Intelligent Vehicles Initiative Field Operational Test

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Why This Research is Needed

For snowplow operators and drivers of other specialty vehicles such as police cars and ambulances, winter driving can be difficult and dangerous. These drivers must routinely navigate icy roads in blowing and drifting snow while trying to avoid moving and parked cars, bridge end treatments, signs, guardrails, and any number of other obstacles. This project is being conducted to assist drivers under these difficult conditions.

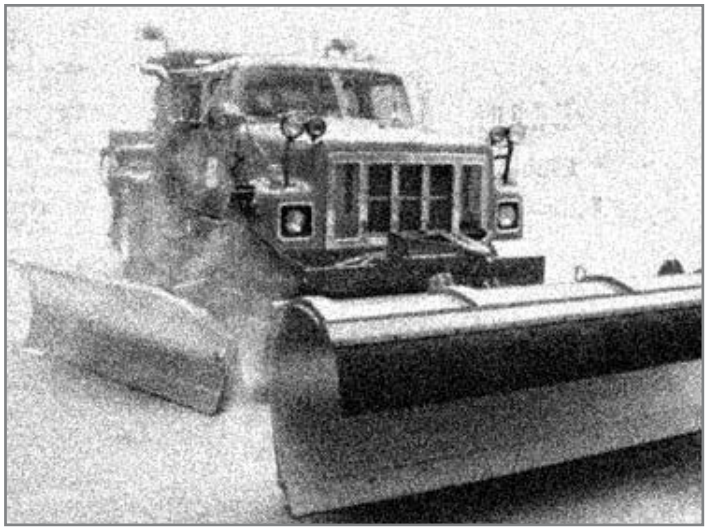
Research Objective

To increase safety for specialty vehicle drivers through the use of vehicle-guidance and collision-avoidance technologies in low visibility conditions.

Methodology

Engineers at the ITS Institute's Intelligent Vehicles Laboratory (IV Lab), in cooperation with human factors researchers from the Institute's HumanFIRST Program and engineers from the University of Minnesota Duluth's Electrical and Computer Engineering Department, are developing and testing a variety of vehicle-guidance and collision-avoidance technologies.

Dr. Kathleen Harder and Dr. John Bloomfield conducted a series of human factors studies involving driving simulation and field testing. They devised a number of lane-departure and collision-avoidance warnings for use with a head-up display (HUD) that allows drivers to "see" road markings via images projected onto a combiner mounted close to the windshield. This system was tested in the driving simulator with 55 specialty vehicle operators.



Specialty vehicles like this snowplow must often operate in conditions of low visibility.

Subsequently, lane-departure warnings were provided with a combination of visual, tactile, and auditory signals and were field-tested by Harder and Bloomfield at the University's Rosemount research facility between November 2000 and January 2001. Tests used the Minnesota Department of

When visibility is poor, drivers use the HUD to "see" what is ahead. Note the high-fidelity match between the projected lane markings, mailbox icon, and radar-detected object with the actual road, mailbox, and vehicle.

Transportation's (Mn/DOT) "SAFEPLOW," which was equipped with a vehicle data acquisition unit to collect data representative of drivers' responses. During the study period, 13 Mn/DOT snowplow operators used the HUD and warnings to drive the vehicle in zero visibility, an effect created by obscuring the front and side vehicle windows with opaque curtains.

Patrol car outfitted with the driver-assistive technologies

Follow-up testing to determine driver response to this technology at high speeds was conducted in cooperation with the Minnesota State Patrol and Hutchinson Ambulance in September of 2001. Thirteen troopers and two ambulance drivers used the system under low-visibility conditions, including moonless nights and fog, and were evaluated by HumanFIRST director Dr. Nicholas Ward. The system performed as intended, even at speeds approaching 100 mph.

Throughout the summer months of 2001, four snowplows, an ambulance, and a State Patrol car were prepared for the field operational test currently in progress. All of the equipment designed to assist the driver, including the HUD, driver's seat (which provides the tactile warning), audio warnings, sensors, and computers, was installed in each vehicle. Data acquisition equipment, consisting of four video cameras, a microphone, and an Ethernet connection to the vehicle computers, was installed to record driver-response to the system during operational testing. During normal operation, vehicle and driver data are recorded onto a removable hard drive and are periodically archived onto DVD-RAM for subsequent study and analysis.

One prerequisite for the operations test included project-related infrastructure equipment installation. The team installed six weather stations along a 45-mile stretch of Minnesota Trunk Highway 7 between Hutchinson, Minnesota, and I-494. These stations have been operational since October and are collecting weather and visibility data at five-minute intervals. Data are archived on a central server located at the University of Minnesota. Team members have also completed installation of three additional GPS correction base stations, providing a means to achieve centimeter-level position accuracy of the test vehicles on Highway 7. In addition, a digital geospatial database of the Highway 7 corridor between Hutchinson and I-494 was created and validated.

Research Impacts

Results from the project will be used to validate the system. The system will ultimately be used both to reduce the risk of driving snowplows or emergency vehicles in low-visibility situations and to increase public safety through improved emergency response and more efficiently plowed roads. In time, this technology may become available in standard passenger vehicles.

Research Partners

The Intelligent Vehicle Initiative Field Operational Test Program is funded by the Federal Highway Administration, Mn/DOT, and industry partners. The ITS Institute is coordinating the research for the program, under which the University is receiving $2.65 million over three years. Mn/DOT, McLeod County, the city of Hutchinson, the Minnesota State Patrol, and private industry partners are providing additional resources and funding for this $6.5 million project.

For More Information

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