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Future Truck Program Position Paper

Future Driver Interface

Equipment User Expectations for the Driver-to-Vehicle Interface

Developed by the Technology & Maintenance Council's (TMC)
Future Electrical and Insturments SystemTask Force

ABSTRACT

Advanced communication systems, collision warning systems and complex display systems are finding their way into commercial vehicles. Dispatcher communications and cellular telephones are already common place. Navigational aids are becoming more popular as prices fall rapidly. Soon the communications bandwidth into a truck will increase to rates that rival current office systems. This will bring with it a proliferation of communications devices. A driver could conceivable have complete Internet access while driving.

As these systems are added to vehicles, it is imperative that the driver's attention is not unduly directed away from the driving task. Driver inattention is already a leading cause of crashes. Many of the estimated 25,000 annual rear end crashes involving heavy trucks are caused by driver inattention. As we move forward into the brave new world of high speed wireless communications, advanced diagnostic systems and collision warning systems, we need to make sure we are not distracting or overloading the driver.

DRIVER VEHICLE INTERFACE ISSUES

There are three main components to driver inattention:

1. Driver fatigue.
2. Gaze distraction.
3. Cognitive inattention.

Items 2 and 3 above are the major concerns when dealing with the efficiency and effectiveness of a driver vehicle interface (DVI). Gaze distraction is simply defined as "the driver's eyes off the road." Drivers tend to make short glances to mirrors and to dashboard controls when driving. For simple tasks such as turning on headlights or glancing at mirrors, a single one-second glance is often sufficient. For more complicated tasks, such as reading a map on a navigational display, multiple one-second glances may be required. For example, studies have shown that reading a map display for

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a typical navigational aid can take as many as 10 glances to the display. This increases the probability that an emergency could develop while the driver is looking away from the road.

Cognitive inattention is closely related to information overload. In this case, the driver may be looking at the road but his mind is on something else. He may be in a serious conversation about a complex matter, or simply thinking about something other than the driving task. This situation can reduce the driver response time when faced with a emergency situation.

DVI DESIGN ISSUES

The purpose of the DVI is to convey information to the driver, or obtain input from the driver in a manner that does not unduly take the drivers attention away from the driving task. Recommended DVI design principles and guidelines include:

- Keep the driver's eyes on the road.
- Keep information close to the horizon.
- Make manual controls identifiable by touch.
- Use non visual displays, such as audible (beeps dings speech), and tactile (vibrating seats, steering wheels and peddles).
- Keep the information exchange as simple as possible.
- Avoid complex displays that take more than a second to decipher.
- Minimize information content to what is needed - what does the driver really need to know?

FUTURE DVI PERFORMANCE

Inattention associated with today's basic DVIs is well documented[1]. TMC recommends that future DVIs not increase driver inattention beyond that of the basic DVI.

Once a new driver vehicle interface is designed the question of how the design affects driver attention and driver performance in general needs to be answered. Short of sending an observer out on the road with each driver, this type of evaluation is best performed in a driving simulator. In a driving simulator, drivers can experience a variety of DVIs, in a variety of driving environments, without compromising safety. Gaze inattention can be measured by keeping track of the frequency and duration of the drivers' glances while driving the simulator. Cognitive inattention can be evaluated by exposing the driver to potentially dangerous situations and measuring his/her responses.

TMC proposes the following DVI-related recommendations:

1. Develop a set of standard protocols for DVI simulation testing that specify:
   - A means for classifying a display for further testing.
   - A set of tests that apply to each display class.
   - Traffic conditions for which each display class will be tested.
   - Emergency situations that will be used as examples of inattention.
   - Measurements that will be used to assess driver performance and inattention.
   - The number of drivers to be used in each test.
   - Minimum fidelity requirements for the driving simulator.
2. Validate these protocols at several locations using different simulators.
3. Encourage manufacturers to adopt these protocols when evaluating new DVIs.

1. "Heavy Vehicle Driver Workload Assessment," Louis Tijerina, NHTSA report # DOT HS 808 467,