Field Demonstration of Heavy Vehicle Camera/Video Imaging Systems: Preliminary Results

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Abstract

Camera/Video Imaging Systems (C/VISs) display video captured from cameras mounted on the truck's fenders and trailer to drivers using displays mounted inside the truck cabin. C/VISs help drivers execute lane changes and provide a countermeasure to blind-spot-related crashes by allowing drivers to see objects not ordinarily visible by a typical mirror configuration. The National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Association (FMCSA) have collaboratively funded research on the development of C/VISs that operate during the day, as well as enhancing C/VISs to operate at night and in inclement weather. Presently, they have contracted the Virginia Tech Transportation Institute (VTTI) to investigate drivers' performance with C/VISs in a revenue-producing environment. A Technology Field Demonstration (TFD) was initiated last year and consists of continuously recording 12 commercial drivers' performance with and without a C/VIS using the naturalistic driving study methodology. Half of the drivers are using a commercially-available C/VIS called Sidetracker that has a side-view camera on each fender and dash-mounted monitors on the left and right side of the steering wheel. The other drivers are using a VTTI-developed Advanced C/VIS (A-C/VIS) that has side-view cameras (Figure 1), a rear-view camera, and night-vision capabilities. The A-C/VIS monitors are located at the top of the left and right A-pillars and the center windshield. Drivers are being recorded while they drive one month without the C/VIS (Baseline) and three months with the C/VIS (Test condition). The TFD is investigating: 1) the objective safety benefits produced by the C/VISs, 2) the effect of the C/VISs on drivers' lane change performance, and 3) drivers' opinions of the C/VISs. Results based on data collected from the first six drivers will be presented at the symposium. A summary of the findings are presented below.

Figure 1. Right Camera Housing for the Advanced Camera/Video Imaging System

Drivers' involvement in Safety-Critical Events (SCEs) over the course of the study is being measured. An SCE is a short-lived event where a driver collides with, or performs an evasive maneuver to avoid, another vehicle, roadway infrastructure, pedestrian, animal, or inanimate object. The data collected thus far indicate that drivers' mean involvement in safety critical events per 100 hours of driving does not significantly change when driving with a C/VIS.

Lane changes executed with a vehicle in the adjacent lane are being randomly sampled. The clearance, or distance between the trailer and the front of the adjacent vehicle, is measured with rearward facing radar units. Drivers' mean clearance to an adjacent vehicle does not appear to change when driving with a C/VIS. However, drivers' mean clearance when making left lane changes was found to be significantly larger than their clearance when making right lane changes ($p < 0.01$). It should be noted that the sampled left lane changes predominantly consisted of initiating a passing maneuver around a slow lead vehicle, while the sampled right lane changes predominantly consisted of completing a passing maneuver.

An analysis of drivers' eye glance patterns when changing lanes suggests that drivers are more likely to use the C/VIS when making right lane changes compared to when making left lane changes. This is because the blind spot on the right side of the truck is larger than the blind spot on the left side of the truck.

Driver opinion data indicate that they feel that they are more aware of their surroundings when driving with a C/VIS. The opinion data have also revealed the importance of: 1) allowing drivers to substantially dim the C/VIS monitors at night, 2) placing translucent light diffusers between the turn signals and fender cameras to assuage the blooming produced on the monitors when the turn signals are activated, and 3) placing the monitors at the top of the windshield to avoid obstructing the driver's view of the road with the light from the monitors reflecting off the windshield and side windows.

Overall, the preliminary results suggest that C/VISs can improve drivers' awareness of the areas around their tractor-trailer and do not negatively affect driving performance. Driver opinion data also begin to highlight the positive and negative aspects of the C/VISs, which can be used to inform the design of future C/VISs. It is important to consider that because these results are based on half of the collected data, the findings should be treated with discretion.

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