Han Wang

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Profile

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

University of California, Berkeley	*GPA 3.93/4.0*	**CA, United States**
Ph.D. in Transportation Engineering	*Advisor: Maria Laura Delle Monache*	08/2021 – Present
M.S. in Electrical Engineering and Computer Science	*Advisor: Alexandre Bayen*	08/2023 – Present
M.Eng. in Transportation Engineering	*Advisor: Alexander Skabardonis*	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	*GPA 85.75/100*	**Nanjing, China**
M.Eng. in Transportation Engineering	*Advisor: Jian Zhang, Bin Ran*	09/2017 – 05/2020

Southwest Jiaotong University	*GPA 80.27/100*	**Chengdu, China**
B.S. in Transportation Engineering		09/2013 – 06/2017

Research Experience

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*
• <u>Role:</u> 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.
• <u>Tools:</u> ML Model Design & Training: PyTorch, Ray | Simulation: SUMO | Dataset: Argoverse
• <u>Outcome:</u> 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
• <u>Role:</u> Led the centralized speed planner to publish the optimized speed for all 100 AVs in real-time during the experiment.
• <u>Tools:</u> Reinforcement Learning Speed Planner: PyTorch, Ray, Gym | Backend: MySQL, Python | API: PHP
• <u>Outcome:</u> 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*
• <u>Role:</u> 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.
• <u>Tools:</u> Network Modeling: GMNS, OpenStreetMap | Simulation: Python, TensorFlow | RL Algorithm: Actor-Critic
• <u>Outcome:</u> 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

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

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 feul 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

Programming Languages:
Python, C#

Backends:
MySQL, AWS

Frameworks and Libraries:
PyTorch, Ray, OpenCV, Ollama, Unsloth, LangChain

Simulation and Modeling:
Unity, SteamVR, Blender, SUMO

Honors

- Best Paper Award: 37th Annual ACM Symposium on User Interface Software and Technology (ACM UIST 2024)
- IEEE ITSC 2024 Institutional Lead Award - CIRCLES Consortium
- 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)

Professional Service & Teaching

- 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