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."** Submitted to Transportation Research Part B: Methodological [**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 — Ann Arbor, MI
Research Associate — 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 — Dearborn, MI
Product Development Intern — 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 — Jinan, China
Network Telecommunications Engineer Intern — 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