Improving CMV Drivers’ Awareness of Surrounding Vehicles

Commercial Motor Vehicle (CMV) drivers are tasked with monitoring an extensive area around their vehicles while they drive. Large blind spots exist along the sides, rear, and front of these vehicles. For instance, the blind spot located behind a tractor-trailer extends up to 200 ft. Camera Video/Imaging Systems (C/VISs) use cameras mounted on the truck's fenders and trailer to provide drivers with a view of the area surrounding the tractor-trailer. They provide a simple low-cost countermeasure to blind-spot-related crashes by allowing drivers to see objects not ordinarily visible by a typical mirror configuration. These systems are expected to help reduce the number of crashes resulting from improper tractor-trailer lane changes/merges, turning maneuvers, and backing maneuvers, which account

Field Demonstration of Camera/Video Imaging Systems for Heavy Vehicles annually for approximately 38,700 crashes (9 percent of the police reported tractor-trailer crashes). Furthermore, C/VISs may also reduce the number of rear-end crashes if they allow CMV drivers to quickly determine the location of adjacent vehicles, thus spending less time looking away from the forward roadway, and becoming more likely to perceive critical changes in the forward roadway.

Evaluating Camera/Video Imaging Systems using a Naturalistic Driving Study Approach

Commercially-available C/VISs exist and have been installed in truck fleets in the United States. For example, U.S. Xpress reportedly has systems on 8,000 trucks in their fleet. An example of a commercial C/VIS monitor mounted on the dash inside a truck cab is shown below in Figure 1a. An advanced C/VIS has also been developed by the Virginia Tech Transportation Institute (VTTI) using an iterative user-centered design approach. This advanced C/VIS provides all-around views through the use of cameras mounted on the fenders and trailer, as well as night vision through the use of infrared (IR) illumination. This system also uses machine vision to outline objects displayed on the monitors to make it easier for drivers to perceive them (particularly in adverse weather conditions). A picture of the advanced C/VIS right fender camera, and tractor-trailer it is installed on, are shown in Figures 1b and 1c, respectively.

The National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Association

Figure 1a) A close up of the commercial C/VIS monitor displaying the right No-Zone. 1b) A close up of the advanced C/VIS right fender camera. 1c) The advanced C/VIS mounted on a Freightliner C120 tractor with a 48-ft trailer.
(FMCSA) have a high interest in identifying technologies that can address crashes resulting from lane-change/merge scenarios. Both agencies contracted VTTI to perform a Technology Field Demonstration (TFD) of road-worthy C/VISs. The TFD enabled the United States Department of Transportation (U.S. DOT) to evaluate whether the concept of providing CMV drivers with enhanced visual information results in improved situational awareness leading to a reduction in safety-critical events caused by scenarios such as other vehicles in blind spots as well as vehicles obscured by inclement weather conditions.

The TFD investigated the utility of both a commercial C/VIS as well as an advanced C/VIS in a revenue-producing environment. Both the commercial C/VIS and advanced C/VIS were installed on six trucks operated by Schneider National, Inc. The commercial C/VIS was installed on three trucks, while the advanced C/VIS was installed on another three trucks (Figure 2). Twelve CMV drivers employed by Schneider National, Inc participated in this research effort. They each drove a truck for one month with the C/VIS disabled (comprising the Baseline condition) and three months with the C/VIS enabled (comprising the Test condition). Video of the roadway and the drivers’ face, as well as various vehicle sensor data such as range and lane position, were continuously recorded.

It was found that when driving with a C/VIS: 1) drivers’ involvement in safety-critical events did not change, 2) the clearance to an adjacent vehicle when changing lanes did not change, and 3) the likelihood that drivers looked forward did not change. Although a reduction in safety-critical events was not observed when driving with a C/VIS, drivers indicated that the C/VISs helped them see other vehicles around their tractor-trailer and made it easier to merge into traffic. They also looked at the fenders mirrors less frequently when driving with a C/VIS, possibly because the C/VIS fender cameras presented similar information. Drivers were more likely to use the C/VISs at night and when making right lane changes. Drivers using the advanced C/VIS rated its features highly and used the rear-view camera more than the left or right fender cameras. In terms of disbenefits, some drivers indicated that: 1) glare from the commercial C/VIS monitors could be uncomfortable at night, 2) light from the turn signals could be too bright on the commercial C/VIS monitors, and 3) the left commercial C/VIS monitor could block their view of the left fender mirror. These issues, however, are easily resolvable by: 1) using monitors that can be substantially dimmed to reduce discomfort glare, 2) diffusing the light emanating from the turn signals that is captured by the C/VIS cameras, 3) positioning the monitors at the top of the A-pillars to improve drivers’ view of the forward roadway and fender mirror. It is important to note here that drivers’ involvement in safety-critical events did not worsen when driving with a C/VIS. Overall, although a reduction in safety-critical events was not observed, this study shows that providing CMV drivers with enhanced visual information does improve their situational awareness and simplifies the execution of lane change maneuvers.