

Xishun Liao

Los Angeles, CA, USA | Phone: (301) 742-5348 | Email: liaoxishun@gmail.com | [Google Scholar](#) | [LinkedIn](#)

SUMMARY

Specializes in driver behavior modeling, prediction, multi-agent interaction, motion planning, human travel behavior modeling, and vehicle-to-everything (V2X). Implemented the proposed methodologies on both simulation platforms and real-world passenger vehicles. Experience in managing multiple projects with strict deadlines and budgetary guidelines. Published 9 journal articles, 14 conference articles, and 1 book chapter. Served as a reviewer for 13 journals and conferences.

EDUCATION

Ph.D. in Electrical and Computer Engineering , University of California, Riverside	Apr. 2019 - Jun. 2023
Areas of Expertise: Autonomous Driving	
M.E. in Mechanical Engineering , University of Maryland, College Park	Jan. 2017- Dec. 2018
Areas of Expertise: Robotics	
B.E. in Mechanical Engineering and Automation , Beijing University of Posts and Telecommunications	Sep. 2012 - Jun. 2016
Areas of Expertise: Machinery Automation	

EMPLOYMENT EXPERIENCE

Postdoctoral Scholar , Dept. of Civil Engineering, University of California, Los Angeles	Aug. 2023 - Present
Advisors: Dr. Jiaqi Ma	
Research Intern , Honda Research Institute USA, San Jose, CA	Sep. 2021 - Mar. 2022
Advisors: Dr. Teruhisa Misu and Dr. Shashank Mehrotra	
Graduate Student Researcher , Dept. of Electrical and Computer Engineering, University of California, Riverside	Apr. 2019 – Jun. 2023
Advisors: Dr. Guoyuan Wu and Dr. Matthew Barth	

RESEARCH FOCUSES

Human Behavior Study for Human-Centered Autonomy

My research is geared towards creating an autonomy system that is deeply attuned to human needs and behaviors, leveraging the advanced capabilities of Digital Twin technology. This initiative utilizes data-driven, deep learning algorithms to refine the understanding and prediction of human driving behaviors at a micro-scale for intelligent vehicles, and to model human travel behaviors at a macro-scale for comprehensive transportation systems. Key components of the project include:

- Driver Behavior: Dedicated to model personalized driving behavior and vehicular interactions.
- Human Travel Behavior: Focused on modeling human mobility patterns across cities and diverse geographical regions.

Motion Planning and Decision Making for Connected and Automated Vehicles

Focused on crafting advanced algorithms for prediction, behavior modeling, and motion planning, this initiative utilizes a custom-built digital twin platform, encompassing both vehicle and driver digital twins. Experiments were conducted in simulated environments as well as real-world settings. Key aspects of this research include:

- Cooperative Motion Planning and Decision Making: Specializing in platooning, ramp-merging, eco-approaching, and departure strategies.
- Vehicle Trajectory Prediction
- Behavior-Aware Advanced Driving Assistance System
- Experiment platform construction: Establishing a comprehensive Vehicle-Edge-Cloud digital twin road experiment platform, alongside a versatile co-simulation platform.

Intelligent Transportation System

This research adopts an AI and data-driven approach, centralizing on the integration of varied datasets to augment transportation systems.

It aims at boosting the capabilities and efficiency of transportation infrastructures through cutting-edge technological innovations. The primary areas of focus include:

- Traffic Flow Modeling and Prediction.
- Spatiotemporal and Environmental Estimation: analyzes impacts of traffic accidents and work zones on traffic dynamics.

PUBLICATIONS

Journal publications

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

- 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*, 2023 (Early Access)

[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, 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, Matthew J. Barth
- *Transportation Research Part D: Transport and Environment*, vol. 117, Apr. 2023, p. 103664

[J3] 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, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *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

[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
- *103rd Annual Meeting of the Transportation Research Board*, Washington, D.C., Jan 2024.

[C13] 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, 2023*
- [C12] 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, 2023*
- [C11] 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*
- [C10] 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, 2023, pp. 1-7*
- [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
 - *102nd Annual Meeting of the Transportation Research Board, 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, 2022, pp. 709-716.*
- [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, 2022, pp. 948-954.*
- [C6] Estimating the Impacts of Automatic Emergency Braking Technology on Traffic Energy and Emissions
- **Xishun Liao**, Guoyuan Wu, Lan Yang, Matthew J. Barth
 - *101st Annual Meeting of the Transportation Research Board, 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.*

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 Reports

[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. METTRANS 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.

STUDY METHODOLOGIES

Programming and Software Tools: Python/PyTorch, C#, C++, MATLAB, Unity, CARLA/Unreal, VISSIM, SUMO, SolidWorks, AutoCAD, Arduino, ANSYS

Deep Learning: Time Series (RNN/GRU/LSTM), Attention Mechanism and Transformer-based Network, Imitation Learning (IRL, GAIL, GAN), Reinforcement Learning, Graph Neural Network (GCN, GAT), Convolution-based Networks (CNN)

Machine Learning: Regression, Classification, Clustering

Control Theory: Linear/ Non-Linear Control (PID, Sliding mode), Distributed Control, Optimal Control (LQR, MPC), Fuzzy Control

Game Theory: Stackelberg Game, Nash Equilibrium, Level-k Game

Computer Vision: YOLO, R-CNN, Hough transform, Camera calibration, Feature extraction (SIFT, HOG etc.)

Additional Technical Skills and Theories: State and Parameter Estimation, Optimization, Motion Planning, Causality Discovery (Granger Causality), Traffic Theory, Kinematics and Dynamics Modeling, Embedded System