2017 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

GOALI CPS: Maneuver and Data Optimization for High Confidence Testing of Future Automotive Cyber-physical Systems

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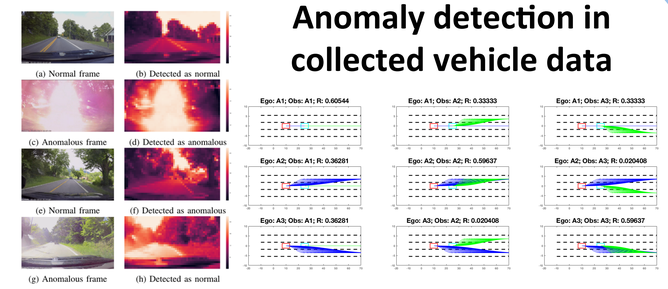
Challenge:

This research addresses urgent challenges in high confidence testing of automotive systems due to on-going and anticipated introduction of advanced, connected, and autonomous vehicle technologies.

Solution:

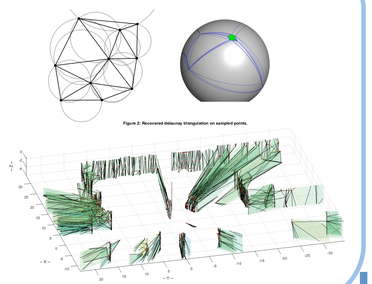
- The development of a toolchain for high confidence testing, validation, and verification of advanced, connected, and autonomous vehicles is pursued to support the introduction of such vehicles into mass production. The development of such tools is based on the research into maneuver and data optimization to determine test trajectories and scenarios for vehicle testing.
- Game theoretic traffic interaction model to inform in-traffic relevant trajectories.
- Model-free optimization to identify trajectories falsifying time domain specifications.
- Smart Black Box to identify and record high-priority data for diagnostics and validation.

Anomaly detection in collected vehicle data

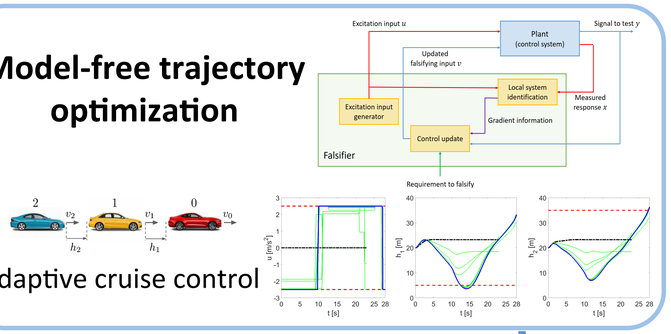


perception anomaly maneuver anomaly

Data reduction

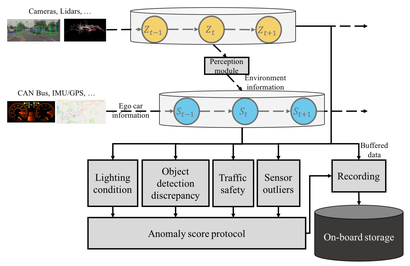


Model-free trajectory optimization

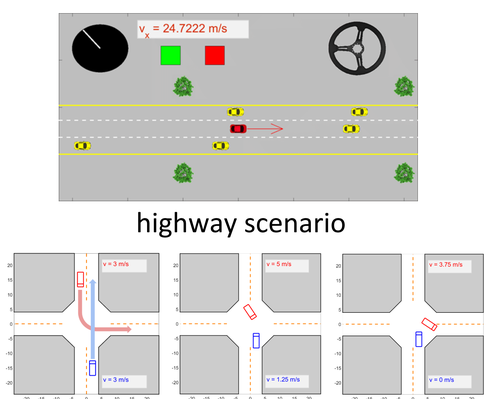


adaptive cruise control

Smart Black Box

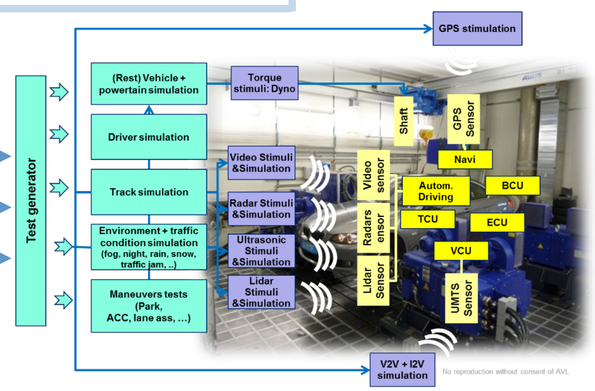


Game theoretic traffic simulation



highway scenario

intersection scenario



Trajectories and data inputs for testing of future autonomous vehicles

Scientific impact:

- Research advances CPS vehicle lifecycle management with focus on test generation and verification & validation.
- Research advances game theory, optimal control, information theory and data mining for applications in autonomous/automated vehicle setting.
- Data acquisition and sampling strategies can be applied broadly to connected vehicle & devices.

Broader impact:

- Research supports the automotive industry in introduction of advanced vehicle technology into mass production.
- Autonomous vehicles can have a significant societal impact, e.g., enabling transportation for people who are not able to drive, and can positively improve road safety, traffic efficiency, reduce energy consumption and environmental impact.
- Interdisciplinary advances are integrated into courses and tutorials.

Project number: NSF ECCS 1544844, The University of Michigan. **Contacts**: I. Kolmanovsky, E. Atkins, B. Mozafari, M. Oliver .