

Yiyang Wang

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EDUCATION

University of Michigan, Ann Arbor

Ann Arbor, MI

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

w/ specialization in *Next Generation Transportation Systems*

Anticipated Dec 2022

Coursework: EECS 598: Reinforcement Learning Theory, IOE 512: Dynamic Programming,

IOE 517: Game Theory, STATS 507: Data Science in Python

University of Michigan, Ann Arbor

Ann Arbor, MI

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

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

Apr 2018

Coursework: EECS 545: Machine Learning, EECS 502: Stochastic Processes

Jilin University

Changchun, China

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

awarded *China National Scholarship*

June 2016

Coursework: Linear Algebra, Probability Theory and Mathematical Statistics, Mathematical Analysis II, Vector Calculus and Field Theory

RESEARCH EXPERIENCE

An Aggregation/Disaggregation Algorithm for Transit Route Planning in Benton Harbor

Paper in Progress

Python, Gurobi, MATLAB

Jan 2021 - present

- Improved mobility for transit-dependent residents within the Benton Harbor community by modelling a **demand-responsive optimization problem** using **Python & Gurobi** on local transportation network

- Implemented the algorithms on both **New York Taxi Dataset** and **MDOT dataset**

- Developed **graph aggregation/disaggregation algorithms (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

[Paper 1]

Python, PyTorch

July 2020 - Dec 2020

- Developed and paired an anomaly classification algorithm based on **convolutional neural network (CNN)**, with a **partially observable Markov decision process (POMDP)** model, which determined the **optimal dynamic threshold** of the anomaly classification algorithm

- 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 Cybersecurity

[Paper 2]

Python

Sep 2019 - Oct 2020

- Developed 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

[Paper 3] [Paper 4] [Paper 5]

MATLAB, Python

Jan 2019-Dec 2019

- Used **car-following model** and **platooning model** for motion prediction and tracking

- Developed an anomaly detection method by combining **adaptive extended Kalman filter (AEKF)** with **One Class Support**

Vector Machine (OCSVM) models, achieved AUC score **0.98/1.00** (23% above benchmark) on **Safety Pilot Dataset**

- Fused surrounding CAV's information via **V2V** by using **Kalman Filter** to improve detection performance

- Developed an **augmented-state formulation** to enhance detection performance under **stochastic time delay** (up to 27%)

PUBLICATIONS

- van Wyk, Franco, Yiyang Wang, Anahita Khojandi, and Neda Masoud. "Real-time Sensor Anomaly Detection and Identification in Automated Vehicles." *IEEE Transactions on Intelligent Transportation Systems* 21, no. 3 (2019): 1264-1276 [Paper]

- Wang, Yiyang, Neda Masoud, and Anahita Khojandi. "Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors." *IEEE Transactions on Intelligent Transportation Systems* (2020) [Paper]

- Wang, Yiyang, Neda Masoud, and Anahita Khojandi. "Anomaly detection in connected and automated vehicles using an augmented state formulation." In 2020 Forum on Integrated and Sustainable Transportation Systems (FISTS), pp. 156-161. IEEE, 2020 [Paper]

- Wang, Yiyang, and Neda Masoud. "Adversarial Online Learning with Variable Plays in the Evasion-and-Pursuit Game: Theoretical Foundations and Application in Connected and Automated Vehicle Cybersecurity." DOI 10.1109/ACCESS.2021.3120700, *IEEE Access*. [Paper]

- Watts, Jeremy, Franco van Wyk, Shahrbanoo Rezaei, Yiyang Wang, Anahita Khojandi, Neda Masoud. "A Dynamic Deep Reinforcement Learning-Bayesian Framework for Anomaly Detection." Submitted to *IEEE Transactions on Intelligent Transportation Systems*. [Paper]

- Wang, Yiyang, Amir Tafreshian, and Neda Masoud. "An Aggregation/Disaggregation Algorithm for Transit Planning Problem." Working paper.

- Wang, Yiyang, and Neda Masoud. "Road-side Based Cybersecurity in Connected and Automated Vehicle System." Working paper.

WORK EXPERIENCE

Next Generation Mobility Systems Lab, Univ. of Michigan

Research Associate

Ann Arbor, MI

Sep 2018 - Dec 2018

- Developed an anomaly detection approach by combining **CNN** and **Kalman filter with χ^2 -detector** in **Python (PyTorch) & MATLAB**
- Utilized **sensor fusion** with **CNN** to further improve detection performance (**14%** above benchmark) on **Safety Pilot Dataset**

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

Product Development Intern

Dearborn, MI

May 2018 - Jul 2018

- Predicted the travel demand in Ann Arbor city using a **four-step travel demand model**
- Visualized the traffic network of Ann Arbor city with **SUMO**
- Analyzed the impact of different penetration rates of CAVs on traffic with **SUMO**

Network Management Center, China Unicom

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

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

Graduate Student Instructor

Sep 2020 - Dec 2020

Sep 2019 - Dec 2019

TALKS AND PRESENTATIONS

- "Real-Time Sensor Anomaly Detection and Recovery in Connected Automated Vehicle Sensors." International Symposium on Transportation Data and Modelling, Ann Arbor, MI. June. 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.

SKILLS

- **Programming Languages:** Python, MATLAB, SQL, C++, Assembly Language
- **Packages & Tools:** Gurobi, PyTorch, TensorFlow, Pandas, GeoPandas, LaTeX, GIT, SUMO, QGIS
- **Research Topics:** Machine Learning, Deep Learning, Multi-Armed Bandits, Anomaly Detection, Combinatorial Optimization, Game Theory, Dynamic Programming, Reinforcement Learning

HONORS

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

LEADERSHIP

Michigan Transportation Student Organization (MiTSO) | Treasurer

University of Michigan, Ann Arbor

Sep 2020 - Present

Michigan Transportation Student Organization (MiTSO) | Secretary & Treasurer

University of Michigan, Ann Arbor

Sep 2019 - Apr 2020