DRISI

Caltrans Division of Research, Innovation and System Information

# Research Notes

# Evaluation Of Autonomous Vehicles And Smart Technologies For Their Impact On Traffic Safety And Traffic Congestion

Predict changes in crash rates and subsequent surprise traffic congestion for different levels of automation.

Transportation Safety and Mobility

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Project Title:
Vehicle Infrastructure Integration (VII)

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## WHAT IS THE NEED?

Surprise or non-recurring traffic flow disruptions are unanticipated temporary disruptions that occur because of an accident, blocking one or more traffic lanes. It has been estimated that 25% of surprise traffic disruptions are caused by vehicle accidents, so reducing the number of vehicle accidents, should improve the flow of traffic. In general, traffic congestion also affects traffic accident rates; therefore, improving traffic safety should improve traffic flow by reducing the number of surprise traffic congestion events.

## WHAT ARE WE DOING?

The research team will conduct the following:

- Determine from a review of existing research on operator inattention, situation awareness and trust in automation, as a function of levels of automation the potential impact on driver performance and subsequent traffic crash risk and surprise congestion.
- Develop and run a driving simulation to identify driver performance costs as the level of automation increases from manual driving (L0) to fully automated travel (L3-L4).
- Determine the extent to which driver performance is affected by situation awareness, workload, trust in automation and inattention.
- Model the effects identified in the driving simulation on potential changes in vehicle crash rates and surprise traffic congestion associated with negative automation effects.

## WHAT IS OUR GOAL?

The goal to predict changes in crash rates and subsequent surprise traffic congestion for different levels of automation.

## WHAT IS THE BENEFIT?

The results will contribute important information for the design of autonomous vehicles and infrastructure needed to support them.

## WHAT IS THE PROGRESS TO DATE?

The tasks involving Current Status of Automation and Crash Risk and Driving Simulator Investigation have been completed.

Key findings of the Current Status of Automation and Crash Risk were:

- Current sources of driver inattention can be placed into two categories:
  1. Inattention due to extended performance of mundane tasks with high workload or low levels of engagement (known as a vigilance decrement), or
  2. Driver inattention caused by distraction from non-driving related tasks and environmental events.

- Although most existing research of driver inattention focusses on the effects of distraction, vigilance decrements also play an important role in inattention-related accidents, and the likelihood of vigilance decrements will be even greater following take-overs from highly automated driving systems. Figure 2 shows the effect of vigilance decrements.

- The effect of Highly Automated Driving Systems on crash rates and congestion must consider the likelihood of increased driver inattention and reduces situational awareness following take-over from automation.

During the Driving Simulator Investigation proved that the participants performed safer obstacle avoidance maneuvers in the Take-Over condition, as indicated by farther distance to contact and longer time to contact for both maneuver initiations and completions.

The project is complete, a final report will be published soon.

## IMAGES

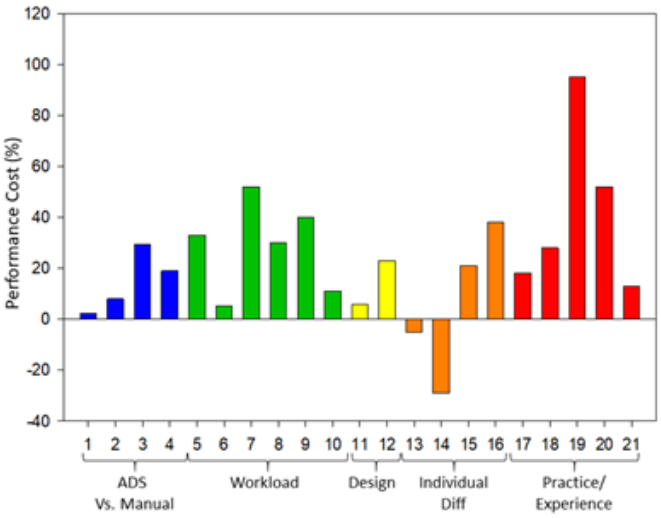


Figure 1: Estimated percent driving performance costs associate with driver take-overs from ADS.

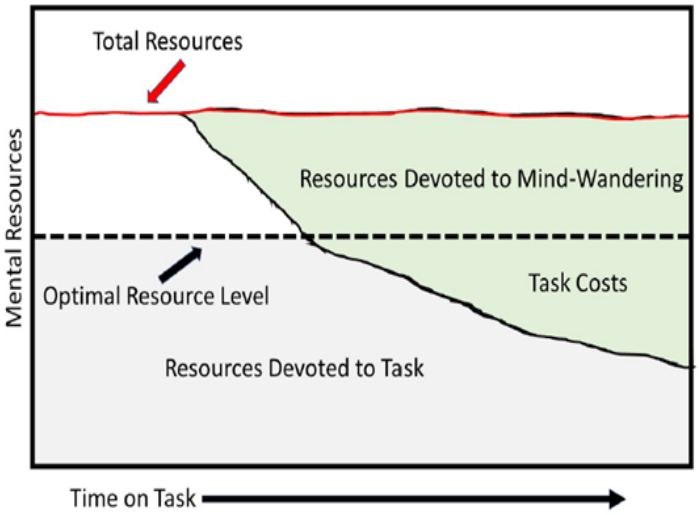


Figure 2: The Mindlessness Account. As time on task increases, total available mental resources remain the same. However, more and more resources become devoted to internal thought processes (Mind-Wandering) instead of the primary task.

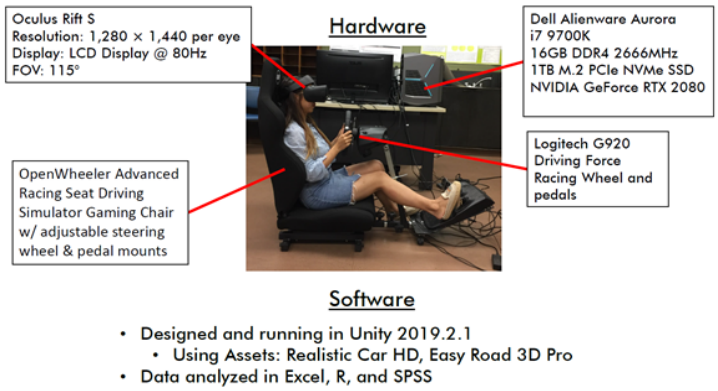


Figure 3: Traffic simulator specifications

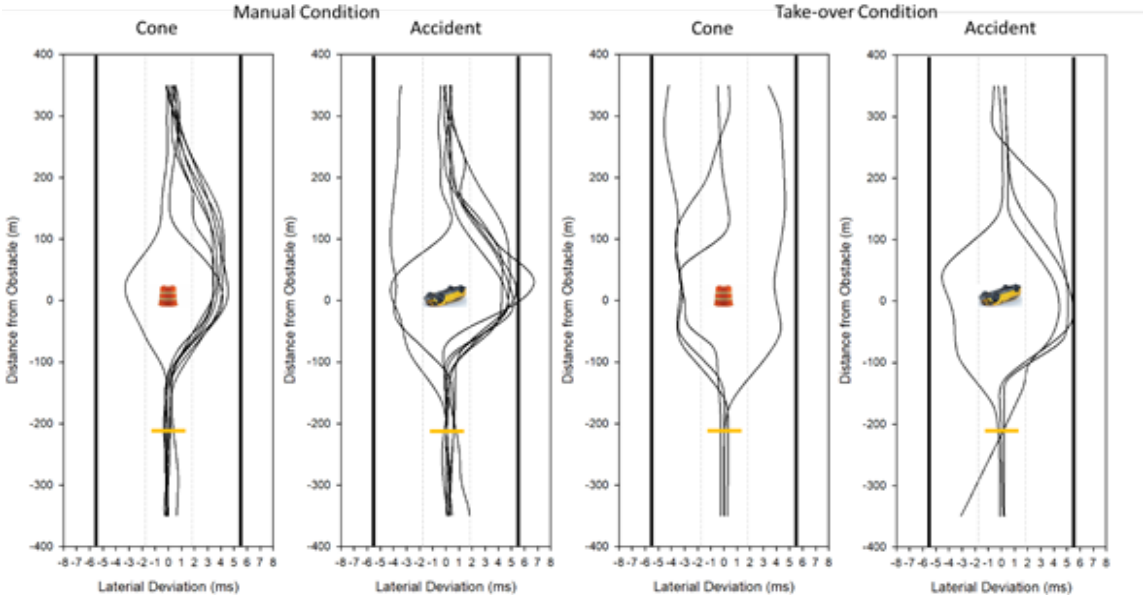


Figure 4: Obstacle maneuvers for obstacle types for one participant