Results from an Extended Pilot Test of an Integrated Vehicle-Based Safety System for Heavy Trucks

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Overview

• Program objectives
• Partners and organization
• FOT Status
• Heavy-truck IVBSS Implementation
• EPT objective and subjective results
• EPT conclusions, lessons learned, and changes for the FOT
Program Objectives

- UMTRI-led cooperative agreement with U.S. DOT (JPO, NHTSA and FMCSA)
- Assess integrated vehicle-based safety systems in passenger cars and heavy trucks
- Lateral Drift, Lane Change/Merge, Forward Crash and Curve Speed Warning functions
  - Builds on previous, non-integrated, systems
  - Provides arbitration of multiple crash threats
Program Objectives

• Includes field testing on public roads by end users

• An independent evaluation to assess:
  – Safety benefits
  – Driver acceptance / ease of use
  – Willingness to purchase / marketability

• Diversity of stakeholders and partners with a common challenge
Partners

Visteon

UMTRI

Eaton

Honda

Takata

International

Battelle

MDOT

Con-way
Heavy Truck Status (Will be updated to include FOT Status)

• 10 Vehicle Fleet
  – 4 tractors in service, collecting FOT baseline
  – 3 tractors in final check-out phase, go into service on February 16
  – 3 tractors being outfitted, early March service

• April 1 the IVBSS systems become active in first 4 tractors

• FOT will be completed in December of ‘09
Heavy Truck Sensor Coverage

Lane-change/Merge (LCM)

Forward Crash Warning (FCW)

Lane Departure Warning (LDW)

* Sensor field-of-view depth not to scale
Heavy Truck Integration
IVBSS Heavy-truck Driver Vehicle Interface
### Heavy Truck DVI

<table>
<thead>
<tr>
<th>Cond. Code</th>
<th>Initiation Condition</th>
<th>Side</th>
<th>Visual Displays Forward</th>
<th>Auditory Display (Directional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCW-3</td>
<td>Forward object within 2s headway</td>
<td>N/A</td>
<td><img src="image" alt="Visual Display" /></td>
<td>Opening=None Closing=Short Alert</td>
</tr>
<tr>
<td>FCW-6</td>
<td>Slower moving vehicle in the front</td>
<td>N/A</td>
<td><img src="image" alt="Visual Display" /></td>
<td>Repeating Alert</td>
</tr>
<tr>
<td>LDW-1</td>
<td>Subject vehicle drift just outside the lane boundary toward an unoccupied lane</td>
<td></td>
<td><img src="image" alt="Visual Display" /></td>
<td>Directional lane excursion warning</td>
</tr>
<tr>
<td>LCM-3</td>
<td>Adjacent vehicle detected AND lane change maneuver IS detected</td>
<td></td>
<td><img src="image" alt="Visual Display" /></td>
<td>Right/Left channel side collision warning</td>
</tr>
</tbody>
</table>
UMTRI DAS
DAS Camera Views and Collection Rates

Forward 5 Hz
Left rear 2 Hz
Right rear 2 Hz
Face 5 Hz
Cabin 2 Hz
Seven drivers over a 4 week period from Nov 13th to Dec 12th, 2008
Exposure: 5562 miles driven over 459 trips. Total time 159 hrs.
Data archive size 30.5 GB both video and numerical (193 MB/hr)
Overall invalid alert rate 10.3 alerts per 100 miles
Alert Rate Summary

- This will be a series of slides that highlights the alert rates for each of the sub-systems by alert category. It will be rather short but will mention the analysis of alert validity and thought leading to the decision to modify the FCW stopped and slower moving suppression algorithms.
Movie of a valid Stopped Alert
Movie of driver falling asleep
Effect of Exposure on Alert Rate

Alert rate per 100 miles as a function of distance

Driver 1; P&D; 499.3 miles
Driver 2; Line-haul; 2,185.4 miles
Driver 3; P&D; 365.7 miles
Driver 4; Line-haul; 970.8 miles
Driver 5; P&D; 393.2 miles
Driver 6; Line-haul; 539.5 miles
Driver 7; P&D; 392.0 miles
Subjective Results

• I will expand on the re-write of the subjective findings from the EPT report and include the questions and ratings for each of the categories (I might not cover all questions but I will highlight ones that speak to the objectives of the program…ease of use, safety, satisfaction and integration.
Conclusions and Implementation of Results

• Results consistent with business practices of the fleet
• Weather did not play a large role in results
• Invalid alert rates independent of route type with an invalid alert rate of 11.3 and 9.9 for P&D and Line-haul, respectively.
• Large number of valid alerts with the exception of Fcw stopped objects (lead to software changes)
Conclusions and Implementation of Results

• Subjectively, Drivers reported they:
  – Were fairly satisfied with IVBSS
  – Understood the warnings
  – Felt intensity of warnings was appropriate
  – One driver used volume control, none used mute
  – LCM: drivers thought location of the side display could make them more noticeable when checking mirrors