

# Zijia (Gary) Zhong

PH.D., P.E.

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## Education

### Ph.D. in Transportation

Sept. 2013 - May. 2018

NEW JERSEY INSTITUTE OF TECHNOLOGY

Newark, NJ

Dissertation: Assessing the Effectiveness of Managed Lane Strategies for the Rapid Deployment of Cooperative Adaptive Cruise Control Technology (Advisor: Dr. Joyoung Lee; committee members: Dr. Lazar Spasovic, Dr. Steven Chien, Dr. Guiling Wang, and Dr. Parth Bhavsar)

### M.S. in Civil Engineering

Sept. 2009 - May 2011

NEW JERSEY INSTITUTE OF TECHNOLOGY

Newark, NJ

### B.E. in Environmental Engineering

Sept. 2005 - June 2009

JINAN UNIVERSITY

Guangzhou, China

Thesis: Study on Municipal Sewage Sludge Dewatering using Aspergillus Sojoe-based Microbial Flocculant and Polyacrylamide (Advisor: Dr. Jinshao Ye)

## Skills

**Programming Skills** Python, C/C++, C#, JavaScript, HTML/CSS, TeX, PHP

**Big Data Analytics** Spark, Hadoop MapReduce, High-performance computing (SLURM & w/ Supercomputer)

**Database Management** MongoDB, Microsoft SQL Server, MySQL, Microsoft Access

**Geospatial Analysis** ArcGIS, QGIS, Apache Sedona

**Traffic Simulation** VISSIM (w/ COM Interface, APIs), SUMO (w/ TraCI API)

Human-in-the-loop simulation (w/ driving simulator),

**Enhanced Simulation** Hardware-in-the-loop (HITL) simulation (w/ signal controllers),

Software-in-the-loop (SITL) simulation

**Statistical Analysis** MATLAB, SAS, Minitab

**Traffic Analysis** Synchro Studio, PTV Vistro, Highway Capacity Software

## Licenses & Certificates

- Professional Engineer (NJ)
- FAA-certified Remote Pilot (Part 107)

## Awards & Scholarships

- 2019 "Best Paper Award", the IEEE 2nd Connected and Automated Vehicles Symposium
- 2017 "Outstanding Graduate Student", the Intelligent Transportation Society New Jersey Chapter
- 2015 "The Future of ITS", the Intelligent Transportation Society New Jersey Chapter

## Research Projects as PI/Co-PI

- **Incorporation of Excessive Energy Measures into Automated Traffic Signal Performance Metrics (Co-PI)**

Financing entity: Department of Energy/ National Renewable Energy Laboratory

Project budget: 100k

Duration of award: 10/2021-02/2023

Project objective: develop and integrate energy module for GPS-based automated traffic signal performance metrics (ATSPM)

# Research Experience

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## Sr. Transportation Engineer

Oct. 2020 - present

NEW JERSEY INSTITUTE OF TECHNOLOGY

Newark, NJ

### **Incorporation of Excessive Energy Measures into Automated Traffic Signal Performance Metrics (Co-PI, DOE\NREL)**

- Explore signalized corridor energy performance and vehicle-based “excess energy” for intersections
- Integrate excessive energy metrics to GPS-based Automated Traffic Signal Performance Metrics (ATSPM)
- Enhance scalability and efficiency of ATSPM model with highly granular vehicle trajectory data

### **Data Analysis Tools, Solutions and Research to Support TSM&O (NJDOT)**

- Develop high-performance computing capability of the ITS Resources Center at NJIT
- Maintain in-house Spark and Hadoop distributed storage and computation cluster
- Prototype TSM&O applications using commercial large-scale, highly granulated spatio-temporal connected vehicle way point data

### **Integration of Mobile Observation for Road & Weather Sensing (FHWA\NJDOT Weather-Savvy Roads Program)**

- Instrument Safety Service Patrol (SSP) vehicles with the multi-sensor platform for collecting high-fidelity data, such as road pavement temperature, dashboard camera video, and vehicle trajectory.
- Perform continuous monitoring of the Weather Savvy IMO systems (e.g., accuracy and reliability, signal reception and network coverage, equipment operability, and benefits)

## Postdoctoral Researcher

Sept. 2019 - Oct. 2020

NATIONAL RENEWABLE ENERGY LABORATORY

Golden, CO

### **Transportation Systems Rapid Response for Safe and Efficient Mobility Return to Operations (DOE VTO)**

- Explored various probe vehicle data sets to identify changes in travel patterns and behaviors during the COVID-19 pandemic
- Processed nationwide, disaggregated INRIX data (at individual trip level) for sister national laboratories for their pandemic-related research using high-performance computing resources
- Fused probe vehicle data with socioeconomic data to quantify urban mobility trends

### **Data-driven Simulation for Citywide Mobility-related Energy Usage (a.k.a. “Digital Twin”) (DOE VTO)**

- Conducted large-scale transportation system modeling (Chattanooga, TN region) and calibrated regional microscopic simulation network by leveraging high-performance computing resources (e.g., the Eagle supercomputer) for real-time traffic prediction and management for better energy efficiency
- Developed vehicle trajectory-based automated traffic signal performance measures (ATSPMs) framework to be scaled up to state and national levels

### **Energy Equivalence of Safety Framework for Motor Vehicle Crashes (DOE SMART Mobility)**

- Collected and processed economic, energy, and traffic crash data from agencies
- Quantified the direct (e.g., economic cost) and indirect cost (e.g., willingness-to-pay cost) for motor vehicle crashes at national, state, and local levels
- Studied the holistic view of motor vehicle crashes by strengthen the connection between transportation safety and energy

### **Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Consortium (DOE SMART Mobility)**

- Developed microscopic simulation toolkit for Automated Mobility District (AMD), a campus-size implementation of CAV-equipped transit system
- Investigated curb-side management of ride-sharing travel mode (i.e., mobility as a service) and its impact on a regional traffic network

## Postdoctoral Researcher

Sept. 2018 - Aug. 2019

UNIVERSITY OF DELAWARE

Newark, DE

### **Unconventional Arterial Intersection Design (UAID) under Connected and Automated Vehicle (CAV) Environment**

- Examined the performance impact of driver’s confusion on UAIDs
- Developed an optimal control framework for CAVs at signal-free UAIDs

### **Impact of Cooperative adaptive cruise control (CACC) Clustering Strategies**

- Created a freeway merging control framework for vehicle platoons enabled by CACC
- Assessed the traffic impacts of platoon-based merging the effectiveness of global CACC coordination under mixed traffic conditions
- Formulated hierarchical control strategies for CACC platoon formation

### **Research Supports for the Delaware Center for Transportation and Department of Civil and Environmental Engineering**

- Maintained the Transportation Research Information Services (TRIS) database for funded transportation projects
- Hosted technical work shop for traffic simulation with the focus on the advanced modules (e.g., Vissim COM and APIs)
- Collaborated and provided guidance for Ph.D. students’ research

## Ph.D. Candidate/Graduate Research Assistant

Sept. 2013 - May. 2018

NEW JERSEY INSTITUTE OF TECHNOLOGY

Newark, NJ

### Dedicating Lanes for Priority or Exclusive Use by Connected Vehicles (CVs) and Automated Vehicles (AVs) (NCHRP-102(08))

- Developed a multi-objective cooperative driving framework for CACC platooning
- Assessed the impact of imperfect wireless communication for CACC platooning with a packet-level DSRC analytical module
- Derived policy recommendations for managed lane strategies in near-term deployment of CAV technologies from large scale individual vehicle trajectory data

### Saxton Transportation Operation Laboratory TOPR 4 & 19: Saxton Lab Simulation Capability (FHWA)

- Developed advanced microscopic traffic simulation testbed by integrating MATLAB, Vissim, Vissim API, and Vssim COM Interface
- Automated calibrations of large-scale freeway and arterial transportation networks (i.e. Virginia I-66 and Virginia SR 286) for CAV simulation using Vissim COM interface
- Published the source code of Automated Longitudinal Vehicle Control (ALVC) package (i.e. including the calibrated network, ALVC behavioral model developed in Vissim API, and VISSIM COM program) on the FHWA Open Source Application Development Portal

### Human Factor Evaluation of Advanced Driver-assistant Systems (NJDOT)

- Managed the day-to-day operations of the Driving Simulator Laboratory of the ITS Resource Center at NJIT
- Developed driving simulation scenarios for ITS applications (e.g., intersection signal advisory, freeway dynamic merging application etc.) using SimVista
- Organized experiments for advanced driving assist systems (ADASs) by using the high-fidelity, full-cabin driving simulator
- Integrated the driving simulator with traffic simulators (e.g. VISSIM, AIMSUM) for human-in-the-loop ADAS evaluation

### Development of Optimal Platoon-based Cooperative Driving Framework (NJIT)

- Developed distributed computational framework for Genetic Algorithm-based Pareto optimization for corridor level microscopic simulation
- Improved the computational efficiency on conducting agent-based microscopic simulation at scale with high-performance computing resources

### Development of Enhanced Hardware-in-the-loop Simulation Environment for ITS Evaluation (NJDOT)

- Developed Controller Interface Device (CID)-free hardware-in-the-loop (HITL) simulation testbed with VISSIM using the National Transportation Communication for ITS Protocol (NTCIP)
- Evaluated Adaptive Signal Control Technologies (e.g., Centrac Adaptive) with Econolite Cobalt Controllers
- Conducted the proof-of-concept test of the mobile-based pedestrian signal for the visually impaired (i.e. Virtual Guide Dog) with HITL simulation in the field

### Unmanned Aerial System (UAS) Application in Traffic Monitoring and Incident Management (NJDOT)

- Explored UAS-based real-time traffic monitoring and its integration to traffic management centers (TMCs)
- Conducted the proof-of-concept test of UAS traffic monitoring by transmitting real-time video footage to the TMC of the City of Newark, NJ via commercial 4G/LTE cellular network
- Collaborated with the PANYNJ for infrastructure inspection with UAS (i.e. visual inspection of the Lincoln Tunnel evase stacks)
- Obtained the FAA Part 107 Remote Pilot certificate

### Real-time Urban Mobility Monitoring System by Wireless Sensor Network (NJIT)

- Designed NJIT in-house, low-cost, Zigbee mobility sensors by integrating mini PCs, Bluetooth scanners, and WiFi sensors
- Improved the effectiveness the Class II Bluetooth sensor by introducing a dual-sensor configuration
- Conducted the proof-of-concept test for the proposed ZigBee mobility monitoring application

### I-295 Direct Connect Work Zone Mobility Monitoring Application Development (FHWA\NJDOT)

- Developed web-based Work Zone Interactive Monitoring Application (WIMAP) for work zone traffic management
- Fused massive and heterogeneous real-time traffic data for visual data analytics and decision-making support
- Deployed Artificial Neural Network prediction model on WIMAP via MATLAB Compiler SDK
- Integrated the GIS database of NJDOT ITS asset inventory for resource visualization and management

## Industrial Experience

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### Engineer I

Aug. 2011 - Aug. 2013

LMW ENGINEERING GROUP

Linden, NJ

- Performed engineering design under direct supervision of senior structural engineers
- Prepared CAD drawings for structure alteration, building demolition and support of excavation according to the building codes of Department of Building of New York City (NYCDOB)

## Teaching & Advising Experience

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- Completion of the ASCE Mini ExCEED teaching workshop, Dec. 2018
- Mentorship for junior Ph.D. students, Department of Civil and Environmental Engineering, University of Delaware, Fall 2018 - Spring 2019
- Vissim Traffic Simulation workshop, Department of Civil and Environmental Engineering, University of Delaware, Fall 2018
- Vissim Traffic Simulation workshop (invited lecture), CE350 Transportation Engineering, John A. Reif, Jr. Department of Civil and Environmental Engineering, New Jersey Institute of Technology, Fall 2015 - Spring 2018
- Emerging ITS technologies (invited lecture), TRAN 755 Intelligent Transportation System, John A. Reif, Jr. Department of Civil and Environmental Engineering, New Jersey Institute of Technology, Fall 2015 - Spring 2018

## Professional Service

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- Panelist, TRB 2020 Workshop: Infrastructure Spatial Sensing at Intersections
- Panelist, AVS 2020 Breakouts: The (Dedicated) Road to Deployment: What are the Priorities?
- Reviewer, Transportation Research Part C: Emerging Technologies
- Reviewer, IEEE Transactions on Intelligent Transportation Systems
- Reviewer, IEEE Transactions on Intelligent Vehicles
- Reviewer, IEEE Transactions on Vehicular Technology
- Reviewer, Journal of Intelligent Transportation Systems
- Reviewer, Transportation Research Record: Journal of the Transportation Research Board
- Reviewer, Journal of Advanced Transportation
- Reviewer, Physica A: Statistical Mechanics and its Applications
- Reviewer, SAE International Journal of Connected and Automated Vehicles
- Reviewer, Korean Society of Civil Engineers (KSCE) Journal of Civil Engineering
- Reviewer, Sensors
- Reviewer, International Journal of Transportation

## Publications

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### JOURNAL PAPERS

1. **Z. Zhong\***, J. Lee, and L. Zhao “[Traffic flow characteristics and lane use strategies for connected and automated vehicles in mixed traffic conditions](#)”, J. Advanced Transp., vol 2021, doi: 10.1155/2021/8816540 (\* corresponding author)
2. **Z. Zhong**, L. Zhu\*, and S. Young, “[Approximation framework of embodied energy of safety: insights, and spatiotemporal analysis](#),” Energies, 20230, 13, 4230, doi: 10.3390/en13164230
3. **Z. Zhong\***, M. Nejad, and E. E. Lee, “[Autonomous and semi-autonomous intersection management: a review](#),” IEEE Intell. Transp. Syst. Mag., doi:10.1109/ITS.2020.3014074
4. **Z. Zhong\***, E. E. Lee, M. Nejad and J. Lee, “[Influence of CAV clustering strategies on mixed traffic flow characteristics: an analysis of vehicle trajectory data](#),” Transp. Res. Part C: Emerging Technologies, vol.115, pp.102611, 2020, doi:10.1016/j.trc.2020.102611
5. **Z. Zhong** and J. Lee\*, “[Virtual Guide Dog: Next Generation Pedestrian Signal for the Visually Impaired](#),” Advances in Mechanical Eng., vol.12(3), pp.1-9, 2020 doi:10.1177/1687814019883096
6. **Z. Zhong\*** and J. Lee, “[The effectiveness of managed lane strategies for the near-term deployment of cooperative adaptive cruise control](#),” Transp. Res. Part A: Policy and Practices, vol.129, pp. 257–270, 2019, doi:10.1016/j.tra.2019.08.015
7. **Z. Zhong**, J. Lee\*, and L. Zhao, “[Multiobjective optimization framework for cooperative adaptive cruise control vehicles in the automated vehicle platooning environment](#),” Transp. Res. Rec. J. Transp. Res. Board, vol. 2625, pp. 32–42, 2017.
8. J. Lee, **Z. Zhong\***, B. Du, S. Gutesa, and K. Kim, “[Low-cost and energy-saving wireless sensor network for real-time urban mobility monitoring system](#),” J. Sensors, vol. 2015, pp. 1–8, 2015.
9. H. Ye, J. Ye\*, and **Z. Zhong**, “Study on sludge dewatering using microbial flocculant,” China Environmental Chemistry, vol. 3, p. 024, 2009

### PEER-REVIEWED CONFERENCE PROCEEDING PAPERS

1. W. Li\*, C. Meese, **Z. Zhong**, H. Guo and M. Nejad, “[Location-aware Verification for Autonomous Truck Platooning Based on Blockchain and Zero-knowledge Proof](#)” in IEEE International Conference on Blockchain and Cryptocurrency (ICBC), virtual conference, 2021.
2. **Z. Zhong\***, M. Nejad, E. E. Lee, and J. Lee, “[Clustering strategies of cooperative adaptive cruise control: impacts on human-driven vehicles](#),” in IEEE 2nd Connected and Automated Vehicles Symposium, Honolulu, Hawaii, USA, 2019. **(Best Paper Award)**
3. **Z. Zhong\*** and E. E. Lee, “[Alternative intersection designs with connected and automated vehicle](#)” in IEEE 2nd Connected and Automated Vehicles Symposium, Honolulu, Hawaii, USA, 2019.
4. **Z. Zhong**, J. Lee\*, “[Simulation framework for cooperative adaptive cruise control with empirical DSRC module](#),” in 44th Annu. Conf. of IEEE Ind Electron. Soc., Washington DC, USA, 2018

5. J. Lee\*, **Z. Zhong**, J. Singh, B. Dimitrijevic, S. Chien, L. Spasovic, “Real-time performance measure monitoring system for long-term freeway work zone,” in Intell. Transp. Syst. World Congress 2017, Montreal, Canada
6. J. Lee\*, S. Gutesa, **Z. Zhong**, B. Dimitrijevic, L. Spasovic, J. Singh, “Evaluation of freeway merging assistance system using driving simulator,” in Intell. Transp. Syst. World Congress 2017, Montreal, Canada
7. **Z. Zhong**, J. Lee\*, and L. Zhao, “Evaluations of managed lane strategies for arterial deployment of cooperative adaptive cruise control,” in 96th Transp. Res. Board Annu. Meeting, Washington, DC, USA, 2017.
8. **Z. Zhong** and J. Lee\*, “Development of CID-free hardware-in-the-loop simulation framework,” in 96th Transp. Res. Board Annu. Meeting, Washington, DC, USA, 2017.
9. J. Lee\* et al., “WIMAP: work zone interactive monitoring application,” in 94th Transp. Res. Board Annu. Meeting, Washington, DC, USA, 2015, no. 15–4257.
10. J. Lee\*, **Z. Zhong**, K. Kim, B. Dimitrijevic, B. Du, and S. Gutesa, “Examining the applicability of small quadcopter drone for traffic surveillance and roadway incident monitoring,” in 94th Transp. Res. Board Annu. Meeting, Washington, DC, USA, 2015, no. 15–4184.
11. **Z. Zhong**, and J. Lee\*, “Estimation of real-time origin-destination flow using mobile sensor network,” in 21st Intell. Transp. Syst. World Congress, Detroit, MI, USA, 2014

#### TECHNICAL REPORTS

1. L. Spasovic, B. Dimitrijevic, J. Lee, P. Jin, **Z. Zhong**, and D. Besenski, “Research of UAS application in traffic monitoring and incident management,” New Jersey Department of Transportation, Mar. 2017
2. L. Spasovic, B. Dimitrijevic, D. Besenski J. Lee, and **Z. Zhong**, “Small unmanned aircraft systems (UAS) for traffic incident management,” New Jersey Department of Transportation, Mar. 2017
3. J. Lee, L. Spasovic, S. Gutesa, **Z. Zhong**, and B. Dimitrijevic, “Examining the applicability of a driving simulator for the evaluation of ITS and TSM&O strategies,” New Jersey Department of Transportation, Mar. 2017
4. J. Lee, L. Spasovic, **Z. Zhong**, B. Dimitrijevic, K. Kim, and S. Chien, “Development and implementation of WIMAP Application (I-295 Direct Connect Case Study),” New Jersey Department of Transportation, Mar. 2017
5. J. Lee, L. Spasovic, S. Gutesa, **Z. Zhong**, and B. Dimitrijevic, “Development of hardware-in-the-loop-simulation (HILS) environment for adaptive traffic control system,” New Jersey Department of Transportation, Dec. 2016

## Presentations

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1. “The Impact of COVID-19 Pandemic on Mobility Systems-an analysis on traffic related data”, Department of Civil & Environmental Engineering, University of Delaware, Nov. 2020
2. “Managed Lane Strategies for Near-term Deployment of Cooperative Adaptive Cruise Control”, in Automated Vehicles Symposium 2020, virtual, Jul. 2020
3. “A GDP-weighted First-order Approximation of Energy Equivalence of Safety Framework”, in 99th Transportation Research Board Annual Meeting, Washington D.C. Jan. 2020
4. “Alternative Intersection Designs with Connected and Automated Vehicle”, in IEEE 2nd Connected and Automated Vehicles Symposium, Honolulu, HI, 2019
5. “Clustering Strategies of Cooperative Adaptive Cruise Control: Impacts on Human-driven Vehicles”, in IEEE 2nd Connected and Automated Vehicles Symposium, Honolulu, HI, 2019
6. “Assessing the Effectiveness of Managed Lane Strategies for the Near-term Deployment of Cooperative Adaptive Cruise Control” , in PTV User Group Meeting, Arlington, VA, 2018
7. “Operation Strategy of the Near-term Deployment of Cooperative Adaptive Cruise Control Technology” , in University of Delaware Transportation and Civil Infrastructure Systems Seminars, 2018
8. “Evaluation of Freeway Merging Assistance System Using Driving Simulator”, Intelligent Transportation Systems World Congress 2017, Montreal, Canada, Oct 2017
9. “Real-time Performance Measure Monitoring System for Long-term Freeway Work Zone”, Intelligent Transportation Systems World Congress 2017, Montreal, Canada, Oct 2017
10. “Evaluations of Managed Lane Strategies for Arterial Deployment of Cooperative Adaptive Cruise Control”, presented at the 96th Transportation Research Board Annual Meeting, Washington D.C. Jan. 2017
11. “Development of CID-Free Hardware-in-the-Loop Simulation Framework”, presented at the 96th Transportation Research Board Annual Meeting, Washington D.C. Jan. 2017
12. “Virtual Guide Dog: Next Generation Pedestrian Signal for the Visually Impaired”, presented at the TRB 10th University Transportation Centers Spotlight Conference: Pedestrian and Bicycle Safety, Washington DC, Dec 2016
13. “Multi-objective Optimization Controller for Cooperative Adaptive Cruise Control”, presented at the 95th Transportation Research Board Annual Meeting, Washington D.C., Jan. 2016
14. “State-of-the-Art Microscopic Simulation for Early Deployment Evaluation of Cooperative Adaptive Cruise Control”, presented at the 4th Connected and Autonomous Vehicles Symposium, Albany, NY, Dec. 2015
15. “WIMAP: Work Zone Interactive Monitoring Application”, presented at the 94th Transportation Research Board Annual Meeting, Washington D.C., Jan. 2015
16. “Examining the Applicability of Small Quad-copter Drone for Traffic Surveillance and Roadway Incident Monitoring”, presented at the 94th Transportation Research Board Annual Meeting, Washington D.C., Jan. 2015
17. “Pilot Test for Personal Signal Assistant (PSA) in New Jersey”, presented at the 3rd Connected and Autonomous Vehicles Symposium, Albany, NY, Dec. 2014
18. “Estimation of Real-time Origin-destination Flow Using Mobile Sensor Network”, presented at the 21st ITS World Congress, Detroit, MI, Sept. 2014