Driver-in-the-Loop (DITL) Automotive Systems

Attendees

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Introduction

DITL automotive system research studies the system which integrates and cooperates the driver with the vehicle's cyber systems through various degrees of autonomy, authority distribution, and systems interaction.

DITL automotive system has multiple levels of dynamic interaction (h2v, v2v,v2i, etc.).

Research Challenges

- Real-time driver state modeling
- Real-time/adaptive decision making
- Presentation of information (e.g., unambiguous communication to the driver)
- Dynamic authority distribution/level of autonomy
- Driver workload estimation (traffic, weather, vehicle, and road conditions)
- Multi-domain simulation capability for driver-vehicle interaction cross all traffic conditions
- Verification and validation
- Cooperative communications
- Fault-tolerance and automatic reconfiguration of the cyber system
- Transferring the decision making knowledge learned in DITL system to automotive systems with different degrees of autonomy (especially fully autonomous systems)

State of Art/State of Practice

- Pretty new area for automotive systems
- Lot of areas have been studied independently
 - Human-robot interaction
 - Adjustable autonomy
 - Pilot-in-the-loop
- This is not another human factor research, it studies a cyber-human interaction in real-time, dynamic, interactive environments for vehicle system control purpose
- We want to move the human modeling to the same level of dynamic models used by the other cyber-physics system
- DITL system is different from Pilot-in-the-loop system

Recommendation for Institutions and Institutional Collaborations

- Recommend NSF/DOT to fund projects in this area
- Expand the current Engineering/CPS to include the other area such as computational neuroscience, cognitive science, etc.
- Establish a funding model to enable transition from NSF funded basic research to DOT funded applied research

The Promising Approach

 Multi-disciplinary approaches to build and integrate on promising approaches from computational neuroscience, computational intelligence, control theory, system identification, imaging processing, communication studies, intelligent transportation systems, embedded control system, multi-agent systems.

Research Milestones/Road Map

SHORT TERM

- Real-time driver state modeling
- Real-time/adaptive decision making
- Presentation of information (e.g., unambiguous communication to the driver)
- Dynamic authority distribution/level of autonomy
- Cooperative communications (V2V, V2I)

INTERMEDIATE

- Fault-tolerance and automatic reconfiguration of the cyber system
- Driver workload estimation (traffic, weather, vehicle, and road conditions)

LONGTERM

- Multi-domain simulation capability for driver-vehicle interaction cross all traffic conditions
- Verification and validation
- Transferring the decision making knowledge learned in DITL system to automotive systems with different degrees of autonomy (especially fully autonomous systems)