). What's the Game, then? Opportunities and Challenges for Runtime Behavior Generation. In *Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology* (pp. 1-13).
- Veksler, Y., Hornstein, S., **Wang, H.**, Monache, M. L. D., & Urieli, D. (2024). Cooperative Cruising: Reinforcement Learning based Time-Headway Control for Increased Traffic Efficiency. Accepted by AAAI2025, arXiv preprint arXiv:2412.02520.
- **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.
- 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.
- 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.

## Pre-prints

- **Wang, H.**, Yeo, Y., Paiva, A. R., Utke, J., Monache, M. L. D. (2025). Modular framework for uncertainty prediction in autonomous vehicle motion prediction within complex traffic scenarios. Submitted to *IEEE Transactions on Intelligent Transportation Systems*. arXiv preprint arXiv:2501.16480.
- Tang, F., **Wang, H.**, & Monache, M. L. D. (2024). Strategizing Equitable Transit Evacuations: A Data-Driven Reinforcement Learning Approach. Submitted to *Transportation Research Part C: Emerging Technologies*. arXiv preprint arXiv:2412.05777.
- 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. Submitted to *Transportation Research Part C: Emerging Technologies*. arXiv preprint arXiv:2402.05663.

## Thesis

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

**Degree:** Ph.D. in Transportation Engineering

**May 2025**

**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.

## Skills

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### Programming Languages:

Python, C#

### Backends:

MySQL, AWS

### Frameworks and Libraries:

PyTorch, Ray, OpenCV, Ollama, Unsloth, LangChain

### Simulation and Modeling:

Unity, SteamVR, Blender, SUMO

## Honors

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- Best Paper Award: 37th Annual ACM Symposium on User Interface Software and Technology (ACM UIST 2024)
- IEEE ITSC 2024 Institutional Lead Award - CIRCLES Consortium
- 2<sup>nd</sup> Award Scholarship of Southeast University - 3 times (2017-2019)
- 3<sup>rd</sup> Award of the National Cup Graduate Mathematical Contest in Modeling (2017)
- 3<sup>rd</sup> Award of the Undergraduate Transportation Science and Technology Competition, SWJTU (2016)
- 1<sup>st</sup> Award of the National Higher Education Association Cup Mathematical Contest in Modeling, Sichuan Province (2015)
- 3<sup>rd</sup> Award Scholarship of Southwest Jiaotong University (2014)

## Professional Service & Teaching

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- Member and Reviewer of:

- IEEE Membership

- Intelligent Transportation Systems Society

- Control Systems Society

- Robotics and Automation Society

- Reviewer for

- Transportation Research Series

- Transactions on Intelligent Transportation Systems

- European Control Conference

- Teaching Assistant of:

- CE265 Traffic Safety at UCB

- Assisted in designing course material

- Led lab sessions and discussions about VR and crowdsourcing

- Graded assignments and exams

- Advanced Mathematics I&II at SEU

- Conducted weekly recitation sessions

- Provided one-on-one tutoring

- Developed supplementary learning materials

- Traffic Analysis I at SEU

- Assisted in preparing lecture

- Facilitated student group projects

- Evaluated student performance through quizzes and exams