Ziran Wang

Ph.D. in Mechanical Engineering

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EDUCATION

Ph.D. in Mechanical Engineering   Sep. 2015 - Jun. 2019

University of California, Riverside (UCR)

Advisor: Dr. Matthew J. Barth, Professor, Electrical and Computer Engineering

Dissertation: Developing Agent-Based Distributed Cooperative Vehicle-Infrastructure Systems in the Connected and Automated Vehicle Environment

B.E. in Mechanical Engineering and Automation   Sep. 2011 - Jun. 2015

Beijing University of Posts and Telecommunications (BUPT)

PROFESSIONAL EXPERIENCE

Research Scientist   Jul. 2019 - Present

Toyota Motor North America, InfoTech Labs, Mountain View, CA

- Involve in the "Digital Twin" project, building a vehicle-to-cloud platform for intelligent vehicles

Graduate Student Researcher   Jun. 2016 - Jun. 2019

Transportation Systems Research Lab, Center for Environmental Research and Technology, UCR

- Developed multiple cooperative automated driving systems in vehicle-to-everything (V2X) environment, including vehicle platooning, cooperative adaptive cruise control (CACC), cooperative eco-approach and departure at signalized intersections, cooperative on-ramp merging, and cooperative lane change
- Proposed distributed consensus-based and optimal control-based motion control algorithms for connected and automated vehicles, addressing issues of safety, mobility, and eco-friendly
- Implemented proposed systems in MATLAB/Simulink, PTV VISSIM (microscopic traffic simulator) driver model API (C++-based), SUMO (microscopic traffic simulator) TraCI API (Python-based), Unity (game engine) scripting API (C#-based), Volvo Truck's on-board .NET framework (C#-based), and Autonomie (vehicle system simulator)

Research Intern   Jun. 2018 - Sep. 2018

Toyota InfoTechnology Center, Mountain View, CA

- Prototyped cooperative automated driving algorithms using game engine Unity with C# scripting API, allowing them to track trajectory with controlled speed, sense neighboring vehicles and obstacles by on-board sensors, and communicate with each other and infrastructures with V2X communications
- Conducted agent-based modeling and simulation of the proposed cooperative on-ramp merging system, and compared the proposed autonomous system with human-in-the-loop simulations
- Submitted two conference papers and four U.S. patent applications during the 3-month internship

Graduate Student Researcher   Nov. 2015 - Jun. 2016

Cooperative Vehicle Networks Lab, Department of Electrical and Computer Engineering, UCR

- Implemented distributed consensus algorithm on different information flow topologies by using MATLAB/Simulink
- Researched platoon-based vehicular systems and proposed to apply flocking algorithm to intelligent transportation systems

Summer Intern   Jul. 2014 - Aug. 2014

Changan Suzuki Co., Ltd., Chongqing, China

- Conducted routine maintenance including testing the machines of the PBS manufacturing monitor system, analyzing the butteries condition of the Yaskawa manipulators, and lubricating the conveyor chains of the YN5 production line
- Analyzed the PLC programs designed by FANUC to control the motion of the welding robots
- Studied the QEHS Management System of the company and hosted meetings in the Equipment Section independently

PUBLICATIONS

Papers Under Review

[J7]Eco-Approach and Departure along Signalized Corridors
- <u>Ziran Wang</u>, Guoyuan Wu, Peng Hao, Yu Jiang, Kanok Boriboonsomsin, Matthew J. Barth, Michael S. McConnell, Shuwei Qiang, and John A. Stark
- *IEEE Transactions on Intelligent Transportation Systems*

[J6]Driver Behavior Modeling using Game Engine: A Learning-Based Approach
- <u>Ziran Wang</u>, 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*

Papers Published or Accepted

[J5]A Survey on Cooperative Longitudinal Motion Control of Multiple Connected Automated Vehicles
- <u>Ziran Wang</u>, Yougang Bian, Steven E. Shladover, Guoyuan Wu, Shengbo E. Li, and Matthew J. Barth
- *IEEE Intelligent Transportation Systems Magazine*, vol. 12, no. 1, Spring 2020, pp. 4–25

[J4]Cooperative Ramp Merging System: Agent-Based Modeling and Simulation Using Game Engine
- <u>Ziran Wang</u>, Guoyuan Wu, Kanok Boriboonsomsin, Matthew J. Barth, Kyungtae Han, BaekGyu Kim, and Prashant Tiwari
- *SAE International Journal of Connected and Automated Vehicles*, vol.2, no.2, May 2019

[J3]Cooperative Eco-Driving along Multiple Signalized Intersections in a Partially Connected and Automated Vehicle Environment
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *IEEE Transactions on Intelligent Transportation Systems*, DOI: 10.1109/TITS.2019.2911607

[J2]Cluster-Wise Cooperative Eco-Approach and Departure Application for Connected and Automated Vehicles along Signalized Arterials
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *IEEE Transactions on Intelligent Vehicles*, vol. 3, no. 4, Dec. 2018, pp. 404–413

[J1]Developing a Distributed Consensus-Based Cooperative Adaptive Cruise Control (CACC) System for Heterogeneous Vehicles with Predecessor Following Topology
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *Journal of Advanced Transportation*, vol. 2017, Article ID 1023654, Aug. 2017

[C14]A Digital Twin Paradigm: Vehicle-to-Cloud Based Advanced Driver Assistance Systems
- <u>Ziran Wang</u>, Xishun Liao, Xuanpeng Zhao, Kyungtae Han, Prashant Tiwari, Matthew J. Barth, and Guoyuan Wu
- *IEEE 91st Vehicular Technology Conference (VTC2020-Spring)*, Antwerp, Belgium, May 2020

[C13]Cooperative Ramp Merging with Vehicle-to-Cloud Communications: A Field Experiment
- Xishun Liao, David Oswald, <u>Ziran Wang</u>, 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

[C12]End-to-End Vision-Based Adaptive Cruise Control (ACC) Using Deep Reinforcement Learning
- Zhensong Wei, Yu Jiang, Xishun Liao, Xuewei Qi, <u>Ziran Wang</u>, Guoyuan Wu, Peng Hao, and Matthew J. Barth,
- *Transportation Research Board 99th Annual Meeting*, Washington D.C., Jan. 2020

[C11]Recent Field Implementation Results of a Heavy-Duty Truck Connected Eco-Driving System
- <u>Ziran Wang</u>, Yuan-Pu Hsu, Alexander Vu, Francisco Caballero, Peng Hao, Guoyuan Wu, Kanok Boriboonsomsin, Matthew J. Barth, Aravind Kailas, Pascal Amar, Eddie Garmon, and Sandeep Tanugula

- *IEEE 22nd International Conference on Intelligent Transportation Systems*, Auckland, New Zealand, Oct. 2019

[**C10**]The State-of-the-Art of Coordinated Ramp Control with Mixed Traffic Conditions
- Zhouqiao Zhao, <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *IEEE 22nd International Conference on Intelligent Transportation Systems*, Auckland, New Zealand, Oct. 2019

[**C9**]Lookup Table-Based Consensus Algorithm for Real-Time Longitudinal Motion Control of Connected and Automated Vehicles
- <u>Ziran Wang</u>, Kyungtae Han, BaekGyu Kim, Guoyuan Wu, and Matthew J. Barth
- *2019 American Control Conference,* Philadelphia, PA, Jul. 2019

[**C8**]Agent-Based Modeling and Simulation of Connected and Automated Vehicles Using Game Engine: A Cooperative On-Ramp Merging Study
- <u>Ziran Wang</u>, BaekGyu Kim, Hiromitsu Kobayashi, Guoyuan Wu, and Matthew J. Barth
- *Transportation Research Board 98th Annual Meeting*, Washington D.C., Jan. 2019

[**C7**]Eco-Approach and Departure along Signalized Corridors
- Guoyuan Wu, Peng Hao, <u>Ziran Wang</u>, Kanok Boriboonsomsin, and Matthew J. Barth
- *Transportation Research Board 98th Annual Meeting*, Washington D.C., Jan. 2019

[**C6**]A Review on Cooperative Adaptive Cruise Control (CACC) Systems: Architectures, Controls, and Applications
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *IEEE 21st International Conference on Intelligent Transportation Systems*, Maui, Hawaii, Nov. 2018

[**C5**]Distributed Consensus-Based Cooperative Highway On-Ramp Merging Using V2X Communications
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *SAE Technical Paper,* 2018-01-1177, Apr. 2018

[**C4**]Cluster-Wise Cooperative Eco-Approach and Departure Application along Signalized Arterials
- <u>Ziran Wang</u>, Guoyuan Wu, Peng Hao, and Matthew J. Barth
- *IEEE 20th International Conference on Intelligent Transportation Systems*, Yokohama, Japan, Oct. 2017

[**C3**]Intra-Platoon Vehicle Sequence Optimization for Eco-Cooperative Adaptive Cruise Control
- Peng Hao, <u>Ziran Wang</u>, Guoyuan Wu, Kanok Boriboonsomsin, and Matthew J. Barth
- *IEEE 20th International Conference on Intelligent Transportation Systems*, Yokohama, Japan, Oct. 2017

[**C2**]Developing a Platoon-Wide Eco-Cooperative Adaptive Cruise Control (CACC) System
- <u>Ziran Wang</u>, Guoyuan Wu, Peng Hao, Kanok Boriboonsomsin, and Matthew J. Barth
- *2017 IEEE Intelligent Vehicles Symposium*, Redondo Beach, CA, Jun. 2017

[**C1**]Developing a Distributed Consensus-Based Cooperative Adaptive Cruise Control (CACC) System
- <u>Ziran Wang</u>, Guoyuan Wu, and Matthew J. Barth
- *Transportation Research Board 96th Annual Meeting*, Washington D.C., Jan. 2017

PROJECTS

Evaluating Connected Vehicle Applications in a Mixed Traffic Environment using a "Digital Twin" Approach
Sponsor: Toyota Motor North America, InfoTech Labs
- Proposed a feedforward/feedback motion controller for autonomous vehicles to cooperate at on-ramp merging
- Developed an augmented reality (AR) based head-up display (HUD) for the driver on intelligent vehicles in Unity
- Built neural network to model human factor based on historical driver data
- Developed a Unity/Arduino-car integrated system to realize the Digital Twin concept

Traffic Optimization for Signalized Corridors (TOSCo) Small Scale Test & Evaluation Project

Sponsor: Federal Highway Administration (FHWA), United States Department of Transportation

Partners: Crash Avoidance Metrics Partners (CAMP) LLC Vehicle to Infrastructure Consortium (Ford, General Motors, Hyundai-Kia, Honda, Mazda, Nissan, Subaru, Volvo Truck, and VW/Audi), IAV GmbH, Texas A&M Transportation Institute (TTI), and The University of Michigan Transportation Institute (UMTRI)

- Proposed advanced TOSCo algorithms based on eco-approach and departure and CACC applications
- Compiled C++ code for external driver model API of PTV VISSIM to realize the proposed framework and algorithms

An Innovative Vehicle-Powertrain Eco-Operation System for Efficient Plug-In Hybrid Electric Buses

Sponsor: Advanced Research Projects Agency-Energy (ARPA-E), United States Department of Energy

- Filtered collected bus data by geofencing methodology using MATLAB and Excel
- Built a hardware-in-the-loop test environment by linking traffic simulation outputs with chassis dyno facility

Connected Eco-Driving for Heavy-Duty Conventional and Plug-In Hybrid Electric Trucks

Sponsor: Volvo Group North America

- Integrated components in the system architecture including map matching, sensor fusion, speed planning and GUI
- Developed an eco-driving motion control algorithm and implement it on Volvo Truck's .NET framework
- Conducted a real-world demonstration of the system on a Volvo truck using cellular-based V2X communication

Development of Eco-Friendly Ramp Control based on Connected and Automated Vehicle Technology

Sponsor: National Center for Sustainable Transportation, United States Department of Transportation

- Developed a hierarchical ramp merging control strategy to reduce overall freeway congestion
- Proposed an optimal control algorithm to control the movement of connected and automated vehicles
- Evaluated the mobility and environmental impacts of the proposed strategy by PTV VISSIM

TALKS

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

- 23rd COTA Annual Winter Symposium, Washington D.C., Jan. 2020

Unity3D-Based AV Simulation with V2X Communication and Human-in-the-Loop Integration

- Automated Vehicles Symposium, Orlando, FL, Jul. 2019

Agent-Based Modeling and Simulation of Connected and Automated Vehicles Using Game Engine

- Transportation Research Board (TRB) 98th Annual Meeting, Washington, D.C., Jan. 2019

Eco-Friendly Applications in Connected and Automated Vehicle Technology

- University of California, Riverside CE-CERT Open House, Riverside, CA, Oct. 2018

Connected Eco-Bus: An Innovative Vehicle Powertrain Eco-Operation System for Efficient Plug-In Hybrid Electric Buses

- ARPA-E NEXTCAR 2018 Annual Meeting, Southfield, MI, Apr. 2018

Distributed Consensus-Based Cooperative Highway On-Ramp Merging Using V2X Communications

- WCX: SAE World Congress Experience, Detroit, MI, Apr. 2018

Connected and Automated Vehicle Research at UCR

- University of California, Riverside Extension, Riverside, CA, Jan. 2018

Developing a Platoon-Wide Eco-Cooperative Adaptive Cruise Control (CACC) System

- Los Angeles Environmental Forum, San Gabriel, CA, Aug. 2017

Distributed Consensus-Based Cooperative Adaptive Cruise Control (CACC) Systems

- TuSimple Technology Co., Ltd., San Diego, CA, Jul. 2017

TEACHING EXPERIENCE

Intelligent Transportation Systems (UCR EE 246)   Oct. 2018
- Conducted 2 hours of lecture independently as a rotating lecturer of the course
- Introduced car-following models, cooperative adaptive cruise control, and simulation tools

Feedback Control (UCR ME 121)   Mar. 2017 - Jun. 2017
- Conducted 20 hours of discussion sessions independently as a teaching assistant of the course
- Introduced the analysis and design of feedback control systems using classical control methods, including block diagrams, closed-loop stability, root locus, Bode plots, and etc.

Mechanical Engineering Modeling and Analysis (UCR ME 118)   Jan. 2017 - Mar. 2017
- Conducted 20 hours of discussion sessions independently as a teaching assistant of the course
- Introduced data analysis and modeling used in engineering through MATLAB, including descriptive and inferential statistics, fitting linear and nonlinear models to observed data, numerical differentiation and integration, etc.

Introduction to Engineering Computation (UCR ME 018)   Sep. 2016 - Dec. 2016
- Conducted 60 hours of lab sessions independently as a teaching assistant of the course
- Introduced the use of MATLAB in engineering computation, including scripts and functions, programming, input/output, two and three-dimensional graphics, elementary numerical analysis, etc.

PROFESSIONAL ACTIVITIES

As a Member

Member of Society of Automotive Engineers (SAE)   Jan. 2018 - Present
Member of Southern California Chinese-American Environmental Protection Association (SCCAEPA)   Feb. 2017 - Present
Member of International Chinese Transportation Professionals Association (ICTPA)   Feb. 2017 - Present
Member of Chinese Overseas Transportation Association (COTA)   Jan. 2017 - Present
Friend of Transportation Research Board (TRB) Standing Committee: Vehicle-Highway Automation   Jan. 2017 - Present
Member of Institute of Electrical and Electronics Engineers (IEEE)   Sep. 2016 - Present

As an Organizer

Organizer of 4th IEEE Conference on Control Technology and Applications (CCTA), Automotive Control Invited Sessions, Montreal, Canada   Jan. 2020 - Present
Organizer of 2020 Intelligent Vehicles Symposium (IV), Internet of Things in Intelligent Transportation Systems: Opportunities and Challenges Workshop, Las Vegas, NV   Dec. 2019 - Present

As a Reviewer

Reviewer of *International Journal of Automotive Technology*   Feb. 2020 - Present
Reviewer of *MDPI Sensors Open Access Journal*   Feb. 2020 - Present
Reviewer of *Journal of Intelligent Transportation Systems*   Jan. 2020 - Present
Reviewer of *International Journal of Transportation Science and Technology*   Jan. 2020 - Present
Reviewer of *IEEE Open Journal of Intelligent Transportation Systems*   Dec. 2019 - Present
Reviewer of *IEEE Vehicular Technology Conference (VTC)*   Nov. 2019 - Present
Reviewer of *MDPI Vehicles Open Access Journal*   Nov. 2019 - Present
Reviewer of *IEEE Transactions on Intelligent Vehicles*   Oct. 2019 - Present
Reviewer of *IEEE Access*   Aug. 2019 - Present
Reviewer of *IEEE CCTA*   Mar. 2019 - Present
Reviewer of *SAE International Journal of Connected and Automated Vehicles*   Oct. 2018 - Present
Reviewer of *American Control Conference (ACC)*   Oct. 2018 - Present
Reviewer of *Transportation Research Record (TRR)*   Aug. 2018 - Present
Reviewer of *International Conference on Computer Science and Application Engineering (CSAE)*   Aug. 2018 - Present

Reviewer of *IEEE International Conference on Intelligent Transportation Systems (ITSC)*	May 2018 - Present
Reviewer of *Case Studies on Transport Policies (CSTP)*	May 2018 - Present
Reviewer of *IEEE Intelligent Vehicles Symposium*	Mar. 2018 - Present
Reviewer of *IET Intelligent Transport Systems*	Jan. 2018 - Present
Reviewer of *ASCE International Conference on Transportation & Development (ICTD)*	Dec. 2017 - Present
Reviewer of *SAE Technical Papers*	Oct. 2017 - Present
Reviewer of *TRB Annual Meeting*	Sep. 2017 - Present
Reviewer of *IEEE Transactions on Intelligent Transportation Systems*	Jun. 2017 - Present
Reviewer of *COTA International Conference of Transportation Professionals (CICTP)*	Feb. 2017 - Present

As a Volunteer

Organizer of *2018 IEEE 21st ITSC*, Maui, HI	Nov. 2018
Onsite support of Humanplus Intelligent Robotics Technology Co., Ltd. on CES 2018, Las Vegas, NV	Jan. 2018
Organizer of Chinese Institute of Engineers (CIE) So-Cal Chapter Annual Convention, Rowland Heights, CA	Sep. 2017
Organizer of *2017 IEEE IV Symposium*, Redondo Beach, CA	Jun. 2017

ACADEMIC HONORS

U.S. Department of Transportation National Center for Sustainable Transportation (NCST) Dissertation Award	Jun. 2018
SAE WCX World Congress Experience Outstanding Service	Apr. 2018
Best Student Research Paper Award, Los Angeles Environmental Forum	Aug. 2017
UCR Dean's Distinguished Fellowship Award	Fall 2015 - Spring 2017
BUPT Scholarship Award	Jun. 2014 & Jun. 2013
The Honorable Mention, The Mathematical Contest in Modeling (MCM)	Feb. 2014

MEDIA EXPOSURES

CECERT Takes Eco-Driving Simulator to CES, Inside UCR, Jan. 2020

Testing a Connected Eco-Driving System in Field Trials with Heavy-Duty Trucks, Featured News, Tech Xplore, Aug. 2019

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

CE-CERT Researchers Open 2019 with a Successful TRB Conference Showing, UCR CE-CERT News, Feb. 2019

TSR Group has a Strong Showing at the 2018 IEEE ITSC Conference, UCR CE-CERT News, Dec. 2018

CE-CERT and Bourns Host 2018 STEP Conference, UCR CE-CERT News, Oct. 2018