NHTSA’s Lateral Deviation Support Test Method Research

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This presentation will...

- Provide an overview of NHTSA’s test track LDS research
- Describe some considerations related to how LDS performance can be objectively assessed

Note: The work described is preliminary; follow-up work is anticipated in 2016.
What is LDS?

• Lateral deviation support (LDS) is a category of crash avoidance technologies designed to address the lane and road departure safety problem

• LDS systems presently range from those that only provide passive warnings (e.g., lane departure warning) to those with active control (e.g., lane centering)

• Includes side crash avoidance technologies (e.g. blind spot intervention)
Examples of LDS Technologies

- Blind Spot Warning (BSW)
- Lane Departure Warning (LDW)
- Lane Keeping Support (LKS)
- Lane Centering Control (LCC)
- Road Departure Support (RDS)
- Crash Imminent Steering (CIS)

Provide active interventions

![Diagram showing applicable technologies: LDW, LKS, LCC, RDS](image1)

![Diagram showing applicable technologies: BSW, CIS](image2)
The Importance of LDS systems

• Applicable pre-crash scenarios include
  – Road edge departure without prior vehicle maneuver
  – Vehicle(s) changing lanes – same direction
  – Vehicle(s) drifting – same direction
  – Vehicle(s) making a maneuver – opposite direction
  – Vehicle(s) not making a maneuver – opposite direction

• Many LDS technologies are stepping stones leading to higher levels of vehicle automation

• Scenarios can be addressed with a combination of technologies including:
  – Conventional sensors
  – V2V communication
## LDS-Relevant Crashes
*(2004 – 2008 GES)*

<table>
<thead>
<tr>
<th>Pre-Crash Scenario</th>
<th>Total Crashes</th>
<th>Percent of Crashes, Per Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Straight</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Dry</strong></td>
</tr>
<tr>
<td>Road edge departure/no maneuver</td>
<td>370,417</td>
<td>63%</td>
</tr>
<tr>
<td>Changing lanes/same direction</td>
<td>335,824</td>
<td>79%</td>
</tr>
<tr>
<td>Opposite direction/no maneuver</td>
<td>118,104</td>
<td>47%</td>
</tr>
<tr>
<td>Drifting/same direction</td>
<td>105,326</td>
<td>72%</td>
</tr>
<tr>
<td>Opposite direction/maneuver</td>
<td>10,987</td>
<td>61%</td>
</tr>
</tbody>
</table>
## Corrective Actions Attempted
(2004 – 2008 GES; Imputed)

<table>
<thead>
<tr>
<th>Pre-Crash Scenario</th>
<th>No Avoidance Maneuver</th>
<th>Braking (No Lockup)</th>
<th>Braking (Lockup)</th>
<th>Steering(^1)</th>
<th>Braking and Steering</th>
<th>Other Action(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road edge departure/ no maneuver</td>
<td>64.3 %</td>
<td>2.4 %</td>
<td>5.3 %</td>
<td>24.4 %</td>
<td>1.1 %</td>
<td>2.5 %</td>
</tr>
<tr>
<td>Changing lanes/same direction</td>
<td>52.0 %</td>
<td>1.3 %</td>
<td>2.1 %</td>
<td>40.0 %</td>
<td>4.4 %</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Opposite direction/ no maneuver</td>
<td>17.8 %</td>
<td>2.8 %</td>
<td>6.5 %</td>
<td>66.6 %</td>
<td>5.1 %</td>
<td>1.2 %</td>
</tr>
<tr>
<td>Drifting/same direction</td>
<td>65.1 %</td>
<td>2.4 %</td>
<td>3.5 %</td>
<td>25.1 %</td>
<td>2.6 %</td>
<td>1.4 %</td>
</tr>
<tr>
<td>Opposite direction/maneuver</td>
<td>14.8 %</td>
<td>0.1 %</td>
<td>3.7 %</td>
<td>75.0 %</td>
<td>4.1 %</td>
<td>2.3 %</td>
</tr>
</tbody>
</table>

\(^1\) Includes categories: “accelerating and steering left/right”  
\(^2\) Includes categories: “releasing brakes” and “accelerating”
2015 NHTSA Test Track Work

- Review existing test methods and procedures, develop relevant updates
- Develop methods for evaluating new technologies, perform pilot testing
• Some drivers feel they experience too many LDW nuisance alerts
  – If the systems are being disabled, they cannot provide any safety benefits
• To address this concern, NHTSA…
  – Summarized all available LDW NCAP test report data
  – Met with ODI and vehicle manufacturers
  – Reviewed GM, IIHS, and CWIM studies
  – Compared test track performance to real-world impressions
  – Developed recommendations on how the LDW evaluation criteria could be changed to improve customer acceptance
LKS Background

• LKS systems are designed to mitigate or prevent lane departures via automatic steering and/or differential braking
• NHTSA presently includes a short series of optional LKS tests within the NCAP LDW test procedure, however:
  – They are supplementary
  – Performed with a straight road only
  – Intended for research purposes
• Questionable performance was observed during 2010 testing
  – Secondary lane departures
  – Ping-ponging
Current LKS Work

• Quantifying current state-of-technology
  – Include a broad range of lateral velocities, from low to the suppression threshold

• Working to expand NHTSA’s existing LKS test matrix
  – Inclusion of straight and curved (500m radius?) roads
  – Include non-activation tests
  – Coordinating with EuroNCAP

• 2015 testing has emphasized the need for a lightweight steering machine
  – A low inertia design should not affect LKS steering interventions
  – Will maximize test accuracy and repeatability
LCC Work

• LCC systems are designed to mitigate or prevent lane departures by using automatic steering to keep the vehicle near the center of the travel lane
• Anticipated scenarios are similar to those used for LKS
• Test methods will likely be different than for LKS
  – Achieving a constant headway towards a lane line will not be possible
  – Evaluation criteria are expected to relate to how well lane position is maintained during a period of activation
• Suppression threshold tests may be of interest
• Use of additional scenarios is anticipated
  – False positive test (e.g., exit ramp)
RDS Work

- RDS systems are designed to mitigate or prevent lane departures if LKS is unable to
- RDS activation may not require lane lines to be present
- Most anticipated scenarios are identical to those used for LKS
  - Straight road
  - Curved road
  - Broad range of lateral velocities
  - Non-activation tests
- Use of a lightweight steering machine is expected to improve the accuracy and repeatability of test conduct
CIS Work

• Examples of CIS technology
  – Blind Spot Intervention (BSI)
  – Head-on crash avoidance
  – Steering-based rear-end crash avoidance
• Production-based CIS technologies are very limited
• Thus far, 2015 testing has been limited to BSI pilot testing
Test matrix includes 5 scenarios

Three test vehicles
- 2014 Infiniti Q50
- 2015 Tesla Model S 85D
- 2016 Mercedes C300

A full-size surrogate vehicle is being used as the principal other vehicle

Test maneuvers are complicated
- Fully automated tests will be developed to improve the accuracy and repeatability of test conduct
Recognizing the potential safety benefits of LDS, EuroNCAP has initiated a program similar to NHTSA’s
  – Test method harmonization is being carefully considered
Additional harmonization efforts include 3D surrogate vehicle development
  – An acceptable global surrogate must appropriately balance of realism, durability, and ease-of-use
  – NHTSA, working with IIHS, and EuroNCAP, are evaluating what features best define “realism”
  – A decision on what 3D surrogate the agency will use for advanced technology evaluations is expected in 2016
Safer drivers. Safer cars. Safer roads.

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