FACULTY MENTOR
Zheng, Yang

PROJECT TITLE
Advanced Control and Optimization for Autonomous Vehicles in Mixed Traffic Systems

PROJECT DESCRIPTION
"The emergence of connected and autonomous vehicles (CAVs) promises to revolutionize road transportation systems. In particular, the advancements of CAVs offer new opportunities for traffic control, where autonomous vehicles can receive information from other traffic participants and act as mobile actuators to influence traffic flow internally, thus increasing efficiency and safety on public roads. Both small-scale real-world experiments (e.g., https://youtu.be/2mBjYZTeaTc) and large-scale numerical simulations (e.g., https://flow-project.github.io/) have shown promising results. Recent work has also started to build a solid theoretical understanding toward of the influence of CAVs in mixed traffic involving both autonomous vehicles and human-driven vehicles.

In this project, the student will investigate some advanced control and optimization techniques (e.g., model predictive control, and distributed optimization) for operating CAVs in mixed traffic, with the goals of smoothing global traffic flow and reducing fuel consumption. The student will first survey and understand recent work on modeling, control, and validation of mixed traffic systems, such as [1]-[3] and the references therein, and then move on to numerical validations with simple linear feedback for CAVs. You will then investigate advanced optimization-based techniques, such as model predictive control, for CAVs. It will be interesting to look into the coordination of multiple CAVs using, e.g., distributed model predictive control techniques. Finally, large-scale numerical validation will be carried out using the proposed design techniques.

[1] Zheng, Yang, Jiawei Wang, and Keqiang Li. "Smoothing traffic flow via control of autonomous vehicles." IEEE Internet of Things Journal 7.5 (2020): 3882-3896.
[2] Stern, Raphael E., et al. "Dissipation of stop-and-go waves via control of autonomous vehicles: Field experiments."" Transportation Research Part C: Emerging Technologies 89 (2018): 205-221.
[3] Wu, Cathy, et al. "Flow: Architecture and benchmarking for reinforcement learning in traffic control." arXiv preprint arXiv:1710.05465 (2017): 10."

This project is remote.

INTERNS NEEDED
1 Student

PREREQUISITES
A strong background in linear algebra and optimization and good programming skills are required