#### Human Factors in ADAS and ADS-Equipped CMVs



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#### Background

- Advanced Driver Assistance Systems (ADAS) and Automated Driving System (ADS)-equipped CMVs hold the promise of increased safety—but are not without risks, particularly for Level 2/3 operation
- Some areas to explore:
  - CMV driver behaviors of interest (such as driver distraction) as they relate to takeover readiness and performance.
  - Transfer and sharing of control that examines the interaction effects among and between individual characteristics, system characteristics, secondary tasks, driving environments, and time to collision.
  - Development and testing of unified education and training programs for CMV drivers that focus on ADASs and ADSs is warranted.
- Additional research is needed to understand how ADAS and ADS features affect drivers' safety performance and ability to safety control the CMV

#### **Overall Study Objectives**



#### Human Factors in ADAS and ADS-equipped CMVs

- Approach: Simulator-based studies and training program
- 100 total participants
- Status: Recruiting drivers and preparing for data collection
- Expect to gain a better understanding of how drivers interact with L2 and L3 systems
- Will develop recommendations for training drivers on these systems
- Study completed by Virginia Tech Transportation Institute



#### **Commercial Training & Prototyping Simulator (CTAPS)**



Utilizes CTAPS, Data Acquisition System, and Eye Tracker

#### **Freeway and Urban Environments**









#### **Freeway and Urban Environments**



#### Latent Hazard Scenario: Freeway



#### Latent Hazard Scenario: Urban



#### **Research Objective 1**

## SAE Level 2 Driver required to monitor the road

#### **Driver Distraction**

- Effect on driver's performance (e.g., changes in speed, following distance)
- Effect on readiness to resume manual control
- Effect of driver characteristics (e.g., age, driving experience)
- Effect of driving conditions (e.g., roadway type, weather)

#### **Experimental Design for L2**

- 50 CMV drivers
- Two simulator drives, each 1 hour in length
  - Drive 1: Secondary tasks assigned at particular locations (including all locations of latent hazards)
    - Reaching for an object
    - Texting on a cellular device
    - Adjusting or monitoring a device integral to the vehicle (i.e., fan or side mirror)
    - Reading
    - Hands-free cell phone talk/listen
    - Identify objects or read text external to the vehicle
  - Drive 2: Secondary tasks performed whenever driver feels it is safe to do such
    - Search a stack of manifest documents for specific information and relaying the information verbally to the researcher.

# SAE Level 3 Driver not required to monitor the road but must be ready to take control as needed

During the transfer and sharing of control:

- What factors affect the drivers' ability to successfully take over the driving tasks, considering physical (steering and braking), visual (eyes on forward roadway), and cognitive components?
- Which types of alerts that manual control is needed have the most positive impact on CMV driver readiness and performance?
- How long at a minimum does the driver need to be warned ahead of time to take over the driving task?

#### **Experimental Design for L3**

- 50 CMV drivers
- Two simulator drives, total 3 hours in length
  - Drive 1: Participants will engage in 3 non-driving-related task types (non-work related, work-related, baseline).
    - Non-driving-related tasks for the L3 study will be physically and cognitively engaging, obscure their situational awareness, and have varying work relevance.
      - Watch a training video
      - Complete a puzzle
    - Takeover requests will alert the participant to re-engage in manual driving.
  - Drive 2: Drivers can perform non-driving-related tasks as they feel comfortable use their phone, read, etc. Takeover requests during voluntary non-driving-related tasks will occur if the vehicle is unable to continue driving.

#### **Research Objective 3: Develop Training Program**

- Capabilities of L2
- Dispelling myths of L2
- The role of the driver in an L2 vehicle
- Risks of driver distraction in an L2 vehicle
- The importance of hazard anticipation, situational awareness, and attention maintenance while operating an L2 vehicle and the reasons behind them



- The role of the driver in an L3 vehicle
- Risks of driver distraction in an L3 vehicle
- What is successful transfer of control in an L3 vehicle
- Importance of hazard anticipation while operating an L3 vehicle

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