

# Chenxi Liu

Ph.D. Candidate, Department of Civil and Environmental Engineering  
University of Washington, Seattle, WA, 98195  
Cell: (+1) 669-246-2687 | E-mail: lcx2017@uw.edu

## HIGHLIGHT

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- Achievements were awarded by TRB, IEEE, ASCE, USDOT, and American Association of State Highway and Transportation Officials (AASHTO).
- Published 15 papers in leading journals, 30 papers at academic conferences and 3 patents. Additionally, 10 journal manuscripts are currently under review.
- Provided 28 talks for the universities, research seminars, academic conferences, workshops, transportation agencies, museums, etc.
- Currently serves as an active member of TRB standing committee, a board member of the ASCE T&DI AI Committee's student sub-committee, and a young member of the ASCE T&DI committees. Also invited as the guest editor of Digital Transportation and Safety (DTS) and referees for 35 journals and conferences.
- Provided initial drafts and contributed to 11 proposals with total awards \$2,340,000 dollars.

## RESEARCH INTERESTS

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- Traffic Sensing and Advanced Computing
- Distributed Machine Intelligence
- Connected and Smart Infrastructure System
- Transportation Safety and Resilience Enhancement

## EDUCATION

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### University of Washington

Seattle, WA, USA

*Ph.D. in Civil and Environmental Engineering (Transportation)*

06/2020 – 06/2024 (expected)

- Advisor: Professor Yin Hai Wang & Professor Edward McCormack
- Thesis: Enhancing Transportation Safety and Resilience through Cyber-physical Cooperation with Edge Artificial Intelligence

### University of Washington

Seattle, WA, USA

*Master of Science in Transportation Engineering*

09/2017 – 06/2020

- Advisor: Professor Yin Hai Wang
- Thesis: Bi-level Optimization Algorithm for Dynamic Reversible Lane Control Based on Short-term Traffic Flow Prediction

### Tsinghua University

Beijing, China

*Bachelor of Science in Civil Engineering*

09/2013 – 06/2017

- Advisor: Professor Meng Li
- Thesis: The Impacts of E-hailing Taxis on Urban Transportation Network

## HONORS & AWARDS

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26. **Best Paper Award**, TRB Standing Committee on Information Systems and Technology (AED30), for the paper titled "Cooperative and Comprehensive Multi-task Surveillance Sensing and Interaction System Empowered by Edge Artificial Intelligence", Jan. 2023.
25. **Outstanding Paper Award**, IEEE Digital Twins and Parallel Intelligence conference (IEEE DTPI 2022), for the paper titled "Real-Time Traffic and Road Surveillance with Parallel Edge Intelligence (JRFID-0141-07-2022)." Nov. 2022.
24. **MichaelKyte Outstanding Student of the Year Award**, US Department of Transportation University Transportation Center (UTC) for Federal Region 10, Oct 2023.
23. **Small Business Innovation Research (SBIR) Award**, U.S. DOT FY 23, "Edge Computing and Sensor Fusion System for Comprehensive Monitoring of Traffic and Road Conditions", Oct. 2023.
22. **Innovative Project Award**, FHWA LTAP/TTAP, Build a Better Mousetrap Innovation 2023. Jul 2023
21. **High-Value Research Award of American Association of State Highway and Transportation Officials (AASHTO)** for project "Real-Time Truck Parking Information Integration, Visualization and Prediction", Aug 2022.
20. **Excellence in Technology Transfer Award**, US Department of Transportation University Transportation Center (UTC) for Federal Region 10, Pacific Northwest Transportation Consortium (PacTrans), AIWaysion Inc., Oct. 2022
19. **Small Business Innovation Research (SBIR) Award**, U.S. DOT FY 22, "Edge Server-Based AI Application for Dilemma Zone and Traffic Conflict", AIWaysion Inc., Oct. 2022.
18. Runner-up, ASCE University of Washington Presentation Competition, May 2023.
17. Outstanding Poster Award, National Science Foundation (NSF) AI in Transportation Workshop, Dec. 2022.
16. Winner, Pacific Northwest Transportation Consortium (PacTrans) Region 10 Poster Competition, for research "Real-time Multi-task Environmental Perception System for Traffic Safety Empowered by Edge Artificial Intelligence", Oct. 2022.
15. Runner-up, ASCE University of Washington Presentation Competition, Jun. 2022.
14. Winner, Second MetroLab Student Cup Organized by MetroLab Network, for project "Real-time Road Surface Conditions and Visibility Monitoring System for Traffic Safety", Jun. 2022.
13. Runner-up, Transportation Forecasting Competition 2022 (TRANSFOR 22), organized by TRB AED50 Artificial Intelligence and Advanced Computing Applications Committee, Jan. 2022.
12. Winner in Mobility Track, First MetroLab Student Cup Organized by MetroLab Network, for project "Curbside Parking Monitoring and Management Using Edge Computing Technology". Dec. 2020.
11. Outstanding Award (6/1500), Third Di-Tech Smart Traffic Signal AI Algorithm Competition organized by Didi Chuxing Technology Co., Mar. 2018.
10. Travel Award, College of Engineering, University of Washington, 2018, 2020, 2022.
9. Travel Award, Pacific Northwest Transportation Consortium (PacTrans) Region 10 University Transportation Center, 2018, 2019, 2020, 2022, 2023.
8. Runner-up, Structural Design Competition, Tsinghua University, Beijing, China, Oct. 2016.
7. Runner-up, Transportation Science & Technology Competition, Tsinghua University, Beijing, China, May 2016.
6. Outstanding Contribution Intern Award, Wuhan Planning & Designing Institute, Wuhan, China, Aug. 2015.
5. Outstanding Social Work Award, Summer Practice Program, Tsinghua University, Beijing, China, Oct. 2014.

4. Outstanding Voluntary Teaching Award, Summer Practice Program, Tsinghua University, Beijing, China, Oct. 2014.
3. University Scholarship, Excellent Practice Team Leader Scholarship, Tsinghua University, Beijing, China, Sep. 2014.
2. Second Prize, China Undergraduate Mathematical Contest in Modeling, Tsinghua University, Beijing, China, Jul. 2014.
1. **First Prize (Top 1/10000)**, National Chinese Physics Olympiad (CPhO), China, Oct. 2012.

## REFEREED PUBLICATIONS

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### Refereed Journal Publications

15. **C. Liu**, F. Yang, R. Ke, S. Yin, and Y. Wang\*. "Scale-Aware Representation Learning Empowered Sensing (SARLES) System for Pedestrian Crowds Perception in Complex Transportation Scenarios", accepted by Transportation Research Part C on Oct 2023, in press
14. **C. Liu**, H. Yang, Z. Cui, M. Zhu, R. Ke and Y. Wang\*. "3D Structural Information Sensing System (3D-SISS) based on Single Monocular Surveillance Camera for Fully-automatic Traffic Scene Perception", accepted by IEEE Transaction on Intelligent Transportation Systems on Oct 2023, in press.
13. **C. Liu**, H. Yang, M. Zhu, T. Vaa, and Y. Wang\*. "Real-time Multi-task Environmental Perception System for Traffic Safety Empowered by Edge Artificial Intelligence", in IEEE Transaction on Intelligent Transportation Systems, 2023, <https://doi.org/10.1109/TITS.2023.3309100>
12. **C. Liu**, H. Yang, Z. Cui, R. Ke, and Y. Wang\*. "Cooperative and Comprehensive Multi-task Surveillance Sensing and Interaction System Empowered by Edge Artificial Intelligence" in Transportation Research Record, 2023, <https://doi.org/10.1177/03611981231160174>.
11. **C. Liu**, H. Yang, R. Ke and Y. Wang\*. "Toward a Dynamic Reversible Lane Management Strategy by Empowering Learning-Based Predictive Assignment Scheme." in IEEE Transactions on Intelligent Transportation Systems, 2022, <https://doi.org/10.1109/TITS.2022.3202487>.
10. Z. Cui, M. Tsai, M. Zhu, H. Yang, **C. Liu**, S. Yin and Y. Wang\*. "Traffic Performance Score: Measure Urban Mobility and Online Predict Near-term Traffic like Weather Forecast." Transportation Research Record, 2024, <https://doi.org/10.1177/03611981231222232>
9. H. Yang, J. Cai, **C. Liu**, R. Ke, and Y. Wang\*. "Cooperative multi-camera vehicle tracking and traffic surveillance with edge artificial intelligence and representation learning." in Transportation Research Part C: Emerging Technologies, 2022, <https://doi.org/10.1016/j.trc.2022.103982>.
8. H. Yang, J. Cai, M. Zhu, **C. Liu** and Y. Wang\*. "Traffic-Informed Multi-Camera Sensing (TIMS) System Based on Vehicle Re-Identification." in IEEE Transactions on Intelligent Transportation Systems, 2022, <https://doi.org/10.1109/TITS.2022.3154368>.
7. H. Yang, **C. Liu**, Y. Zhuang, W. Sun, K. Murthy, Z. Pu, and Y. Wang\*. "Truck Parking Pattern Aggregation and Availability Prediction by Deep Learning." in IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 8, pp. 12778-12789, 2022, <https://doi.org/10.1109/TITS.2021.3117290>.
6. H. Yang, **C. Liu**, M. Zhu, X. Ban and Y. Wang\*. "How Fast You Will Drive? Predicting Speed of Customized Paths By Deep Neural Network." in IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 3, pp. 2045-2055, 2022, <https://doi.org/10.1109/TITS.2020.3031026>.
5. M. Zhu, H. Yang, **C. Liu**, Z. Pu and Y. Wang\*. "Real-time Crash Identification Using Connected Electric Vehicle Operation Data." Accident Analysis & Prevention, 173(2022), p.106708, 2022, <https://doi.org/10.1016/j.aap.2022.106708>.

4. R. Ke, **C. Liu**, H. Yang, W. Sun and Y. Wang\*. "Real-Time Traffic and Road Surveillance with Parallel Edge Intelligence," in IEEE Journal of Radio Frequency Identification, 2022, <https://doi.org/10.1109/JRFID.2022.3211262>.
3. X. Zhou, R. Ke\*, H. Yang, **C. Liu**. "When Intelligent Transportation Systems Sensing Meets Edge Computing: Vision and Challenges." Applied Sciences. 2021; 11(20):9680. <https://doi.org/10.3390/app11209680>.
2. J. Guo, X. Zhu, **C. Liu**, and SS Ge, "Resilience modeling method of airport network affected by global public health events." Mathematical Problems in Engineering 2021, 1-13, 2021, <https://doi.org/10.1155/2021/6622031>.
1. X. Fu, H. Yang, **C. Liu**, J. Wang and Y. Wang\*. "A hybrid neural network for large-scale expressway network OD prediction based on toll data." PloS one, 14(5), p.e0217241, 2019, <https://doi.org/10.1371/journal.pone.0217241>.

### Under Review Journal Submissions

10. **C. Liu**, C. Pu, L. Du, and Y. Wang\*. "Advancing Automatic Asset Management: An edge-based US-specific Traffic Sign Detection and Recognition (TSDR) System based on Image Processing," Journal of Transportation Engineering, Part A: Systems, Dec. 2023, under review.
9. **C. Liu**, C. Pu, L. Du, and Y. Wang\*. "Potentials and Challenges of AI-Empowered Solutions to Urban Transportation Infrastructure Systems (UTIS): NSF AI-Transportation Workshop Phase I." Journal of Transportation Engineering, Part A: Systems, Sep. 2023, under review.
8. C. Pu, **C. Liu**, Y. Wang, and L. Du\*. "Frontiers of Emerging AI Technologies Best Practices and Workforce Development in Transportation: NSF AI-Transportation Workshop Phase II" Journal of Transportation Engineering, Part A: Systems, Oct. 2023, under review.
7. H. Yang, **C. Liu**, M. Zhu, Y. Chen, and Y. Wang\*. "Trustworthy Cost-effective Vehicle Recognition System Empowered by Micro-Pulse LiDAR and Edge Artificial Intelligence." IEEE Transactions on Intelligent Vehicles, Sep. 2023, under review.
6. **C. Liu**, Y. Zhang, H. Yang, Z. Song, and W. Sun\*. "Real-time Trajectory Prediction for Potential Collision Warning System in Intersection." Journal of Intelligent Transportation Systems, Mar. 2023, under review.
5. **C. Liu**, W. Sun, L. Gong, Z. Song and Y. Wang\*. "Self-calibration Surveillance System for Dilemma Zone Detection and Warning." Journal of Intelligent Transportation Systems, Apr. 2023, under review.
4. **C. Liu**, H. Yang, M. Zhu, Zihe Song, Y. Wang\*. "Real-time Vehicle Turning Movements Tracking based on Single Monocular Surveillance Camera with Edge Computing." Submitted to Journal of Intelligent Transportation Systems, Oct. 2022, under review.
3. X. Ban, P. Chen, **C. Liu**, F. Wang, and R. Zhao\*. "Mitigating biases in big mobility data: a case study of monitoring large-scale transit systems." Transportation Letters: the International Journal of Transportation Research, Sep. 2023, under review.
2. H. Yang, J.cai, **C. Liu**, and Y.Wang\*. "De-biased Cost-effective Vehicle Classification System Empowered by Micro-Pulse LiDAR and Edge Artificial Intelligence." Submitted to IEEE Internet of Things Journal, Sep. 2022, under review
1. H. Yang, J.cai, **C. Liu** and Y. Wang\*. "Privacy-preserving Non-motorized Users and Disabilities Detection and Tracking by Learning Few-shot Representations." Submitted to IEEE Internet of Things Journal, Sep. 2022, under review.

### Refereed Conference Proceedings

30. **C. Liu**, H. Yang, K. Ma, X. Jiang, S. Yin, and Y. Wang\*. "Scale-Aware Representation Learning Empowered Sensing (SARLES) System for Pedestrian Crowds Perception in Complex Transportation Scenarios.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
29. **C. Liu**, L. Lu, Y. Zhang, H. Yang, M. Zhu, and Y. Wang\*. "Single Monocular Camera System for Road Visibility Measurement: A Dark Channel Prior-Based Approach.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.

28. **C. Liu**, O. Wiesner, H. Yang, M. Tsai, and Y. Wang\*. "Bi-level Optimization Algorithm for Dynamic Reversible Lane Control based on Short-term Traffic Flow Prediction.", **Lectern Session**, Accepted, 4<sup>th</sup> International Symposium on Freeway and Tollway Operations, Vienna, Austria, Jun. 2023.
27. **C. Liu**, H. Yang, R. Ke, W. Sun, J. Wang and Y. Wang\*. "Cooperative and Comprehensive Multi-task Surveillance Sensing and Interaction System Empowered by Edge Artificial Intelligence." **Best Paper Award of TRB AED30 Committee, Lectern Session**, Proceedings of the 102<sup>nd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2023.
26. **C. Liu**, H. Yang, R. Ke and Y. Wang\*. "Edge-based Automatic Real-time Road Surface Condition Monitoring System (RSCMS) based on Single Monocular Surveillance Camera.", Proceedings of the 102<sup>nd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2023.
25. **C. Liu**, H. Yang, S. Yin, G. Dolley, and Y. Wang\*. "Edge-based Real-time Roadway Environment Detection and Warning System for Traffic Safety based on Single Monocular Surveillance Camera", **First Prize, Lectern Session**, 2<sup>nd</sup> Metro-Lab Network's Annual Summit, Chicago, IL, USA, May 2022.
24. **C. Liu**, H. Yang, Z. Cui, W. Sun, and Y. Wang\*. "3D Structural Information Sensing System (3D-SISS) based on Car Key-points Detection with Single Monocular Surveillance Camera (TRBAM-22-04562)", Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
23. **C. Liu**, H. Yang, H. Chen, and Y. Wang\*. "Bi-level Optimization Algorithm for Dynamic Reversible Lane Control based on Short-term Traffic Flow Prediction (TRBAM-21-03352)." Proceedings of the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2021.
22. **C. Liu**, H. Yang, N. Dong, and Y. Wang\*. "Advanced Multidimensional Sequence Alignment Method (AMSAM) for Activity-based Travel Pattern Similarity Identification." Proceedings of 2020 ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2020.
21. **C. Liu**, H. Yang, P. Xu, X. Fu, and Y. Wang\*. "Advanced Multidimensional Sequence Alignment Method for Activity-Based Travel Pattern Similarity Identification (TRBAM-20-03210)." Proceedings of the 99<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2020.
20. S. Yin, R. Ke, **C. Liu**, Z. Cui, R. Shrestha, and Y. Wang\*. "Automated Road Infrastructure Safety Assessments with Emerging Data Sources: a Survey.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
19. N. Jantarathaneewat, **C. Liu**, H. Yang, Y. Chen, M. Tsai, and Y. Wang\*. "Advancing Automatic Asset Management: An Innovative System for Traffic Sign Detection and Recognition with Monocular Camera.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
18. H. Yang, **C. Liu**, B. Zhang, M. Tsai, Z. Pu, Y. Wang\*. "Trustworthy Cost-effective Vehicle Recognition System Empowered by Micro-Pulse LiDAR and Edge Artificial Intelligence.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
17. H. Yang, **C. Liu**, M. Zhu, R. Ke, and Y. Wang\*. "Mitigating the Bias for Traffic Visual Perception Systems Empowered by Learning Few-Shot Representations.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
16. M. Tsai, **C. Liu**, H. Yang, X. Jiang, M. Zhu, and Y. Wang\*. "Unified Framework for Multi-Contrastive Learning in Spatial-Temporal Traffic Forecasting.", Proceedings of the 103<sup>rd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2024.
15. M. Zhu, H. Yang, **C. Liu** and Y. Wang\*. "Multi-Agent Deep Reinforcement Learning for Network-Wide Traffic Signal Control." Accepted, Proceedings of the 102<sup>nd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2023.
14. H. Yang, **C. Liu**, M. Zhu, Y. Wang\*. "Cooperative Perception and Interaction Smart Node for Non-motorized Users and Disabilities Empowered by Edge Ensemble Learning (TRBAM-23-04541)." Proceedings of the 102<sup>nd</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2023.

13. R. Ke, **C. Liu**, H. Yang, W. Sun and Y. Wang\*. "Real-Time Traffic and Road Surveillance with Parallel Edge Intelligence", **Outstanding Paper Award**, The 2nd IEEE International Conference on Digital Twins and Parallel Intelligence (IEEE DTPI), Boston, MA, USA, Oct. 2022.
12. M. Tsai, Z. Cui, **C. Liu**, H. Yang and Y. Wang\*. "An Incremental Learning-Based Framework for Non-Stationary Traffic Representations Clustering and Forecasting." Proceedings of the 25<sup>th</sup> IEEE International Conference on Intelligent Transportation Systems (ITSC 2022), Macau, China, Oct. 2022.
11. H. Yang, **C. Liu**, R. Ke, M. Zhu, and Y. Wang\*. "RISTS: Real-time IoT System for Traffic Sensing by Edge Computing and Multi-camera Vehicle Re-identification (TRBAM-22-04404)." **Lectern Session**, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection, Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
10. H. Yang, M. Tsai, **C. Liu**, and Y. Wang\*. "Equity-aware Cost-effective Vehicle Classification System by Compact Pulse LiDAR and Edge Artificial Intelligence (TRBAM-22-04640)." **Lectern Session**, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection. Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
9. R. Ke, **C. Liu**, Z. Pu, H. Yang, Y. Zhuang, and Y. Wang\*. "Multi-Task System for Real-Time Surveillance of Road and Traffic with Edge Artificial Intelligence (TRBAM-22-00979)", **Lectern Session**, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection, Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
8. H. Yang, M. Tsai, **C. Liu**, and Y. Wang\*. "Equity-aware Cost-effective Vehicle Classification System by Compact Pulse LiDAR and Edge Artificial Intelligence (TRBAM-22-04640)." **Lectern Session**, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection. Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
7. Z. Cui, M. Tsai, H. Yang, **C. Liu**, and Y. Wang\*. "Traffic Performance Score 2.0: Measure Urban Mobility and Online Predict Near-term Traffic like Weather Forecast (TRBAM-22-04705)", Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection. Proceedings of the 101<sup>st</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
6. H. Yang, **C. Liu**, Y. Zhuang, W. Sun, and Y. Wang\*. "Truck Parking Pattern Aggregation and Real-time Availability Prediction by Multi-task Learning (TRBAM-21-04040)" Proceedings of the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2021.
5. H. Yang, M. Zhu, R. Ke, **C. Liu**, and Y. Wang\*. "Novel Network-Scale Traffic Sensing Approach Using Multi-camera Object Tracking and Re-Identification (TRBAM-21-04114)." Proceedings of the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2021.
4. H. Yang, **C. Liu**, R. Ke, M. Zhu, and Y. Wang\*. "Privacy-preserving Non-motorized Users and Disabilities Detection and Tracking by Learning Few-shot Representations (TRBAM-21-02145)." Proceedings of the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2021.
3. H. Yang, M. Zhu, **C. Liu**, and Y. Wang\*. "A Novel Framework for City-scale Road Network Congestion Prediction and Cascading Analysis based on Multi-Target Multi-Camera Tracking (MTMCT)." Proceedings of the 2020 ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2020.
2. H. Yang, **C. Liu**, M. Zhu, W. Sun, and Y. Wang\*. "Hybrid Data-fusion Model for Short-term Road Hazardous Segments Identification based on the Acceleration and Deceleration Information." Proceedings of the 2020 ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2020.
1. H. Yang, **C. Liu**, X. Ban, C. Zhang, and Y. Wang\*. "Cell-speed Prediction Neural Network (CPNN): A Deep Learning Approach for Trip-based Speed Prediction (TRBAM-19-02492)." Proceedings of the 98<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2019.

## PATENTS SUBMITTED & AWARDED

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3. **C. Liu**, R. Ke, and Y. Wang. "Dark Channel Prior Real-time Visibility Detection Using Monocular Surveillance Cameras". Patent application filed Apr. 15, 2022.
2. Z. Pu, R. Ke, **C. Liu**, H. Yang, Y. Wang. "Traffic Sensor and System", Provisional Patent Application, Filed Oct. 28, 2021, 48858.01US1.
1. **C. Liu**, Z. Pu, and C. Shi. "Sensor Platform Design", Design Patent, Filed Jul. 14, 2021, Patent No.: ZL 2021 3 0445061. X, CN 306978071 S.

## TECHNICAL REPORTS

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5. Y. Wang, W. Sun, and **C. Liu**. "Cost-effective Approach Towards Building a Traffic Sign Data Inventory Using Open Street Images" Final Project Report for Connected Cities with Smart Transportation (C2Smart) Center. Sep. 2023. <https://rosap.ntl.bts.gov/view/dot/72351>
4. Y. Wang and **C. Liu**. "3D Structural Information Sensing System (3D-SISS) based on Road-side Unit (RSU)." Final Project Report for Pacific Northwest Transportation Consortium (PacTrans). Mar. 2023.
3. Y. Wang, W. Sun, and **C. Liu**. "Implement Sensors along Local Roadway for Data Collection, Condition Assessment, and V2X Applications." Final Project Report for FHWA Washington State Transportation Innovation Council (STIC) Incentive Program. Dec. 2022.
2. Y. Wang, W. Sun, and **C. Liu**. "Cooperative Perception of Road-Side Unit and Onboard Equipment with Edge Artificial Intelligence for Driving Assistance." Final Project Report for Connected Cities with Smart Transportation (C2Smart) Center. Nov. 2021. <https://rosap.ntl.bts.gov/view/dot/60635>
1. Y. Wang, Y. Zhuang, R. Ke, **C. Liu**, Z. Pu, and H. Yang. "A Multi-Sensor Solution for Sound Transit Parking Space Detection." Final Research Report for Sound Transit. Dec. 2018.

## PROPOSAL WRITING

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11. **Accepted**. Complete proposal drafting, revision, and finalization. Funded by FHWA Washington State Transportation Innovation Council (STIC) Incentive Program, "An Innovative Internet of Things (IoT) Technologies for Active Transportation Sensing and I2X Applications", \$50,000, Oct. 2023
10. **Accepted**. Complete proposal drafting, revision, and finalization. Funded by Washington State Department of Transportation (WSDOT), "Cost-effective Traffic and Roadway Data Collection Using Edge-based Comprehensive Sensing System: A Machine Learning based Approach", \$200,000, Sep. 2023
9. **Under Review**. Contribute to proposal revision. NSF Cyber-Physical Systems (CPS) program, "Learning-based Optimal Curb Space Management in Emerging Intelligent Urban Transportation Systems", \$1,050,000.
8. **Accepted**. Contribute to figure design and proposal revision. Funded by USDOT regional Transportation University Center (UTC) program, "Pacific Northwest Transportation Consortium (PacTrans)", \$15,000,000, Oct. 2022.
7. **Accepted**. Complete proposal drafting, revision, and finalization. Funded by Pacific Northwest Transportation Consortium (PacTrans), "Roadway Traffic and Environmental Conditions Monitoring and Safety Alert System", \$20,000, Sep. 2022.
6. **Accepted**. Complete proposal drafting and revision. Funded by Washington State Department of Transportation (WSDOT), "Computer Vision for Automated Traffic Sign Detection and Data Inventory", \$200,000, Jul. 2022.
5. **Accepted**. Complete proposal drafting, revision, and finalization. Funded by Pacific Northwest Transportation Consortium (PacTrans), "3D Structural Information Sensing System (3D-SISS) based on Road-side Unit (RSU)", \$80,000, Dec. 2021.
4. **Accepted**. Complete proposal drafting and revision. Funded by Center for Safety Equity in Transportation (CSET), "Cost-Effective System for Rural Roadway Traffic, Surface Conditions and Weather Conditions Monitoring", \$520,000, Sep. 2021.

3. **Accepted.** Complete proposal drafting, revision, and finalization. Funded by Connected Cities with Smart Transportation (C2Smart), "Cost-effective Approach Towards Building a Traffic Sign Data Inventory Using Open Street Images", \$160,000, Mar. 2021.
2. **Accepted.** Complete proposal drafting, revision, and finalization. Funded by FHWA Washington State Transportation Innovation Council (STIC) Incentive Program, "An Innovative Internet of Things (IoT) Technology for Comprehensive Traffic Sensing and V2X Applications ", \$930,000, Mar. 2021.
1. **Accepted.** Complete proposal drafting, revision, and finalization. Funded by University of Washington CoMotion Center, "Mobile Unit for Sensing Traffic (MUST)", \$100,000, Jul. 2020.

## PROFESSIONAL SERVICES

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### Academic Journal Guest Editor

Guest Editor, Digital Transportation and Safety (DTS) for the special issue "Smart and Green Travel with Mobility as a Service", since 2023

### Board Member

Board Member of student sub-committee, ASCE T&DI AI Committee, since 2023

### Committee Member

Young Member. TRB Standing Committee on Traffic Signal Systems (ACP25), since 2023.

Member. ASCE Active Transportation Committee, since 2023.

Associate Member. ASCE Artificial Intelligence in Transportation Committee, since 2023.

Student Member. ASCE Artificial Intelligence in Transportation Committee, 2022 - 2023.

Young Member. TRB Standing Committee on Managed Lanes (ACP35), 2020 - 2022.

### Academic Society Membership

Student Member. Institute of Transportation Engineers (ITE), since 2021.

Student Member. Institute of Electrical and Electronics Engineers (IEEE), since 2020.

Student Member. American Society of Civil Engineers (ASCE), since 2020.

Student Member. Chinese Overseas Transportation Association (COTA), since 2020.

## RESEARCH EXPERIENCE

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### Research Assistant

*Smart Transportation Application & Research Lab (STAR Lab), University of Washington*

Advisor: Professor Yin Hai Wang

Seattle, WA, USA

09/2018 – present

### Applied Scientist

*AIWaysion Inc.*

Advisor: Dr. Wei Sun

Seattle, WA, USA

06/2022 – 03/2023

### Research Assistant

*Tsinghua-Gaode Research Institute*

Advisor: Professor Meng Li

Beijing, China

06/2016 – 06/2017

### Research Intern

*Tencent Holdings Limited*

Advisor: Dr. Hongxia Liu

Beijing, China

10/2016 – 01/2017

### Intern Engineer

*China Construction Eighth Engineering Division. Corp. LTD*

Advisor: Dr. Qing Ye

Beijing, China

06/2016 – 08/2016



## TEACHING EXPERIENCE

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<b>Guest Lecture</b> <i>America's Car Museum High School Student Summer Camp</i> <ul style="list-style-type: none"><li>• Main course (basic CAV knowledge) design and instruction</li><li>• Practice session (data collection and experiments) design and instruction</li></ul>	Tacoma, WA, USA 07/2023
<b>Teaching Assistant</b> <i>Graduate Level Course: CET 590 Traffic Systems Operation</i> <ul style="list-style-type: none"><li>• Practice sessions design, organization, and instruction</li><li>• Assignments grading, simulation tutoring, and exams preparation</li></ul>	Seattle, WA, USA 09/2022 - 12/2022
<b>Instructor</b> <i>C2Smart Learning Hub Training Courses: Computer Vision in Transportation</i> <ul style="list-style-type: none"><li>• Main course design, organization, and instruction</li><li>• Practice session design, organization, and instruction</li></ul>	New York, NY, USA 01/2022 - 04/2022
<b>Guest Lecture</b> <i>Graduate Level Course: CET 590 Traffic Systems Operation</i> <ul style="list-style-type: none"><li>• Topic: An Innovative Comprehensive Sensing System: Mobile Unit for Sensing Traffic (MUST)</li></ul>	Seattle, WA, USA 11/2021
<b>Guest Lecture</b> <i>PacTrans Workforce Development Institute Phase II Training Course</i> <ul style="list-style-type: none"><li>• Topic: Advanced Sensors &amp; Traffic Sensing Technologies</li></ul>	Seattle, WA, USA 03/2022
<b>Team Mentor</b> <i>University of Washington K-12 Program for High-school Students</i> <ul style="list-style-type: none"><li>• Main course (basic transportation knowledge) design and instruction</li><li>• Practice session (data collection and experiments) design and instruction</li></ul>	Seattle, WA, USA 07/2021

## INVITED ACADEMIC TALKS AND SEMINARS

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28. "Improving Transportation Safety with Edge Computing and Machine Learning Empowered Technologies", Invited Presentation to Norwegian University of Science and Technology, Nov. 2023
27. "University of Washington Transportation Research Resources and Example Projects at the PacTrans STAR Lab", Invited Presentation to Norwegian Public Roads Administration (NPRA), Oct. 2023
26. "WSF Terminal Wait Times Traveler Information System", Invited Presentation to Washington State Ferries (WFS), Sep. 2023
25. "Mobile Unit for Sensing Traffic (MUST) Sensor For Traffic Sensing & Applications", Invited Presentation to The Hong Kong University of Science and Technology (HKUST), Guangzhou, Aug. 2023
24. "Introduction of AI Technologies in Transportation: Connected and Autonomous Vehicle (CAV) Case Study", Invited Lecture to High School Students Summer Camp, America's Car Museum, Tacoma, WA, Jul. 2023
23. "An Innovative Internet of Things (IoT) Technologies for Active Transportation Sensing and I2X Applications", Invited Presentation, FHWA Washington State Transportation Innovation Councils (STIC), Jun. 2023
22. "3D Structural Information Sensing System (3D-SISS) based on Single Monocular Surveillance Camera for Fully-automatic Traffic Scene Perception", ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
21. "Zero-shot Learning based de-biased Automatic Traffic Sign Detection and Recognition for Transportation Asset Management", ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.

20. "Cooperative Traffic Signal Assistance System for Non-motorized Users and Disabilities Empowered by Computer Vision and Edge Artificial Intelligence", ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
19. "Enhancing-Minority Vehicle Classification System Empowered by Micro-Pulse LiDAR and Edge Artificial Intelligence", ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
18. "Cooperative and Comprehensive Multi-task Surveillance Sensing and Interaction System Empowered by Edge Artificial Intelligence", ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
17. "Research Highlights for Ph.D. Students", Invited Young Faculty & Practitioner Workshop Panel Speaker, ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
16. "Research, Careers, and Service Roundtable", Invited Young Faculty & Practitioner Workshop Panel Speaker, ASCE International Conference on Transportation and Development (ICTD), Austin, TX, USA, Jun 2023.
15. "An AI-empowered Surveillance System on Edge for Active Transportation Safety", Cooper Jones Active Transportation Safety Council Meeting, Washington Traffic Safety Commission (WTSC), Seattle, WA, USA, Mar. 2023.
14. "Traffic Sensing for E8 Corridor Performance Monitoring and Travel Reliability Enhancement", Invited presentation to Norwegian Public Roads Administration (NPRA), Trondheim, Trøndelag, Norway, Feb. 2023.
13. "Cooperative and Comprehensive Multi-task Surveillance Sensing and Interaction System Empowered by Edge Artificial Intelligence", **Best Paper Award**, committee meeting of Information Systems and Technology (AED30) Standing Committee, Washington D.C. USA, Jan. 2023.
12. "MUST Sensor for Ped/Bike/Car", Track 4: Advances in Video Technology in Traffic Monitoring, 2022 National Travel Monitoring Expo and Conference (NaTMEC). Online, Jun. 2022.
11. "Real-time IoT System for Traffic Sensing by Edge Computing and Multi-camera Vehicle Re-identification", Podium Presentation of AI & Big Data Track, Sensing and Data Analytics, ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2022.
10. "Traffic Sign Detection and Recognition for Autonomous Driving in Virtual Simulation Environment", Podium Presentation of AI & Big Data Track, Sensing and Data Analytics, ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2022.
9. "Transfollower: Long Sequence Car-Following Trajectory Prediction through Transformer", Podium Presentation of AI & Big Data Track, AI in Transportation I, ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2022.
8. "Edge-based Automatic Real-time Road Surface Condition Monitoring System (RSCMS) based on Single Monocular Surveillance Camera", Podium Presentation of AI & Big Data Track, AI in Transportation II, ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2022.
7. "Towards Equal Traffic Signal Services for Non-motorized Users and Disabilities in Connected Vehicle Environment by Edge Computing", Podium Presentation of AI & Big Data Track, AI in Transportation I, ASCE International Conference on Transportation and Development (ICTD), Seattle, WA, USA, May 2022.
6. "Equality-aware Cost-effective Vehicle Classification System by Compact Pulse LiDAR and Edge Artificial Intelligence", Lectern Session, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection, the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
5. "Multi-Task System for Real-Time Surveillance of Road and Traffic with Edge Artificial Intelligence", Lectern Session, Advances in Edge Computing for Intelligent Real-Time Traffic Sensing and Detection, the 100<sup>th</sup> Annual Meeting of Transportation Research Board, Washington D.C. USA, Jan. 2022.
4. "Edge-based Real-time Roadway Environment Detection and Warning System for Traffic Safety based on Single Monocular Surveillance Camera", Winner, 2<sup>nd</sup> Metrolab Network's Annual Summit, Chicago, IL, May 2022.
3. "Cooperative Perception of Road-Side Unit and Onboard Equipment with Edge Artificial Intelligence for Driving Assistance", Connected Cities with Smart Transportation (C2Smart) Annual Meeting, New York, NY, USA, Dec. 2021.

2. "Curb Space Monitoring and Management Using Mobile Unit for Sensing Traffic (MUST) Sensors", City of Bellevue, Bellevue, WA, USA, Jul. 2020.
1. "Curbside Management Challenges and Pilot Project", Pacific Northwest Transportation Consortium (PacTrans) Annual Conference, Success Story, Seattle, WA, USA, Dec. 2020.

## REFeree FOR JOURNALS AND CONFERENCES

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### Peer Review Journals

Transportation Research Part C: Emerging Technologies, since 2018  
 IEEE Transactions on Vehicular Technology, since 2020  
 IEEE Transactions on Intelligent Transportation Systems, since 2017  
 IEEE Transactions on Neural Networks and Learning Systems, since 2021  
 IEEE Transactions on Circuits and Systems for Video Technology, since 2021  
 IEEE Intelligent Transportation Systems Magazine, since 2017  
 IEEE Transactions on Knowledge and Data Engineering, since 2021  
 IEEE Internet of Things Journal, since 2022  
 International Journal of Intelligent Systems, since 2021  
 Journal of Advanced Transportation, since 2019  
 IET Intelligent Transport Systems, since 2020  
 Accident Analysis & Prevention, since 2020  
 Transportation Research Record, since 2020  
 Journal of Intelligent Transportation Systems, since 2018  
 ASCE Journal of Transportation Engineering, Part A: Systems, since 2019  
 Transportmetrica B-Transport Dynamics, since 2020  
 Scientific Reports, since 2021  
 PLoS ONE, since 2018

### Conferences

Conference on Computer Vision and Pattern Recognition (CVPR), since 2017  
 Association for the Advancement of Artificial Intelligence (AAAI), since 2021  
 IEEE International Conference on Computer Vision (ICCV), 2020  
 Special Interest Group on Knowledge Discovery and Data Mining (SIGKDD), since 2021  
 IEEE International Intelligent Transportation Systems Conference, 2019-2020  
 TRB AED20 Urban Transportation Data and Information Systems Standing Committee, since 2022  
 TRB ACP25 Standing Committee on Intelligent Transportation Systems, since 2019  
 TRB ACP35 Standing Committee on Freeway Operations, since 2020  
 ACP70 Standing Committee on Highway Traffic Monitoring, since 2021  
 AED30 Standing Committee on Information Systems and Technology, since 2019  
 AED50 Standing Committee on Artificial Intelligence and Advanced Computing Application, since 2017  
 AED70 Standing Committee on Freight Transportation Data, since 2021  
 AED80 Standing Committee on Visualization in Transportation, 2017-2018  
 ASCE International Conference on Transportation & Development (ICTD), since 2020  
 International Conference on Transportation Information and Safety, 2021  
 COTA International Conference of Transportation Professionals, since 2019  
 IEEE International Smart Cities Conference, since 2021

## SKILLS

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- **Programming:** Python, C, R, SQL, C++, HTML/CSS, Java
- **Deep learning frameworks:** Pytorch, TensorFlow, TensorRT
- **Edeg Devices:** Raspberry Pi4, Nvidia Jetson Nano, Nvidia Jetson Xavier NX
- **Simulation Tools:** VISSIM, SUMO
- **Design and 3D Modeling:** AutoCAD, Revit, Fusion 360, SolidWork
- **Languages:** English, Mandarin