

# Yiyang Wang

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## CAREER OBJECTIVE

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- PhD student who works on big data with more than **5-year** experience in **Python** and **7-year** experience in **MATLAB**
- Extensive experience in **reinforcement learning**, **machine learning theory**, and **deep learning**

## 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, National Scholarship Award)

Changchun, China

Jun 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, Multi-Armed Bandits, Algorithmic Game Theory, Optimization

## 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 a trajectory prediction and anomaly detection framework for real-time 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) Safety Pilot Dataset for training and testing using **SQL** to retrieve vehicle trajectories
- **Sensor fusion** with CNN to further improve detection performance (**14%** above benchmark)

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

Product Development Intern

Dearborn, MI

May 2018 - Jul 2018

- Forecasted travel demand in 5 to 10 years of Ann Arbor city using a **four-step travel demand model**
- Used **logistic regression** for travel mode choice prediction, with socioeconomic features selected from MDOT survey data
- Utilized **gravity model** for trip distribution prediction, with household and employment data
- Simulated live traffic on road network of Ann Arbor city with **SUMO**, specified the congested roads needed expansion

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

Graduate Student Instructor

Ann Arbor, MI

2019 Fall, 2020 Fall

## RESEARCH EXPERIENCE

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

*Python, PyTorch*

- Established a **deep reinforcement learning (DRL)** based mechanism, i.e. partially observable Markov decision process (POMDP), to online update CNN to detect 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*

- 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 Car-Hacking Dataset
- Derived a **sublinear regret bound** for MAB-VP problem where the number of arms played at each time is variable
- 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*

- 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 in platoon and fused surrounding vehicles' information by adaptive extended Kalman filter, which enhanced detection performance up to **21%**
- Combined **baysian network** and **inverse reinforcement learning** for vehicle intention (**91%** accuracy) and trajectory prediction
- Derived an **augmented-state formulation** to compensate model mismatch under **stochastic time delay** and further enhance detection performance (up to **27%**)

## 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.**” Working paper.
- “**Anomaly Detection and String Stability Analysis in Connected Automated Vehicular Platoons.**” Transportation Research Part C (under review)
- “**Improving Transit in Small Cities through Collaborative and Data-driven Scenario Planning.**” Transportation (under review)