Xishun Liao

Research Scientist, Department of Civil and Environmental Engineering,

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Updated on Oct. 2024

RESEARCH INTEREST

1) Designing and Implementing AI-Powered Cyber-Physical Systems for Safe, Efficient and Sustainable Transportation System
2) Advancing Data-Driven Urban Mobility/Vehicular System Modeling and Automation
3) Developing Human-Centric AI and Personalized Mobility Solutions

EDUCATION

Ph.D. in Electrical and Computer Engineering   *Apr. 2019 - Jun. 2023*

University of California, Riverside

- Advisors: Dr. Matthew Barth and Dr. Guoyuan Wu
- Dissertation: A Personalized Behavior-Aware Motion Planning Framework for Intelligent Vehicles Operation

M.E. in Mechanical Engineering   *Jan. 2017- Dec. 2018*

University of Maryland, College Park

- Advisor: Dr. Nikhil Chopra
- Areas of Expertise: Control System

B.E. in Mechanical Engineering and Automation   *Sep. 2012 - Jun. 2016*

Beijing University of Posts and Telecommunications

EMPLOYMENT

University of California, Los Angeles, CA

- Research Scientist (Advisor: Dr. Jiaqi Ma)   *Oct. 2024 - Present*
- Postdoctoral Scholar (Advisor: Dr. Jiaqi Ma)   *Aug. 2023 - Sep. 2024*

University of California, Riverside, CA

- Graduate Researcher (Advisors: Dr. Matthew Barth and Dr. Guoyuan Wu)   *Apr. 2019 - Jun. 2023*

Honda Research Institute USA, San Jose, CA

- Research Intern (Mentors: Dr. Teruhisa Misu and Dr. Shashank Mehrotra)   *Sep. 2021 - Mar. 2022*

PUBLICATIONS

Journal publications

[J12] A Review of Personalization in Driving Behavior: Dataset, Modeling, and Validation

- **Xishun Liao**[*1], Zhouqiao Zhao, Matthew J. Barth, Amr Abdelraouf, Rohit Gupta, Kyungtae Han, Jiaqi Ma, and Guoyuan Wu
- *IEEE Transactions on Intelligent Vehicles*, 2024 (Early Access)

[J11] Game Theoretic Application to Intersection Management: A Literature Review

- Ziye Qin, Ang Ji, Zhanbo Sun*, Guoyuan Wu, Peng Hao, and **Xishun Liao**
- *IEEE Transactions on Intelligent Vehicles*, 2024 (Early Access)

[J10] Mobility AI Agents and Networks

- Haoxuan Ma, Yifan Liu, Qinhua Jiang, Brian Yueshuai He, **Xishun Liao***, and Jiaqi Ma
- *IEEE Transactions on Intelligent Vehicles*, vol. 9, no. 7, Jul. 2024, pp. 5124-5129

[J9] Foundation Intelligence for Smart Infrastructure Services in Transportation 5.0

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[1]* The corresponding author

- Xu Han, Zonglin Meng, Xin Xia, **Xishun Liao**, Yueshuai He, Zhaoliang Zheng, Yutong Wang, Hao Xiang, Zewei Zhou Letian Gao, Lili Fan, Yuke Li, and Jiaqi Ma*
- *IEEE Transactions on Intelligent Vehicles*, vol. 9, no. 1, Jan. 2024, pp. 39-47

[J8] Driver Digital Twin for Online Prediction of Personalized Lane Change Behavior
- **Xishun Liao***, Xuanpeng Zhao, Ziran Wang, Zhouqiao Zhao, Kyungtae Han, Rohit Gupta, Matthew J. Barth, and Guoyuan Wu
- *IEEE Internet of Things Journal*, vol. 10, no. 15, Aug. 2023, pp. 13235–13246.

[J7] A Real-World Data-Driven Approach for Estimating Environmental Impacts of Traffic Accidents
- **Xishun Liao***, Guoyuan Wu, Lan Yang, and Matthew J. Barth
- *Transportation Research Part D: Transport and Environment*, vol. 117, Apr. 2023, p. 103664

[J6] Evaluating Cybersecurity Risks of Cooperative Ramp Merging in Mixed Traffic Environments
- Xuanpeng Zhao, Ahmed Abdo, **Xishun Liao**, Matthew J. Barth, and Guoyuan Wu*
- *IEEE Intelligent Transportation Systems Magazine*, vol. 14, no. 6, Nov.-Dec. 2022, pp. 52-65

[J5] Game Theory-Based Ramp Merging for Mixed Traffic with Unity-SUMO Co-Simulation
- **Xishun Liao***, Xuanpeng Zhao, Ziran Wang, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 52, no. 9, Sep. 2022, pp. 5746–5757.

[J4] Cooperative Ramp Merging Design and Field Implementation: A Digital Twin Approach Based on Vehicle-to-Cloud Communication
- **Xishun Liao***, Ziran Wang, Xuanpeng Zhao, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *IEEE Transactions on Intelligent Transportation Systems*, vol. 23, no. 5, May 2022, pp. 4490–4500

[J3] Co-Simulation Platform for Modeling and Evaluating Connected and Automated Vehicles and Human Behavior in Mixed Traffic
- Xuanpeng Zhao, **Xishun Liao**, Ziran Wang, Guoyuan Wu, Matthew J. Barth, Kyungtae Han, and Prashant Tiwari
- *SAE International Journal of Connected and Automated Vehicles*, vol. 5, no. 4, Apr. 2022

[J2] A Systematic Review of Autonomous Emergency Braking System: Impact Factor, Technology, and Performance Evaluation
- Lan Yang, Yipeng Yang*, Guoyuan Wu*, Xiangmo Zhao, Shan Fang, **Xishun Liao**, Runmin Wang, and Mengxiao Zhang
- *Journal of Advanced Transportation*, vol. 2022, Article ID 1188089, Apr. 2022

[J1] Driver Behavior Modeling using Game Engine and Real Vehicle: A Learning-Based Approach
- Ziran Wang*, **Xishun Liao**, Chao Wang, David Oswald, Guoyuan Wu, Kanok Boriboonsomsin, Matthew J. Barth, Kyungtae Han, BaekGyu Kim, and Prashant Tiwari
- *IEEE Transactions on Intelligent Vehicles*, vol. 5, no. 4, Dec. 2020, pp. 738–749

Conference Publications

[C19] NUMOSIM: A Synthetic Mobility Dataset with Anomaly Detection Benchmarks (Accepted)
- Chris Stanford, Suman Adari, **Xishun Liao**, Yueshuai He, Qinhua Jiang, Chenchen Kuai, Jiaqi Ma, Emmanuel Tung, Yinlong Qian, Lingyi Zhao, Zihao Zhou, Zeeshan Rasheed, and Khurram Shafique
- *32nd ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (ACM SIGSPATIAL)* Atlanta, GA, USA, 2024

[C18] Semantic Trajectory Data Mining with LLM-Informed POI Classification **(Best Paper Award)**
- Yifan Liu, Chenchen Kuai, **Xishun Liao***, Haoxuan Ma, Brian Yueshuai He, and Jiaqi Ma
- *IEEE 27th International Conference on Intelligent Transportation Systems (ITSC), Edmonton, Canada, 2024*

[C17] Reconstructing Human Mobility Pattern: A Semi-Supervised Approach for Cross-Dataset Transfer Learning (Accepted)
- **Xishun Liao,** Qinhua Jiang, Yifan Liu, Haoxuan Ma, Chenchen Kuai, Brian Yueshuai He, Shangqing Cao, Chris Stanford, and Jiaqi Ma*
- *Transportation Research Board 104th Annual Meeting*, Washington D.C., Jan. 2025

[C16] Human Mobility Modeling with Limited Information via Large Language Models (Accepted)

- Yifan Liu, **Xishun Liao***, Haoxuan Ma, Brian Yueshuai He, Chris Stanford, and Jiaqi Ma
- *Transportation Research Board 104th Annual Meeting*, Washington D.C., Jan. 2025

[C15] An Attention-Based Multi-Context Convolutional Encoder-Decoder Neural Network for Work Zone Traffic Impact Prediction (Accepted)

- Qinhua Jiang, **Xishun Liao***, Yaofa Gong, and Jiaqi Ma
- *Transportation Research Board 104th Annual Meeting*, Washington D.C., Jan. 2025

[C14] Deep Activity Model: A Generative Deep Learning Approach for Human Mobility Pattern Synthesis

- Brian Yueshuai He, **Xishun Liao**, Qinhua Jiang, Chenchen Kuai, Jiaqi Ma*
- *Transportation Research Board 103rd Annual Meeting*, Washington D.C., Jan. 2024

[C13] Exploring Vehicular Interaction from Trajectories Based on Granger Causality

- **Xishun Liao***, Guoyuan Wu, Matthew J. Barth, Rohit Gupta, and Kyungtae Han
- *2023 IEEE Intelligent Vehicles Symposium (IV),* Anchorage, AK, USA, Jun. 2023

[C12] Inverse Reinforcement Learning and Gaussian Process Regression-based Real-time Framework for Personalized Adaptive Cruise Control

- Zhouqiao Zhao*, **Xishun Liao**, Amr Abdelraouf, Kyungtae Han, Rohit Gupta, Matthew J. Barth, Guoyuan Wu
- *2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC),* Bilbao, Bizkaia, Spain, Sep. 2023

[C11] Improving Truck Merging at Ramps in a Mixed Traffic Environment: A Multi-human-in-the-loop (MHuiL) Approach

- Xuanpeng Zhao*, **Xishun Liao**, Guoyuan Wu, Kanok Boriboonsomsin, Matthew J. Barth
- *2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC),* Bilbao, Bizkaia, Spain, Sep. 2023

[C10] Real-time Learning of Driving Gap Preference for Personalized Adaptive Cruise Control

- Zhouqiao Zhao*, **Xishun Liao**, Amr Abdelraouf, Kyungtae Han, Rohit Gupta, Matthew J. Barth, Guoyuan Wu
- *2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC),* Honolulu, Oahu, HI, USA, Oct. 2023

[C9] Driver Digital Twin for Online Prediction of Personalized Lane Change Behavior

- **Xishun Liao***, Xuanpeng Zhao, Ziran Wang, Zhouqiao Zhao, Kyungtae Han, Rohit Gupta, Matthew J. Barth, and Guoyuan Wu
- *Transportation Research Board 102nd Annual Meeting*, Washington D.C., Jan. 2023

[C8] Driver Profile Modeling Based on Driving Style, Personality Traits, and Mood States

- **Xishun Liao***, Shashank Mehrotra, Samson Ho, Yuki Gorospe, Xingwei Wu, and Teruhisa Mistu
- *2022 IEEE 25th International Conference on Intelligent Transportation Systems (ITSC),* Macau, China, Oct. 2022

[C7] Online Prediction of Lane Change with a Hierarchical Learning-Based Approach

- **Xishun Liao***, Ziran Wang, Xuanpeng Zhao, Zhouqiao Zhao, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *2022 International Conference on Robotics and Automation (ICRA),* Philadelphia, PA, USA, May 2022

[C6] Estimating the Impacts of Automatic Emergency Braking Technology on Traffic Energy and Emissions

- **Xishun Liao***, Guoyuan Wu, Lan Yang, Matthew J. Barth
- *Transportation Research Board 101st Annual Meeting*, Washington D.C., Jan. 2022

[C5] A Game Theory Based Ramp Merging Strategy for Connected and Automated Vehicles in the Mixed Traffic: A Unity-SUMO Integrated Platform

- **Xishun Liao***, Xuanpeng Zhao, Guoyuan Wu, Matthew J. Barth, Ziran Wang, Kyungtae Han, and Prashant Tiwari
- *Transportation Research Board 100th Annual Meeting*, Virtual Conference, Jan. 2021

[C3] Cooperative Ramp Merging with Vehicle-to-Cloud Communications: A Field Experiment

- **Xishun Liao***, David Oswald, Ziran Wang, Guoyuan Wu, Kanok Boriboonsomsin, Matthew J. Barth, Kyungtae Han, BaekGyu Kim, and Prashant Tiwari

- *Transportation Research Board 99th Annual Meeting*, Washington D.C., Jan. 2020

[C2] End-to-End Vision-Based Adaptive Cruise Control (ACC) Using Deep Reinforcement Learning

- Zhensong Wei*, Yu Jiang, **Xishun Liao**, Xuewei Qi, Ziran Wang, Guoyuan Wu, Peng Hao, and Matthew J. Barth
- *Transportation Research Board 99th Annual Meeting*, Washington D.C., Jan. 2020

[C1] A Digital Twin Paradigm: Vehicle-to-Cloud Based Advanced Driver Assistance Systems

- Ziran Wang*, **Xishun Liao**, Xuanpeng Zhao, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *IEEE 91st Vehicular Technology Conference (VTC2020-Spring),* Virtual Conference, May 2020

Under Review Submission

[J13] Deep Activity Model: A Generative Approach for Human Mobility Pattern Synthesis

- **Xishun Liao**, Brian Yueshuai He, Qinhua Jiang, Yifan Liu, Chenchen Kuai, and Jiaqi Ma*
- Submitted to *IEEE Transactions on Intelligent Transportation Systems*

Book Chapter

[B1] Driver Behavior-Aware Cooperative Ramp Merging for Intelligent Vehicles

- **Xishun Liao***, Xuanpeng Zhao, Ziran Wang, Matthew J. Barth, Guoyuan Wu, and Kyungtae Han
- Towards Human-Vehicle Harmonization, vol. 3, pp. 193 – 210, De Gruyter

Technical Report

[R2] Connectivity-Based Cooperative Ramp Merging in Multimodal and Mixed Traffic Environment

- Guoyuan Wu*, Xuanpeng Zhao, **Xishun Liao**, Kanok Boriboonsomsin, Matthew J. Barth
- No. PSR-21-20. METRANS Transportation Center in California, 2022.

[R1] Estimating the Impacts of Automatic Emergency Braking (AEB) Technology on Traffic Energy and Emissions

- Guoyuan Wu*, **Xishun Liao**, Lan Yang, Matthew J. Barth
- No. PSR-MT-19-26-a. Pacific Southwest Region University Transportation Center (UTC), 2021.

Patent

[P1] Profile modeling

- **Xishun Liao**, Shashank Mehrotra, Chun-Ming Samson Ho, and Teruhisa Misu
- U.S. patent application 17/869,426, Filed Jul. 2022, Published Jan. 2024

PARTICIPATED FUNDED PROJECTS

Hidden ActivitY Signal and Trajectory Anomaly Characterization (HAYSTAC)

- Sponsor: The Intelligence Advanced Research Projects Activity (IARPA) at Office of the Director of National Intelligence.
- Partners: IARPA, Novateur Research Solutions, University of California, Berkeley, and University of Minnesota, Twin Cities.
- Fund received: $1,820,000
- Period: May. 2023 - Present

Evaluating Connected Vehicle Applications in a Mixed Traffic Environment using a "Digital Twin" Approach

- Sponsor: Toyota Motor North America
- Fund received: $320,000
- Period: Oct. 2019 – 2023

Connectivity-Based Cooperative Ramp Merging in Multimodal and Mixed Traffic Environment

- Sponsor: U.S. Department of Transportation
- Partner: University of Southern California
- Fund received: $70,000
- Period: Sep. 2021 - Sep. 2022

Estimating the Impacts of Automatic Emergency Braking (AEB) Technology on Traffic Energy and Emissions

- Sponsor: METRANS Transportation Center
- Partner: University of Southern California
- Fund received: $70,000
- Period: Jul. 2020 - Jul. 2021

USDOT-JPO Data Program Research: Data for Artificial Intelligence (AI)

- Sponsor: U.S. Department of Transportation Joint Program Office
- Period: Sep. 2023 - Sep. 2024

PROFESSIONAL ACTIVITIES

As a Reviewer

Reviewer of *MDPI Sensors*	*Sep. 2024 - Present*
Reviewer of *Scientific Reports*	*Aug. 2024 - Present*
Reviewer of *Mechanical Systems and Signal Processing*	*Jul. 2023 - Present*
Reviewer of *Proceedings of the Institution of Mechanical Engineers, Part D*	*Jun. 2023 - Present*
Reviewer of *IEEE International Conference on Systems, Man, and Cybernetics (SMC)*	*May 2023 – Present*
Reviewer of *International Conference on Intelligent Robots and Systems*	*Apr. 2023 – Present*
Reviewer of *IEEE Internet of Things Journal*	*Jan. 2023 - Present*
Reviewer of *IEEE Transactions on Intelligent Transportation Systems*	*Nov. 2022 - Present*
Reviewer of *Engineering Applications of Artificial Intelligence*	*Oct. 2022 - Present*
Reviewer of *Frontiers in Sustainable Cities*	*Apr. 2022 - Present*
Reviewer of *IEEE Transactions on Intelligent Vehicles*	*Apr. 2022 - Present*
Reviewer of *IEEE Robotics and Automation Letters*	*Mar. 2022 - Present*
Reviewer of *SAE China Event Technical Papers*	*Mar. 2022 – Present*
Reviewer of *IEEE Vehicular Technology Conference*	*Feb. 2022 - Present*
Reviewer of *IEEE Open Journal of Intelligent Transportation Systems*	*Jan. 2022 - Present*
Reviewer of *IET Intelligent Transport Systems*	*Jun. 2021 - Present*
Reviewer of *SAE International Journal of Connected and Automated Vehicles*	*Jul. 2020 - Present*
Reviewer of *IEEE International Conference on Intelligent Transportation Systems (ITSC)*	*Apr. 2020 - Present*
Reviewer of *IEEE Intelligent Vehicles Symposium*	*Apr. 2020 - Present*
Reviewer of *Transportation Research Record (TRR)*	*Feb. 2020 - Present*
Reviewer of *TRB Annual Meeting*	*Sep. 2019 – Present*

As a Committee/Member

Friend of Transportation Research Board (TRB) Standing Committee on Artificial Intelligence and Advanced Computing Applications	
	Jan. 2024 – Present
Member of Association for Computing Machinery (ACM)	*Oct. 2024 - Present*
Review Editor of Frontiers in Sustainable Cities	*Apr. 2022 - Present*
Friend of Transportation Research Board (TRB) Standing Committee: Vehicle-Highway Automation	*Jan. 2021 – Present*
Friend of Transportation Research Board (TRB) Standing Committee on Intelligent Transportation Systems	*Jan. 2021 – Present*
Member of Intelligent Transportation Systems Society (ITSS), IEEE	*Sep. 2020 - Present*
Member of Institute of Electrical and Electronics Engineers (IEEE)	*Sep. 2020 - Present*

As a Volunteer

Session Chair of *2022 IEEE 25th ITSC*, Macau, China	*Oct. 2022*
Onsite support of *2022 ITSS Summer School on Cooperative Interactive Vehicles,* Lake Tahoe, CA	*Jan. 2020*
Onsite support of *US DOT. on CES 2020*, Las Vegas, NV	*Jan. 2020*

MENTORSHIP AND TEACHING

Mentored Students at UCLA

- Qinhua Jiang, now: Ph.D. candidate in CEE @UCLA
- Yifan Liu, now: Ph.D. student in CEE @UCLA
- Haoxuan Ma, now: Ph.D. student in CEE @UCLA
- Chenchen Kuai, then: M.S. student in CEE @UCLA, now: Ph.D. student in CEE @TAMU
- Mohammad Reza Sadoughi, now: M.S. student in CEE @UCLA

- Yaofa Gong, now: M.S. student in CEE @UCLA
- Jerry Shi, now: B.S. student in ASDS @UCLA
- Bruce Zhang, now: B.S. student in ASDS @UCLA

Mentored Students at UCR
- Xuanpeng Zhao, then: B.S. & M.S. student in ECE @UCR, now: Ph.D. candidate in ECE @UCR
- Xiaofeng Zhang, then: B.S. student in ECE @UCR, now: Software Engineer @Bosch

Teaching Experience

Traffic Operations and Control (UCLA CEE 181/281)
- Conducted lectures (4 hours per week) independently as a rotating lecturer of the course
- Introduced transportation system, statistics in transportation, traffic data collection and analysis, and traffic simulation

Introduction to Mechanical Engineering (BUPT)
- Conducted lectures as an invited lecturer of the course
- Introduced automation, simulation, robotics in mechanical engineering

HONORS & AWARDS

Best Paper Award, *IEEE 27th International Conference on Intelligent Transportation Systems (ITSC)* *Oct. 2024*
Best Presentation Award, At 3rd Annual Conference of Next-Generation Transportation Systems (NGTS-3) *May 2023*
Esther F. Hays Graduate Fellowship *Jun. 2021*
UCR Dean's Distinguished Fellowship Award *Apr. 2019*
BUPT Scholarship Award *Jun. 2015 & Jun. 2014*

MEDIA EXPOSURES

Scientists Propose a New Method of Data Mining to Add Semantic Information to GPS Tracks and Enrich Behavior Modeling, MIT Technology Review China & DeepTech China, Aug. 2024

NCST Partner CE-CERT Takes Eco-Driving Simulator to CES, National Center for Sustainable Transportation, Jan. 2020

Steering into the Future of Connected and Automated Vehicles, UCR News, Jul. 2019