

# Zhiyong CUI

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## RESEARCH INTEREST

- Urban Data Science
- Artificial Intelligence in Transportation
- Connected Autonomous Vehicles
- Intelligent Transportation Systems

## EDUCATION

<b>University of Washington</b> , Seattle, USA <i>Ph.D. in Civil Engineering (Intelligent Transportation Systems)</i> Dissertation: Artificial Intelligence based Transportation Data Modeling and Applications Advisor: Prof. Yinhai Wang Tools Developed: [ <a href="#">TraffiX</a> ], [ <a href="#">TPS</a> ], [ <a href="#">DRIVE Net</a> ]	2015– 2020 (expected)
<b>National Taiwan University</b> , Taipei, Taiwan <i>Visiting M.S. Student in Computer Science</i> Advisor: Prof. Hsin-Mu Tsai	Feb. – July 2014
<b>Peking University</b> , Beijing, China <i>M.S. in Software Engineering</i> Thesis: Autonomous Front-Vehicle Taillights Detection and Signal Recognition Advisor: Prof. Ying Huang and Prof. Tong Mo	2012 – 2015
<b>Beihang University</b> , Beijing, China <i>B.S.E in Software Engineering</i>	2008 – 2012

## HONORS AND AWARDS

Student Paper Award, “Graph Markov Network for Traffic Forecasting with Missing Data” Transportation Statistics Interest Group (TSIG), American Statistical Association (ASA)	2020
Student Travel Award, Joint Statistical Meeting	2020
Second Place in Student Poster Award, PacTrans   CSET Region 10 Transportation Conference	2019
Outstanding Award, Transportation Forecasting Competition (TRANSFOR19)	2019
Outstanding Award, 3rd DI-TECH Transportation Algorithm Competition	2018
Graduate Student Travel Award, PacTrans	2016-2020
AASHTO High Value Research Project Award	2016
Outstanding master’s thesis nomination (Peking University Software Engineering Communication)	2015
Second Place Award, International Contest of Network of Things	2011
Excellent Student Cadre Award, Beihang University	2008 – 2011
Scholarship of Innovation Work, Beihang University	2008 – 2012
Emergency Treatment Volunteer Award, Beihang University	2009

## REFEREED JOURNAL PUBLICATIONS

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- J1. **Cui Z**, Lin L, Pu Z, Wang Y\*. (2020) Graph Markov Network for Traffic Forecasting with Missing Data. *Transportation Research Part C: Emerging Technologies* (**ASA TSIG Student Paper Award**)
- J2. **Cui Z**, Ke R, Wang Y\*. (2020) Stacked Bidirectional and Unidirectional LSTM Recurrent Neural Network for Forecasting Network-wide Traffic State with Missing Values. *Transportation Research Part C: Emerging Technologies*
- J3. **Cui Z**, Ke R, Pu Z, Ma X, Wang Y\*. (2020) Learning Traffic as a Graph: A Gated Graph Wavelet Recurrent Neural Network for Network-scale Traffic Prediction. *Transportation Research Part C: Emerging Technologies* (doi: [10.1016/j.trc.2020.102620](https://doi.org/10.1016/j.trc.2020.102620))
- J4. **Cui Z**, Henrickson K, Ke R, Wang Y\*. (2019) Traffic Graph Convolutional Recurrent Neural Network: A Deep Learning Framework for Network-Scale Traffic Learning and Forecasting. *IEEE transaction on Intelligent Transportation Systems* (doi: [10.1109/TITS.2019.2950416](https://doi.org/10.1109/TITS.2019.2950416))
- J5. **Cui Z**, Long Y\*. (2019) Perspectives on Stability and Mobility of Transit Passenger's Travel Behaviour through Smart Card Data. *IET Intelligent Transport Systems*. (doi: [10.1049/iet-its.2019.0212](https://doi.org/10.1049/iet-its.2019.0212))
- J6. **Cui Z**, Henrickson K, Biancardo S, Pu Z, Wang Y\*. (2019) Establishing a Multi-Source Data Integration Framework for Transportation Data Analytics. *Journal of Transportation Engineering, Part A: Systems* (in press). (doi: [10.1061/JTEPBS.0000331](https://doi.org/10.1061/JTEPBS.0000331))
- J7. Ma X, Li Y, **Cui Z**\*, Wang Y. (2020) Forecasting Transportation Network Speed Using Deep Capsule Networks with Nested LSTM Models. *IEEE transaction on Intelligent Transportation Systems* (doi: [10.1109/TITS.2020.2984813](https://doi.org/10.1109/TITS.2020.2984813))
- J8. Pu Z, **Cui Z**, Wang S, Li Q, Wang Y\*. (2020) Time-Aware Gated Recurrent Unit Networks for Road Surface Friction Prediction Using Historical Data. *IET Intelligent Transport Systems*. (doi: [10.1049/iet-its.2019.0428](https://doi.org/10.1049/iet-its.2019.0428))
- J9. Ke R, Li W, **Cui Z**, Wang Y\*. (2020) Two-Stream Multi-Channel Convolutional Neural Network (TM-CNN) for Multi-Lane Traffic Speed Prediction Considering Traffic Volume Impact. *Transportation Research Record* (doi: [10.1177/0361198120911052](https://doi.org/10.1177/0361198120911052))
- J10. Ke R, Feng S, **Cui Z**, Wang Y\*. (2020) An advanced framework for microscopic and lane-level macroscopic traffic parameters estimation from UAV video. *IET Intelligent Transport Systems* (doi: [10.1049/iet-its.2019.0463](https://doi.org/10.1049/iet-its.2019.0463))
- J11. Pu Z, Zhu M, Li W, Cui Z, Guo X, Wang Y. (2020) Monitoring Public Transit Ridership Flow by Passively Sensing Wi-Fi and Bluetooth Mobile Devices. *IEEE Internet of Things Journal*
- J12. Wang Y\*, **Cui Z**. (2019) The Development of Smart Transportation in Urgent Need of Transportation Data Science (in Chinese). *Urban Transport of China*, 17(3), 8-10. (doi: [10.13813/j.cn11-5141/u.2019.0301](https://doi.org/10.13813/j.cn11-5141/u.2019.0301))
- J13. Liang Y, **Cui Z**, Tian Y, Chen H, Wang Y\*. (2018) A Deep Generative Adversarial Architecture for Network-Wide Spatial-Temporal Traffic State Estimation. *Transportation Research Record*, 2672(45), 87-105. (doi: [10.1177/0361198118798737](https://doi.org/10.1177/0361198118798737))
- J14. Ke R, Li Z, Kim S, Ash J, **Cui Z**, Wang Y\*. (2017) Real-time bidirectional traffic flow parameter estimation from aerial videos. *IEEE Transactions on Intelligent Transportation Systems*, 18(4), 890-901. (doi: [10.1109/TITS.2016.2595526](https://doi.org/10.1109/TITS.2016.2595526))
- J15. Chen X, Li Z, Wang Y, **Cui Z**, Shi C, Wu H\*. (2017). Evaluating the impacts of grades on vehicular speeds on interstate highways. *PloS one*, 12(9), e0184142. (doi: [10.1371/journal.pone.0184142](https://doi.org/10.1371/journal.pone.0184142))

## PAPERS IN REVIEW

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- [1] **Cui Z**, Fu M, Zhu M, Ban X, Wang Y\*. (2019) Transportation Artificial Intelligence Platform for Traffic Forecasting. *Transportation Research Record* (under first round review)
- [2] **Cui Z**, Wang X, Wang Y\*. (2020) Understanding Limits of Predictability in Free-floating Car Sharing Vehicles' Mobility. *Transportation* (under first round review)

- [3] Pu Z, **Cui Z**, Zhu M, Wang Y\*. (2019) Mining Public Transit Ridership Flow and Origin-Destination Information from Wi-Fi and Bluetooth Sensing Data. *Transportation Research Part C: Emerging Technologies* (under first round review)
- [4] Zhu M, Zhu W, Lutin J, **Cui Z**, Yinhai Wang\*. (2020) Developing a Statistically Valid and Practical Method to Compute State-Level Bus Occupancy Rates. *Transportation Research Part A: Policy and Practice* (under first round review)

## REFEREED CONFERENCE PROCEEDINGS

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- C1. **Cui Z**, Lin L, Pu Z, Wang Y. (2020) Graph Markov Network for Traffic Forecasting with Missing Data. *Transportation Research Board 99th Annual Meeting*
- C2. **Cui Z**, Fu M, Zhu M, Ban X, Wang Y. (2020) Transportation Artificial Intelligence Platform for Traffic Forecasting. *Transportation Research Board 99th Annual Meeting*
- C3. Ke R, Li W, **Cui Z**, Wang Y. (2020) Two-Stream Multi-Channel Convolutional Neural Network (TM-CNN) for Multi-Lane Traffic Speed Prediction Considering Traffic Volume Impact. *Transportation Research Board 99th Annual Meeting*
- C4. Pu Z, Guo X, **Cui Z**, Zhu M, Wang Y. (2020) Mining Public Transit Ridership Flow and Origin-Destination Information from Wi-Fi and Bluetooth Sensing Data. *Transportation Research Board 99th Annual Meeting*
- C5. **Cui Z**, Henrickson K, Ke R, Dong X, Wang Y. (2019) High-Order Graph Convolutional Recurrent Neural Network: A Deep Learning Framework for Network-Scale Traffic Learning and Forecasting. *Transportation Research Board 98th Annual Meeting*
- C6. **Cui Z**, Henrickson K, Pu Z, Guo G, Wang Y. (2019) A New Multi-Source Traffic Data Integration Framework for Traffic Analysis and Performance Measurement. *Transportation Research Board 98th Annual Meeting*.
- C7. Ke R, Feng S, **Cui Z**, Wang Y. (2019) An Advanced Framework for Traffic Parameters Estimation from UAV Video. *Transportation Research Board 98th Annual Meeting* (No. 19-02564).
- C8. Ke R, Li W, **Cui Z**, Wang Y. (2018) Multi-Lane Traffic Pattern Learning and Forecasting Using Convolutional Neural Network. *COTA International Symposium on Emerging Trends in Transportation (ISETT)*.
- C9. **Cui Z**, Ke R, Wang Y. (2017) Deep Bidirectional and Unidirectional LSTM Recurrent Neural Network for Network-wide Traffic Speed Prediction. *ACM SIGKDD International Workshop on Urban Computing (UrbComp)*
- C10. Wang X, MacKenzie D, **Cui Z**. (2017) Complement or Competitor? Comparing car2go and Transit Travel Times, Prices, and Usage Patterns in Seattle. *Transportation Research Board 96th Annual Meeting* (No. 17-06234).
- C11. Pu Z, Li Z, Zhu W, **Cui Z**, Wang Y. (2017) Evaluating Safety Effects of Variable Speed Limit System using Empirical Bayesian Before-After Analysis. *Transportation Research Board 96th Annual Meeting* (No. 17-05863).
- C12. **Cui Z**, Zhang S, Henrickson K, Wang Y. (2016) New progress of DRIVE Net: An E-science transportation platform for data sharing, visualization, modelling, and analysis. *IEEE International Smart Cities Conference (ISC2)*, (pp. 1-2).
- C13. **Cui Z**, Long Y, Ke R, Wang, Y. (2015) Characterizing evolution of extreme public transit behavior using smart card data. *IEEE International Smart Cities Conference (ISC2)*, (pp. 1-6).
- C14. **Cui Z**, Long Y. (2015) Perspectives on Stability and Mobility of Passenger's Travel Behaviour through Smart Card Data. *ACM SIGKDD International Workshop on Urban Computing (UrbComp)*.
- C15. **Cui Z**, Yang S W, Tsai H M (2015) A vision-based hierarchical framework for autonomous front-vehicle taillights detection and signal recognition. *IEEE International Conference on Intelligent Transportation Systems (ITSC)*, (pp. 931-937).
- C16. Gao Y, Swaminathan K, **Cui Z**, Su, L. (2015) Predictive Traffic Assignment: A New Method and System for Optimal Balancing of Road Traffic. *IEEE 18th International Conference on Intelligent Transportation Systems (ITSC)*, (pp. 400-407).
- C17. **Cui Z**, Wang C, Tsai H M. (2014) Characterizing channel fading in vehicular visible light communications with video data. *IEEE Vehicular Networking Conference (VNC)*, (pp. 226-229).

- C18. **Cui Z**, Yang S W, Wang C, Tsai H M. (2014) On addressing driving inattentiveness: Robust rear light status classification using hierarchical matching pursuit. *IEEE 17th International Conference on Intelligent Transportation Systems (ITSC)*, (pp. 2243-2244).

## TECHNICAL REPORTS

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- R1. Wang Y, Ban X, **Cui Z**, Zhu M. (2019) An artificial intelligence platform for network-wide congestion detection and prediction using multi-source data. Connected Cities and Smart Mobility (C2SMART) Research Report (USDOT award number: 69A3551747124)
- R2. Wang Y, **Cui Z**, Henrickson, K. (2018) Pilot Testing of SHRP2 Reliability Data and Analytical Products: Washington. SHRP2 Reliability Project L38 Report.
- R3. Hallenbeck M, Ishimaru J, **Cui Z**, Wang Y, Wright D, Zhang W, Henrickson K. (2017) Implementing the Routine Computation and Use of Roadway Performance Measures Within WSDOT. SHRP2 PM Software Research Report. (Grant number: Agreement T1461, Task 16)
- R4. Wang Y, Ke R, Zhang W, **Cui Z**, Henrickson K. (2016) Digital roadway interactive visualization and evaluation network applications to WSDOT operational data usage. Washington State Department of Transportation (WSDOT) Research Report (Report number: WA-RD 854.1).

## ACADEMIC TALKS

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- T1. May. 2020, "Learning from Network-wide Traffic Sensor Data: Vehicle Travel and Traffic Performance Changes under the Influence of COVID-19", PacTrans Webinar, Seattle, USA.
- T2. Jan. 2020, "Transportation Artificial Intelligence Platform", Transportation Research Board (TRB) ABJ70 Artificial Intelligence and Advanced Computing Standing Committee Meeting, Washington, DC, USA.
- T3. Jan. 2020, "Artificial Intelligence in Transportation", COTA Young Professional Presentation, Transportation Research Board (TRB) Annual Meeting, Washington, DC, USA.
- T4. Oct. 2019, "Learning Traffic as a Graph: Graph-based Neural Networks for Network-scale Traffic Prediction". *INFORMS 2019*, Seattle, USA.
- T5. May 2019, "Artificial Intelligence based Transportation Analysis Platforms and Applications", *Institute of Transportation Engineers (ITE) Student Night*, Seattle, USA.
- T6. Jan. 2019, "A Multi-Source Transportation Data Integration Framework based on High-resolution Geospatial Data for Transportation Analysis", *Transportation Research Board (TRB) AFB80 Standing Committee - Geospatial Control Subcommittee Meeting*, Washington, DC, USA.
- T7. Jan. 2019, "A New Multi-Source Traffic Data Integration Framework for Traffic Analysis and Performance Measurement". *Transportation Research Board (TRB) 98th Annual Meeting*. Washington, DC, USA.
- T8. Jan. 2019, "Traffic Graph Convolutional Recurrent Neural Network: A Deep Learning Framework for Network-scale Traffic Learning and Forecasting". *Transportation Research Board (TRB) 98th Annual Meeting*. Washington, DC, USA.
- T9. Dec. 2018, "Big Data Applications in ITS – Key Arterial Performance Project", *ITS Washington Annual Meeting*, Seattle, USA.
- T10. Aug. 2017, "Deep Bidirectional and Unidirectional LSTM Recurrent Neural Network for Network-wide Traffic Speed Prediction". *ACM SIGKDD International Workshop on Urban Computing (UrbComp)*, Halifax, Canada.
- T11. Aug. 2016, "Predictability of Vehicular Mobility in Free-floating Car Sharing System", *PacTrans-Tongji PhD Student Research Symposium in Transportation Science and Technologies*, Seattle, USA.
- T12. Oct. 2015, "Characterizing evolution of extreme public transit behavior using smart card data". *IEEE International Smart Cities Conference (ISC2)*. Guadalajara, Mexico.
- T13. Aug. 2015, "Perspectives on Stability and Mobility of Passenger's Travel Behaviour through Smart Card Data". *ACM SIGKDD International Workshop on Urban Computing (UrbComp)*, Sydney, Australia.

- T14. Sep. 2015, “Predictive Traffic Assignment: A New Method and System for Optimal Balancing of Road Traffic”. *IEEE 18th International Conference on Intelligent Transportation Systems (ITSC)*.
- T15. Sep. 2015, “A vision-based hierarchical framework for autonomous front-vehicle taillights detection and signal recognition”. *IEEE International Conference on Intelligent Transportation Systems (ITSC)*.

## PROPOSAL WRITING

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- P1. NCHRP 03-138. Application of Big Data Approaches for Traffic Incident Management (TIM). Submitted in Feb. 2020 (Pending).
- P2. USDOT UTC (PacTrans). TRAFFIX: A Platform for Evaluating and Sharing Traffic Forecasting Datasets and Models. Submitted in Nov. 2019 (Pending).
- P3. USDOT Federal Highway Administration (FHWA). A Framework/Methodology to Support Data Fusion, Analysis, and Decision Making. Submitted in Aug. 2019 (Pending).
- P4. Transportation Cooperative Research Program (TCRP). TCRP G-18: Improving Access and Management of Transit ITS Data. Submitted in Sep. 2019 (Pending).
- P5. Washington State Department of Transportation (WSDOT). Real-Time Truck Parking Information Integration, Visualization and Prediction. (**Accepted**. Funds: \$150,000. Funding Period: Sept. 2019-Mar.2021)
- P6. National Cooperative Highway Research Program (NCHRP). NCHRP 07-26: Update of Highway Capacity Manual: Merge, Diverge, and Weaving Methodologies. (**Accepted**. Funds: \$400,000, Funding Period: June, 2019-Dec., 2021)
- P7. Center for Safety Equity in Transportation (CSET). Developing a Data-Driven Safety Assessment Framework for RITI Communities in Washington State. (**Accepted**. Funds: \$120,000, Funding Period: July, 2018-Sept., 2019)
- P8. USDOT UTC (C2SMART). An artificial intelligence platform for network-wide congestion detection and prediction using multi-source data. (**Accepted**. Funds: \$82,500, Funding Period: June, 2018-July, 2019)
- P9. Seattle DOT (SDOT). Performance Measurement for a Selected Pilot Urban Corridor in Seattle. (**Accepted**. Funds: \$39,198, Funding Period: April, 2017-June, 2017)

## TOOLS

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### Platforms

**TRAFFIX.AI**: A Platform for Evaluating and Sharing Traffic Forecasting Datasets and Models. [[website](#)]

**Traffic Performance Score (TPS)** in Greater Seattle area. [[website](#)]

**Digital Roadway Interactive Visualization and Evaluation Network (DRIVE Net)**: A Transportation Big Data Analytics Platform [[website](#)]

### Code

Spatiotemporal Data Modeling Algorithms

**TGC-LSTM**: Traffic Graph Convolution Recurrent Neural Network [[100+ stars](#)]

**GRU-D**: Gated Recurrent Unit (GRU) dealing with missing values [[50+ stars](#)]

**SBD-LSTM**: Stacked Bidirectional and Unidirectional LSTM [[15+ stars](#)]

### Datasets

Seattle Loop Detector Dataset [[GitHub-version](#)] [doi: [10.5281/zenodo.3258904](#)]

## TEACHING EXPERIENCE

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**Pre-Doctoral Instructor**, University of Washington

Winter 2020

CEE 412/CET522 Transportation Data Management and Visualization

- 50 students including undergrads and grads; Course Evaluation Score: 4.1/5.0

**Teaching Assistant**, University of Washington

Winter 2019

CEE 412/CET512 Transportation Data Management

**Guest Lecturer**, University of Washington

Winter 2019

CEE 412/CET512 Transportation Data Management

Lecture Topic: Introduction of Transportation Data Management  
**Guest Lecturer**, University of Washington  
 Engineering Discovery Days  
 Lecture Topic: Transportation Big Data Analytics Platform

2017 - 2019

## MEDIA COVERAGE

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- Measuring Traffic Performance during COVID-19. [UW CEE News](#) May, 2020
- 2018 Special TRB Meeting Newsletter. [PacTrans](#). Apr. 2018
- PacTrans Success Story: STAR Lab DRVIE Net. [DRIVE Net 1](#), [DRIVE Net 2](#) Oct. 2018

## MENTORSHIP

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**Undergraduate Student Research Mentor** at University of Washington  
 Longfei Lin Beihang University Summer 2019  
 Muzhi Han, Tsinghua University (now at University of California, Los Angeles) Winter - Spring 2019  
 Tian Wang, Beijing University of Posts and Telecommunications (now at Northeastern Univ.) Summer 2018  
 Yijun Sun, Tsinghua University (now at Tsinghua University) Summer 2017  
 Zhaoyi Li, Tsinghua University Summer 2017

**Graduate Student Research Mentor** at University of Washington  
 Shuyi Yin, Stanford University (now at University of Washington) Summer 2019  
 Mingjian Fu, University of Washington (now at INRIX) Summer 2017

## PROFESSIONAL SERVICES

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**Committee Member** 2019 – Present  
 Transportation Research Board (TRB) Standing Committee on Intelligent Transportation Systems (AHB15)

**Committee Member** 2019 – Present  
 Transportation Research Board (TRB) Standing Committee on Geospatial Data Acquisition Technologies (AFB80)

**Membership**

American Statistical Association (ASA) Transportation Statistical Interest Group Member 2020  
 Institute of Transportation Engineers (ITE) member 2018, 2019  
 ACM-SIGKDD member 2015, 2017  
 IEEE student member 2017, 2018, 2019  
 ASCE student member 2018, 2019  
 Chinese Overseas Transportation Association (COTA) member 2017, 2018, 2019

## REFeree FOR JOURNALS AND CONFERENCES

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### JOURNALS

Transportation Research Part C: Emerging Technologies  
 IEEE Transactions on Intelligent Transportation Systems  
 IEEE Transactions on Vehicular Technology  
 IEEE Transactions on Knowledge and Data Engineering  
 IEEE Vehicular Technology Magazine  
 Information Science  
 Physica A: Statistical Mechanics and its Applications  
 IET Intelligent Transport Systems  
 Transportation Research Record  
 Journal of Intelligent Transportation Systems  
 International Journal of Geographical Information Science  
 ASCE Journal of Transportation Engineering, Part A: Systems  
 PLoS ONE

### CONFERENCES

Transportation Research Board (TRB) Annual Meeting 2017, 2018, 2019  
 IEEE Global Communications Conference: Wireless Communications 2019

COTA International Conference of Transportation Professionals	2018
IEEE International Smart Cities Conference	2016
IEEE International Intelligent Transportation Systems Conference	2015

## INDUSTRIAL EXPERIENCES

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**Alibaba**, Cainiao Network, Artificial Intelligence Group (Hangzhou, China) Oct. 2019 – Present  
*Remote Research Intern* *Mentor: Lixia Wu*  

- Project: Reinforcement Learning based Adaptive Dynamic Bipartite Graph Matching for Task Assignment Problems

**Accenture**, Smart City Technology Lab (Beijing, China) Oct. 2013 – Jan. 2014 & Aug. 2014 – Nov. 2014  
*Research Intern* *Mentor: Dr. Yan Gao*  

- Project 1: Mobility pattern mining based on cellular data and taxi trajectories
- Project 2: predictive traffic assignment (ITSC 2015)

**Intel Labs** (Taipei, Taiwan) Feb. 2014 – Jul. 2014  
*Research Intern* *Mentor: Dr. Shao-Wen Yang & Prof. Tsin-Mu Tsai*  

- Project 1: Vehicle taillights detection and signal recognition based on hierarchical framework (ITSC 2014, 2015);
- Project 2: Channel fading in vehicular visible light communications with video data (VNC 2015).

**IBM**, China Systems and Technology Laboratory (Beijing, China) Apr. 2013 – Oct. 2013  
*Intern* *Mentor: Xin Liu*  

- Project: Tool development for formatting z/OS migration files in the workflow system.

**IBM-Peking University Creative Laboratory** (Beijing, China) Sept. 2012 – Feb. 2013  
*Research Intern* *Mentor: Dexin Wu*  

- Project: Evaluating the live virtual machine migration performance, KVM on Linux

**National Ocean Technology Center** (Tianjin, China) Jul. 2012 – Aug. 2012  
*Intern*  

- Project: Configuring and Maintaining dynamic marine monitoring platform