

# Yiyang Wang

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## EDUCATION

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### University of Michigan, Ann Arbor

Ph.D. in **Civil Engineering** (GPA: 3.96/4.00)

w/ specialization in *Next Generation Transportation Systems*

M.S. in **Electrical Engineering and Computer Science** (GPA: 3.81/4.00)

w/ specialization in *Signal & Image Processing and Machine Learning*

Ann Arbor, MI

Anticipated Dec 2022

Apr 2018

### Jilin University

B.Eng. in **Telecommunications Engineering** (GPA: 90.32/100, Rank: Top 1/91)

w/ *National Scholarship Award*

Changchun, China

June 2016

## SKILLS

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- **Programming Languages:** Python (Proficient), MATLAB (Proficient), SQL, R, C/C++
- **Packages & Tools:** PyTorch, Gurobi, NumPy, Pandas, Scikit-learn, GCP, TensorFlow, Git, Bash
- **Research Interests:** Machine Learning, Deep Learning, Anomaly Detection, Multi-Armed Bandits, Combinatorial Optimization

## RESEARCH EXPERIENCE

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### Dynamic Security Resource Allocation in Connected and Automated Vehicles

*Python*

Aug 2022 - Present

- Formulated a partially observable Markov Decision Process (POMDP) to prescribe an optimal policy for dynamical security resource allocation during the trip, which ensures the security and energy efficiency of CAVs
- Solved the POMDP model using **point based value iteration (PBVI)** algorithm in **Python**

### Demand Forecasting and Vehicle Route Planning Algorithm in Benton Harbor

*Python (Gurobi), MATLAB*

Jan 2021 - Jan 2022

- Forecasted travel demand and designed new transit routes in Benton Harbor to improve mobility for local residents, which increased the annual ridership up to **78%**
- Trained **radial basis function (RBF) network for regression**, with socioeconomic data, for travel demand forecasting by **MATLAB** with high accuracy (**RMSE 4.93**)
- Proposed and solved a demand-responsive optimization model in **Python & Gurobi** on large-scale datasets (preprocessed by **SQL**), which provided the optimal new bus routes
- Devised a graph aggregation-disaggregation algorithm (**Python & Gurobi**) which dynamically clustered the large-scale network to **reduce computation time**, and efficiently recovered from the aggregated solution (w/ convergence guaranteed)

### Deep Reinforcement Learning-Bayesian Framework for Anomaly Detection

*Python (PyTorch)*

July 2020 - Dec 2020

- Developed a POMDP model, which was solved by a novel and effective deep reinforcement learning algorithm (**A3C**), to online update CNN detecting anomalies in vehicle sensor data
- Outperformed state-of-the-art benchmarks (**12%** above CNN, **18%** above RNN) on large-scale dataset (Safety Pilot Dataset)

### Adversarial Online Learning with Variable Plays in Sequential Game for Vehicle Cybersecurity

*Python*

Sep 2019 - Oct 2020

- Devised a fast (no-regret) algorithm for the **adversarial multi-armed bandit with variable plays (MAB-VP)** problem to predict adversarial behaviours and tested on real dataset (Car-Hacking Dataset)
- Showed two directions on improving the cybersecurity from a game-theoretical perspective (**two-player sequential constant-sum games**): increase threat-monitoring resources, and/or increase reliability of the system

### Anomaly Detection in Connected & Automated Vehicle Sensors

*Python, MATLAB*

Jan 2019-Dec 2019

- Proposed an anomaly detection method for time series trajectory data by combining **Kalman filter** with unsupervised learning **One Class Support Vector Machine (OCSVM)** models, achieved AUC score **0.98/1.00** (**23%** above  $\chi^2$ -detector benchmark)
- Predicted and estimated vehicle trajectory and fused surrounding vehicles' information by adaptive extended Kalman filter, which enhanced detection performance up to **21%**
- Used **car-following model** and **platooning model** for motion prediction and tracking
- Derived an **augmented-state formulation** to further boost detection performance (up to **27%**) under **stochastic time delay**

## WORK & TEACHING EXPERIENCE

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## SiriusXM & Pandora | Science Pandora Department

Science Intern - Recommendation, Search, & Voice

Oakland, CA  
May 2022 - Aug 2022

- Build a **Siamese neural network with attention fusion** for semantic retrieval of music in **Python (PyTorch)**, running on **GCP**
- Extensive text data acquiring in **PySpark**, and nature language processing (NLP) in **Gensim** and **NLTK**
- Demonstrate that the proposed model outperforms the current search engine in product by up to **22%** on recall, and is more robust to query variations

## Univ. of Michigan | Next Generation Mobility Systems Lab

Research Associate

Ann Arbor, MI  
Sep 2018 - Dec 2018

- Designed an anomaly detection approach with time series trajectory data by combining **convolutional neural network (CNN)** and **Kalman filter with  $\chi^2$ -detector** in **Python (PyTorch) & MATLAB** with F1 score **97.8%**
- Pre-processed the large-scale (more than 1GB) raw dataset (Safety Pilot Dataset) for training and testing using **SQL** to filter specific vehicle trajectories
- **Sensor fusion** with CNN to further improve detection performance (**14%** above benchmark) on time series dataset

## Ford Motor Company | Research and Advanced Engineering (R&A)

Product Development Intern

Dearborn, MI  
May 2018 - Jul 2018

- Forecasted the travel demand in 5 and 10 years of Ann Arbor city using a **four-step travel demand model**
- Used **logistic regression** for travel mode choice prediction, and **gravity model** for trip distribution prediction
- Predicted and visualized the traffic congestion level on each road in Ann Arbor city with **SUMO**, specified the roads need expansion

## China Unicom | Network Management Center

Network Telecommunications Engineer Intern

Jinan, China  
Jul 2015 - Sep 2015

- Enabled rapid and dynamic IP assignment to all China Unicom internet customers in Jinan city, by pre-allocating IP address resources in the IP address resources management system
- Tested the packet loss rate with **secureCRT** and fixed the line failures

## TEACHING EXPERIENCE

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### CEE 373: Statistical Methods for Data Analysis and Uncertainty Modeling, Univ. of Michigan

Graduate Student Instructor

Sep 2020 - Dec 2020  
Sep 2019 - Dec 2019

## PUBLICATIONS

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- “**Real-time Sensor Anomaly Detection and Identification in Automated Vehicles.**” IEEE Transactions on Intelligent Transportation Systems [Paper]
- “**Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.**” IEEE Transactions on Intelligent Transportation Systems [Paper]
- “**Anomaly detection in connected and automated vehicles using an augmented state formulation.**” 2020 Forum on Integrated and Sustainable Transportation Systems (FISTS) [Paper]
- “**Adversarial Online Learning with Variable Plays in the Pursuit-Evasion Game: Theoretical Foundations and Application in Connected and Automated Vehicle Cybersecurity.**” IEEE Access [Paper]
- “**A Dynamic Deep Reinforcement Learning-Bayesian Framework for Anomaly Detection.**” IEEE Transactions on Intelligent Transportation Systems [Paper]
- “**An Aggregation/Disaggregation Algorithm for Transit Route Planning Problem.**” Transportation Research Part C (under review)
- “**Anomaly Detection and String Stability Analysis in Connected Automated Vehicular Platoons.**” IEEE Transactions on Intelligent Transportation Systems (under review)
- “**Improving Transit in Small Cities through Collaborative and Data-driven Scenario Planning.**” Transportation (under review)

## TALKS AND PRESENTATIONS

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- “Anomaly Detection and String Stability Analysis in Connected Automated Vehicular Platoons.” Mcity’s Cyber Working Group. Oct. 2022. (virtual)
- “Anomaly Detection and String Stability Analysis in Connected Automated Vehicular Platoons.” NGTS Seminar, Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, Sept. 2022.
- “Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.” Bridging Transportation Researchers (BTR) Online Conference. Aug. 2022. (virtual)
- “Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.” International Symposium on Transportation Data and Modelling, Ann Arbor, MI. Jun. 2021. (virtual)
- “Anomaly Detection in Connected and Automated Vehicles Using an Augmented State Formulation.” Forum on Integrated and Sustainable Transportation Systems (FISTS), Nov. 2020. (virtual)
- “Adversarial Online Learning with Variable Plays in the Evasion-and-Pursuit Game: Theoretical Foundations and Application in Connected and Automated Vehicle Cybersecurity.” Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, Oct. 2020. (virtual)
- “Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.” International Symposium on Transportation Data and Modelling, Ann Arbor, MI. June. 2020. (postponed)

- “A Data-Driven Framework for Optimizing Transit Itineraries.” Michigan Institute for Data Science 2019 Symposium, Ann Arbor, MI, Nov. 2019.
- “Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.” INFORMS Annual Conference, Seattle, WA, Oct. 2019.
- “Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors.” 3rd IAVSD Workshop on Dynamics of Road Vehicles Connected and Automated Vehicles, Ann Arbor, MI, Apr. 2019.
- “Real-time Sensor Anomaly Detection and Recovery in Connected Automated Vehicles.” Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, Jan. 2019.

## ACADEMIC SERVICES

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- **Conference Reviewer:** TRB Annual Meeting 2023, TRB Annual Meeting 2022, BTR4, ITSC 2021, TRB Annual Meeting 2021, ITSC 2020, TRB Annual Meeting 2020
- **Journal Reviewer:** IEEE Sensors Journal (IEEE Sens. J.), IEEE Transactions on Intelligent Transportation Systems (IEEE T-ITS), IEEE Transactions on Vehicular Technology (IEEE TVT), Peer-to-Peer Networking and Applications

## HONORS

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| • <b>William S. Housel Fellowship</b> , University of Michigan, Ann Arbor            | Jan 2019 - Dec 2019 |
| • <b>Outstanding Graduates Honer</b> , Jilin University                              | Apr 2016            |
| • <b>Posts and Telecommunications Alumni Scholarship (top 2%)</b> , Jilin University | Sep 2015 - Apr 2016 |
| • <b>Dong-Rong Scholarship (top 3%)</b> , Jilin University                           | Sep 2015 - Apr 2016 |
| • <b>First Prize Scholarship (top 5%)</b> , Jilin University                         | Sep 2015 - Apr 2016 |
| • <b>National Scholarship (top 1/91)</b> , Jilin University                          | Sep 2014 - Apr 2015 |
| • <b>First Prize Scholarship (top 5%)</b> , Jilin University                         | Sep 2013 - Apr 2014 |

## LEADERSHIP

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**Michigan Transportation Student Organization (MiTSO) | Treasurer**

University of Michigan, Ann Arbor

Sep 2019 - Apr 2022

**Michigan Transportation Student Organization (MiTSO) | Secretary**

University of Michigan, Ann Arbor

Sep 2019 - Apr 2020