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) — Anticipated Dec 2022
w/ specialization in *Next Generation Transportation Systems*
M.S. in **Electrical Engineering and Computer Science** (GPA: 3.81/4.00) — Apr 2018
w/ specialization in *Signal & Image Processing and Machine Learning*

Jilin University — Changchun, China
B.Eng. in **Telecommunications Engineering** (GPA:90.32/100, Rank: Top 1/91) — June 2016
w/ *National Scholarship Award*

SKILLS

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

RESEARCH EXPERIENCE

Demand Forecasting and Vehicle Route Planning Algorithm in Benton Harbor
Python, Gurobi, SQL, MATLAB — Jan 2021 - present

- **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 novel and effective **deep reinforcement learning (DRL)** model, i.e. partially observable Markov decision process (POMDP), conjunct with **CNN** to detect anomalies in time series trajectory
- 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 χ^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

Univ. of Michigan | Next Generation Mobility Systems Lab — Ann Arbor, MI
Research Associate — Sep 2018 - Dec 2018

- Designed an anomaly detection approach with time series trajectory data by combining **convolutional neural network (CNN)** and **Kalman filter with χ^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) Dearborn, MI
Product Development Intern 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 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

PUBLICATIONS

- **"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 (under review) **[Paper]**
- **"An Aggregation/Disaggregation Algorithm for Transit Planning Problem."** Working paper
- **"Road-side Based Cybersecurity in Connected and Automated Vehicle System."** Working paper

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.

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