Connected Vehicle/Infrastructure University Transportation Center

Program Director: Dr. Thomas Dingus

Consortium Lead: Virginia Tech Transportation Institute (VTTI)

Program Overview

In 2012, VTTI and partners from the University of Virginia and Morgan State University were awarded a Tier 1 UTC grant from USDOT to research, develop, test, and evaluate CV applications that will lead to improvements in safety, mobility, the environment, and agency operations. In support of this effort, the Virginia Transportation Research Council (VTRC)/VDOT provided matching funds to establish CV test beds on the Virginia Smart Road in Blacksburg and in an operational setting in Northern Virginia; these test beds are now collectively referred to as the Virginia Connected Corridors. The CVI-UTC produced two primary outcomes: 1) the development of a robust program of research in both V2V and V2I applications; and 2) the establishment of a fully functional test bed environment including vehicles and associated backend.

The CVI-UTC research program includes 24 research projects that address a variety of safety and mobility challenges and investigate topics related to CV deployment. Those projects that reached an appropriate level of maturity were tested in the test bed environment at the Smart Road and then migrated to the Northern Virginia (I-66) test bed.

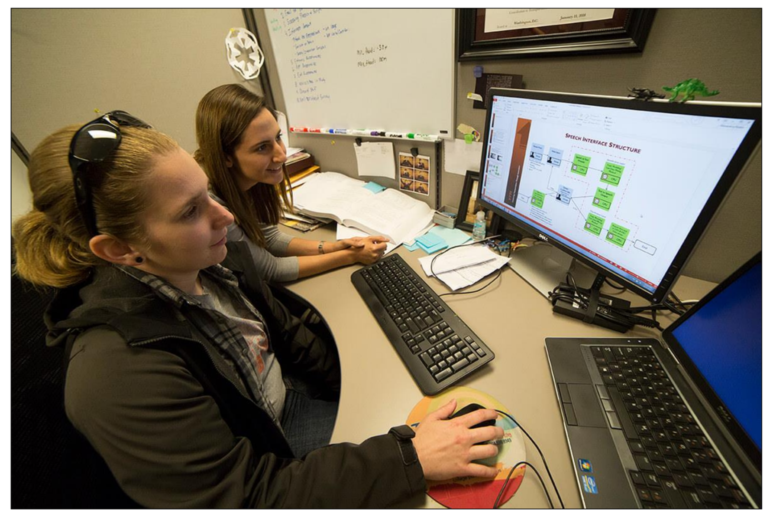
Goals

- Increased understanding and awareness of transportation issues
- Improved body of knowledge
- Improved processes, techniques, and skills in addressing transportation issues
- Enlarged pool of trained transportation professionals
- Greater adoption of new technology

Supporting Women in Transportation

Research

The CVI-UTC Consortium has a commitment to fostering the diversity of its faculty, staff, and students. The CVI-UTC has had a number research projects which have supported women pursuing undergraduate and graduate degrees at consortium universities, including many which were led by female student and faculty researchers.



Outreach and Education

The CVI-UTC also focuses on promoting STEM education and careers in transportation. Through participation in engaging events such as the 2015 Girls in Transportation Workshop and 2016 USA Science and Engineering Festival, the CVI-UTC is committed to developing the next generation of the transportation workforce.

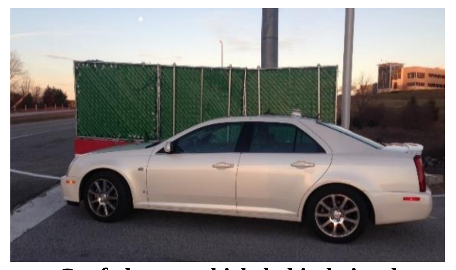
Selected Women-Led CVI-UTC Research Projects

Safety, Operational, and Energy Impacts of In-vehicle Adaptive Stop Displays Using Connected Vehicle Technology

Lead Researcher: Alexandria Noble, M.S.

Abstract

Un-signalized intersections create multiple opportunities for missed or misunderstood information. Stop sign-controlled intersections have also been shown to be a source of delay and emissions due to their frequent, often inappropriate use. By using connected vehicle technology, it is possible to place electronic stop signs at more conspicuous locations that can communicate with the in-vehicle systems. Then, if a conflict is imminent at an intersection, the vehicle's system alerts the driver, thus reducing the probability of missed information, as well as decreasing the amount of unnecessary delay, fuel consumption, and emissions by only prompting a stop when a conflict is present.



Confederate vehicle behind visual obstruction.

Participant view on approach (35 m behind stop bar).

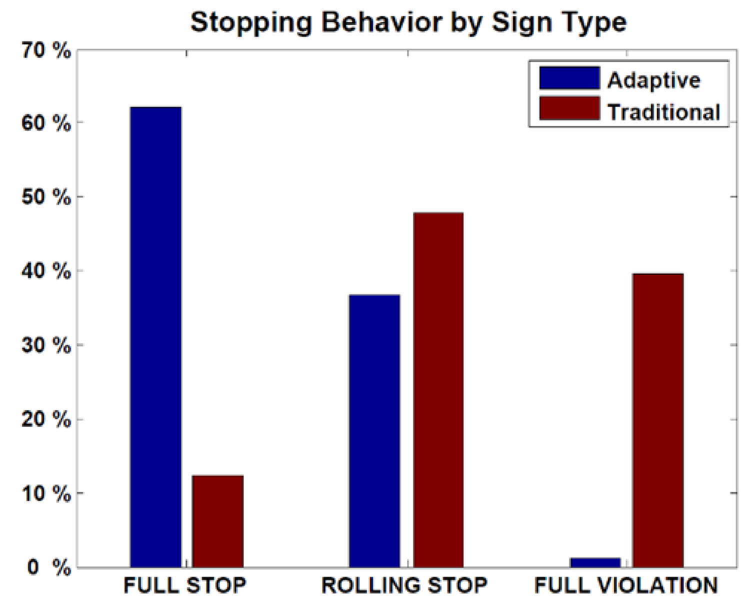
Confederate vehicle encroaching on participant vehicle.

Final stopping location for confederate vehicle.

Sign State	Image	Alert Pairing
STOP	STOP	Alert 1
Proceed with Caution (PWC)	PROCEED WITH CAUTION	Alert 1
Switch	PROCEED WITH CAUTION t = 1 s → STOP	Alert 1 then Alert 2
Blackout	VirginiaTech Transportation Institute	No Auditory Alert

The objective of this study was to assess perceived benefits of an adaptive in-vehicle stop display and to determine if there were any negative safety implications with the use of this system. This was accomplished through a test track experiment with 49 participants. These drivers were presented with a standard R1-1 stop sign on the in-vehicle display, as well as an experimental sign, which informed them to proceed through the intersection with caution. Results indicate the implementation of this technology reduces delay, decreases fuel consumption, and does not instigate any safety decrements.

Highlights



- Participants were generally able to learn how to use the display quickly.
- The performance of participants using the adaptive stop display indicates no difference in stopping behavior in terms of driver input when compared to a traditional stop sign. However, the increased level of compliance to the stop display is something that should be noted; participants were not missing valuable information and were more willing to stop when using the adaptive stop display.
- A stop made in compliance with the adaptive stop display had a compliance level of 62.11% compared to a stop made at a traditional stop sign (12.44% compliance).
- Mean glance duration and frequency decreased rapidly with increased driver experience with the in-vehicle system.
- The mean eyes-off-road time and number of glances to the in-vehicle device when functioning normally are comparable to that of checking the speedometer (Dingus et al.[1]).
- For one intersection with an ADT of 1,950 vehicles per day controlled by adaptive stop display compared to traditional stop signs the savings to society in terms of CO_2 emissions is $24,349.14 over 45 years.

[1] Dingus, Thomas A., Klauer, Sheila G. (2008). The Relative Risks of Secondary Task Induced Driver Distraction SAE Technical Paper Series. Detroit, Michigan.

Human Factors Evaluation of an In-Vehicle Active Traffic and Demand Management (ATDM) System

Lead Researcher: Kayla Sykes, M.S.

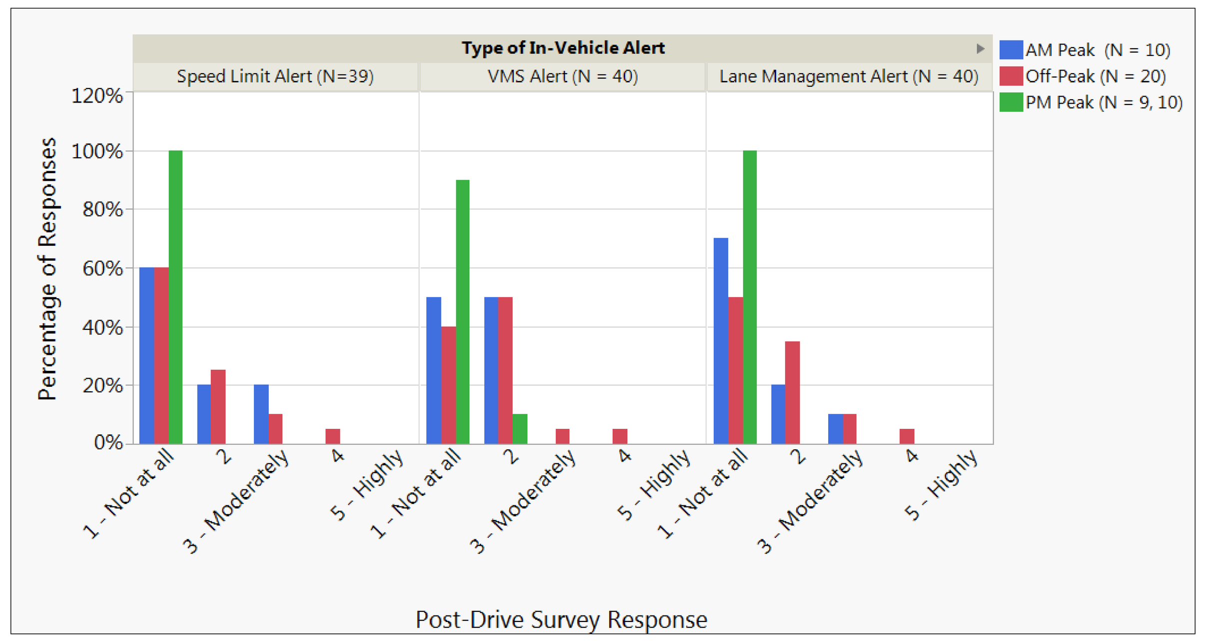
Abstract

This research study focused on the development and subsequent evaluation of an in-vehicle Active Traffic and Demand Management (ATDM) system deployed on Interstate 66 in Northern Virginia. The ATDM elements inside the vehicle allowed drivers to remain consistently aware of traffic conditions and roadway requirements even if external signage was inaccessible.

Forty participants were accompanied by a member of the research team and experienced the following in-vehicle device (IVD) features: 1) dynamic speed limits, 2) dynamic lane use/shoulder control, 3) High Occupancy Vehicle (HOV) restrictions, and 4) variable message signs (VMS). This ATDM system was equipped with auditory and visual alerts to notify the driver when relevant information was updated. The research questions addressed distraction, desirability, and driver behavior associated with the system. Participant data was collected from the instrumented vehicle, various surveys, and researcher observation.

Highlights

- According to the eye glance reduction analysis, all of the National Highway Traffic Safety Administration (NHTSA) distraction guidelines were met; therefore, the IVD would not be considered a distraction to drivers.
- None of the in-vehicle alerts were distracting or annoying based on in-vehicle and post-drive survey responses.
- 73% of participants would want the in-vehicle technology in their next vehicle.
- When asked if they would use an in-vehicle device that provided HOV, lane management, speed limit, and VMS if such system existed, 98% of participants said they would use the device in both the pre-drive and post-drive surveys.
- The speed limit alert motivated participants to alter their speed (based on both survey results and actual participant speed data).
- A vast majority of the participants found the in-vehicle VMS to be clear and concise based on post-drive survey responses (95%).



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