Human Factors Studies of Next-generation Vehicular Technology

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Human Factors Issues Associated with Limited Ability Autonomous Driving Systems (HF4LAADS)

Sponsors: General Motors
USDOT Federal Highway Administration

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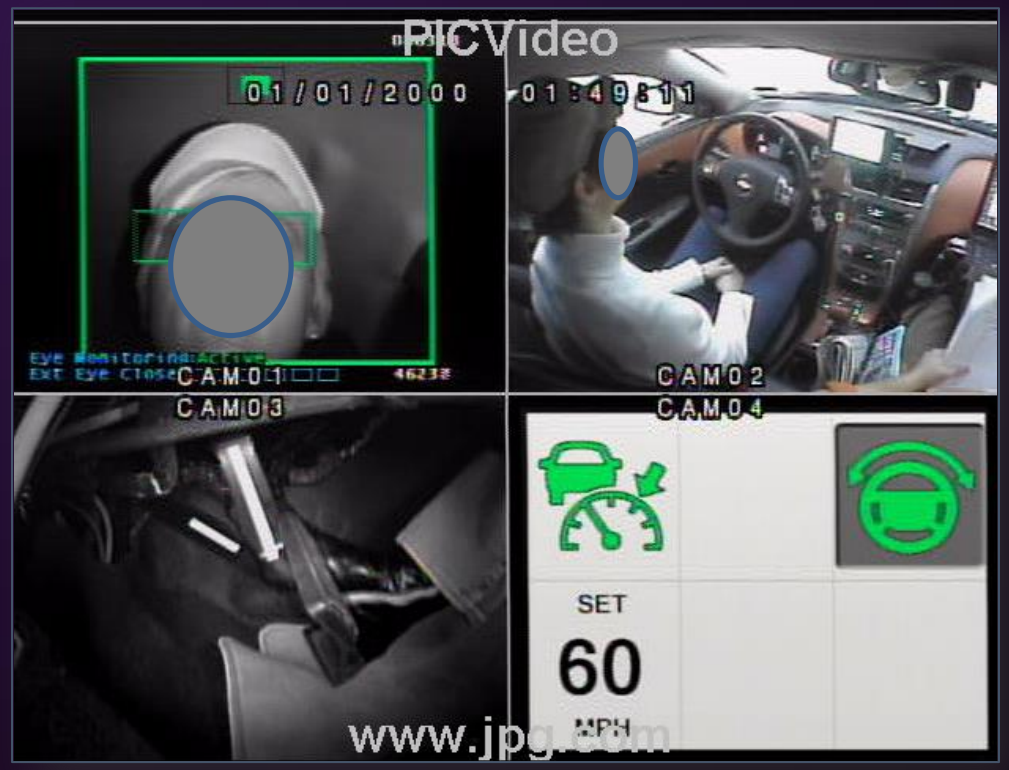
- Focused on potential issues associated with use of semi-autonomous systems (e.g., adaptive cruise control, lane centering), such as:
  - Driver's willingness to engage in secondary non-driving-related tasks
  - Driver vigilance and allocation of visual attention

- Level 2 automation:
  - Capable of automated steering and speed/headway maintenance on freeways
  - Does not relieve drivers of all driving tasks



In-cab views showing driver operating under semi-autonomous driving mode

One integrated display concept used to communicate system state information to driver

HF4LAADS: Results

- Suggests most drivers will engage in moderate to complex secondary task activities
  - Increased engagement in very risky tasks (e.g., watching DVDs, reading, texting)

- Drivers tended to spend less time looking at the forward roadway and had longer off-road glances when operating under the autonomous Level 2-type system vs. non-autonomous driving
  - Time spent looking away from the forward roadway increased by average of 33% relative to ACC driving
  - Duration of excessive off-road glances increased by average of 27%

- Emphasizes need for development and evaluation of countermeasure concepts

Human Factors Evaluation of Level 2 and Level 3 Automated Driving Concepts

Sponsors: National Highway Traffic Safety Administration
USDOT Office of the Assistant Secretary for Research and Technology

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photo by Steven Mackay

Project Team and Partners

Automated Research Vehicles:

- GM: Level 2 Automation
- Google: Level 3 Automation

Stakeholder Group:

- BMW
- Bosch
- Continental
- GM
- Google
- Mercedes-Benz
- SwRI
- TORC Robotics
- Toyota

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Three experiments:

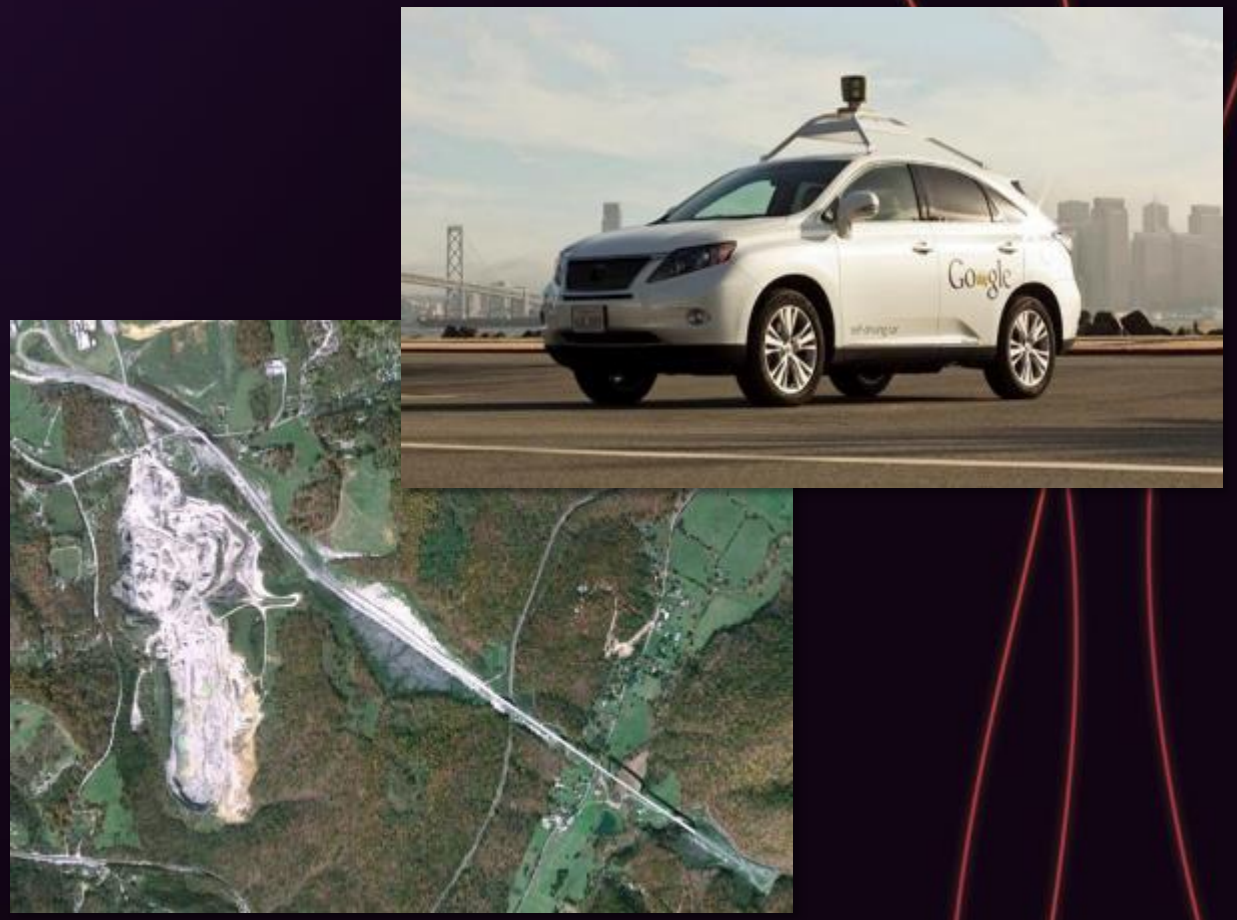
1. Driver Responses to Staged Warnings
2. System Prompt Effectiveness Over Time
3. Human-automation System Performance Over Time

System Prompt Effectiveness Over Time

- 2010 MY Cadillac SRX
  - ➢L2 automation:
    - ACC and Lane Centering
- Location: GM MPG

Human-automation System Performance Over Time

- 2012 Lexus RX450h
- L2 vehicle equipped with a prototype automated driving system that can simulate L3 driving on a test track
- Instrumented with VTTI data acquisition system



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For additional information about this study:

- Visit www.nhtsa.gov
- Trimble, T. E., Bishop, R., Morgan, J. F., & Blanco, M. (2014). *Human factors evaluation of level 2 and level 3 automated driving concepts task: Past research, state of automation technology, and emerging system concepts*. Washington, DC: National Highway Traffic Safety Administration.
- Marinik, A., Bishop, R., Fitchett, V., Morgan, J. F., Trimble, T. E, & Blanco, M. (2014). *Human factors evaluation of level 2 and level 3 automated driving concepts task: Concepts of Operation for Levels 2 and 3*. Washington, DC: National Highway Traffic Safety Administration.

Summary of Findings to Date

Partial automation presents a number of human factors challenges:

- The drivers need to clearly understand both the capabilities and limitations of the system and their roles and responsibilities in all modes of operation, including failure modes.
- The systems have to be robust enough in all modes to provide the driver with sufficient information and time for control transition.
- The systems need to be robust enough to operate with a driver who is significantly less vigilant than that which occurs in current manual driving.

We believe that effective onboard sensors, vehicle connectivity, and driver state monitoring will all be required to achieve the necessary levels of robustness and redundancy to deploy automated systems.