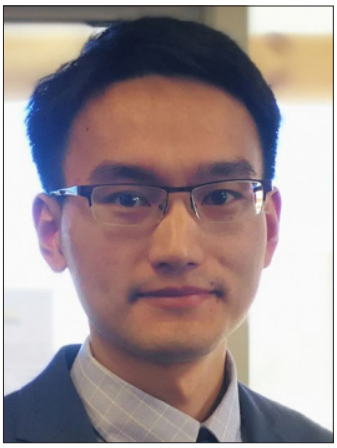
COLLEGE OF ENGINEERING

Control Seminar

Sponsored by: Bosch, Ford, and Toyota

Planning, Control, and Test of Connected Automated Vehicles



SHAOBING XU

Assistant Research Scientist

Department of Mechanical Engineering, University of Michigan

November 6, 2020 3:30 - 4:30 pm

Event will take place via Zoom

ABSTRACT: In this talk, we present our practice in developing the algorithm/software stack of motion planning and control modules for connected automated vehicles (CAVs) as well as a sensor-level augmented reality (AR) system for efficient CAV test. Three topics are highlighted. 1) Motion control: many controls have no explicit or closed-from response to future path curvatures, time-delay, and steering lag, thus ending up with less satisfied tracking performance. We design a dynamics-and-delay-aware preview control, which achieves analytical control law and improved tracking accuracy and steering stability against time delay. A barrier control is also implemented for bounded tracking errors. 2) Motion planning: a stack that delivers capabilities of routing, behavior decision, and scalable trajectory generation is designed for safe driving amidst dynamic and stationary obstacles. We show how to solve the motion planning problem via a hierarchical framework and a deterministic sampling strategy. Deployments and experiments on the Mcity CAV fleet, i.e., 3 Lincoln MKZ Sedans, are also presented. 3) Sensor-level AR: how to create diverse traffic scenarios to test the CAV system poses challenges to us as well as organizations such as Mcity and ACM. We propose and develop an AI-driven sensor-level AR which augments the raw sensor data with diverse weather conditions (e.g., snow and rain) and virtual interactive objects. The system enables a CAV to experience different weather/traffic conditions efficiently and safely for accelerated tests.

BIO: Shaobing Xu is currently an assistant research scientist (from 1/2019) and was a postdoctoral researcher (10/2016-12/2018) working with Prof. Huei Peng at the Department of Mechanical Engineering and Mcity, University of Michigan, Ann Arbor. He obtained his Ph.D. degree in Mechanical Engineering from Tsinghua University in 2016. His research lies at the interface of learning, control, and design of cyberphysical systems with an emphasis on connected automated vehicles (CAVs). He received the outstanding Ph.D. dissertation award of Tsinghua University in 2016 and the Best Paper Award at the 14th International Symposium on Advanced Vehicle Control in 2018.

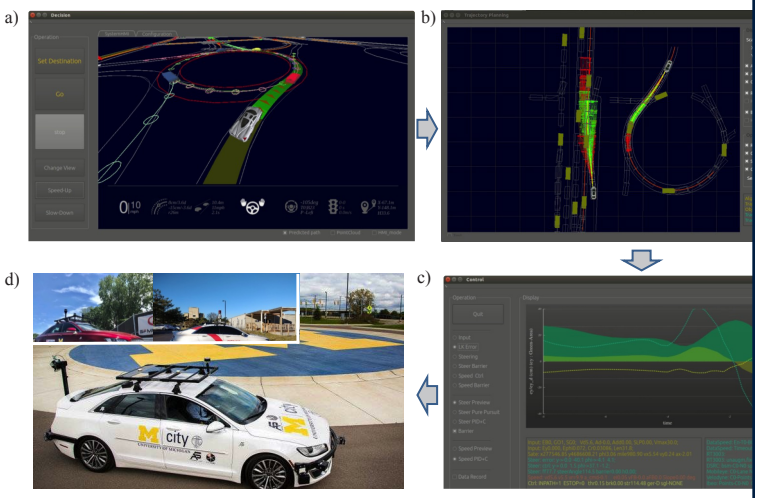


Fig. 1. The developed motion planning and control stack. a) Routing, behavior planning, and motion prediction. b) Trajectory generation with the proposed deterministic sampling algorithm. c) Motion control with the proposed delay-and-dynamics-aware preview control. d) Mcity self-driving car fleet, i.e., 3 automated Lincoln MKZ Sedans.

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