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NHTSA's Lateral Deviation Support Test Method Research

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Garrick J. Forkenbrock
NHTSA Research

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.

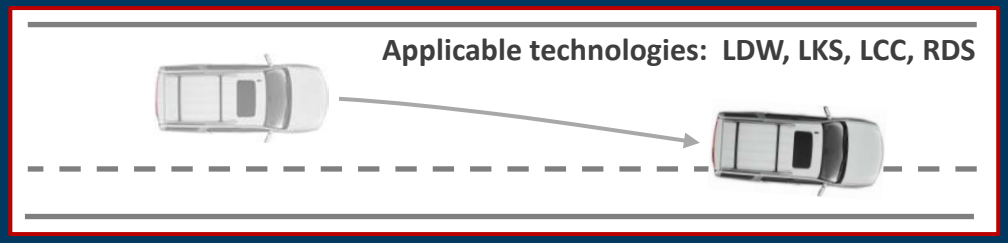
What is LDS?

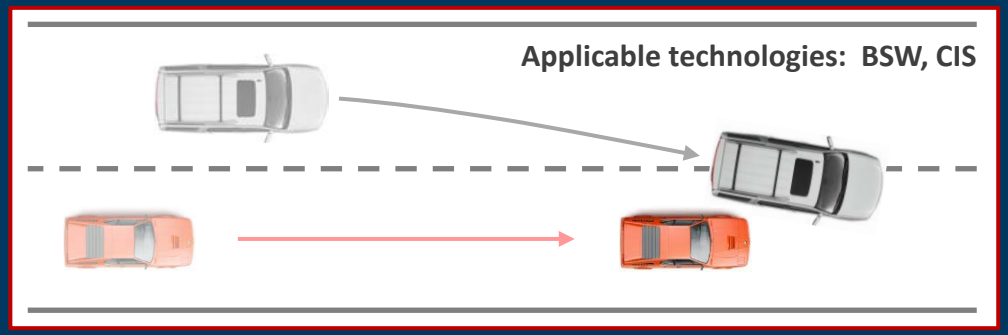
- Lateral deviation support (LDS) is a category of crash avoidance technologies designed to address the lane and road departure safety problem
- LDS systems presently range from those that only provide passive warnings (e.g., lane departure warning) to those with active control (e.g., lane centering)
- 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





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)

Pre-Crash Scenario	Total Crashes	Percent of Crashes, Per Scenario			
		Straight		Curved	
		Dry	Slippery	Dry	Slippery
Road edge departure/no maneuver	370,417	63%	13%	19%	5%
Changing lanes/same direction	335,824	79%	14%	6%	1%
Opposite direction/no maneuver	118,104	47%	15%	26%	12%
Drifting/same direction	105,326	72%	18%	8%	2%
Opposite direction/maneuver	10,987	61%	23%	13%	3%

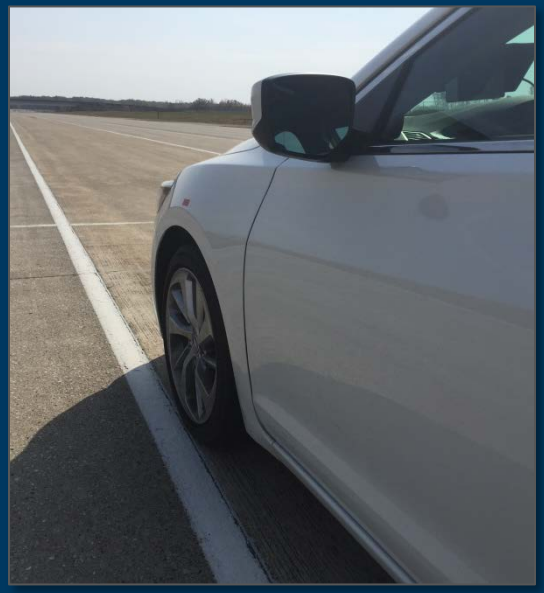
Corrective Actions Attempted
(2004 – 2008 GES; Imputed)

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

[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



LDW

- 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

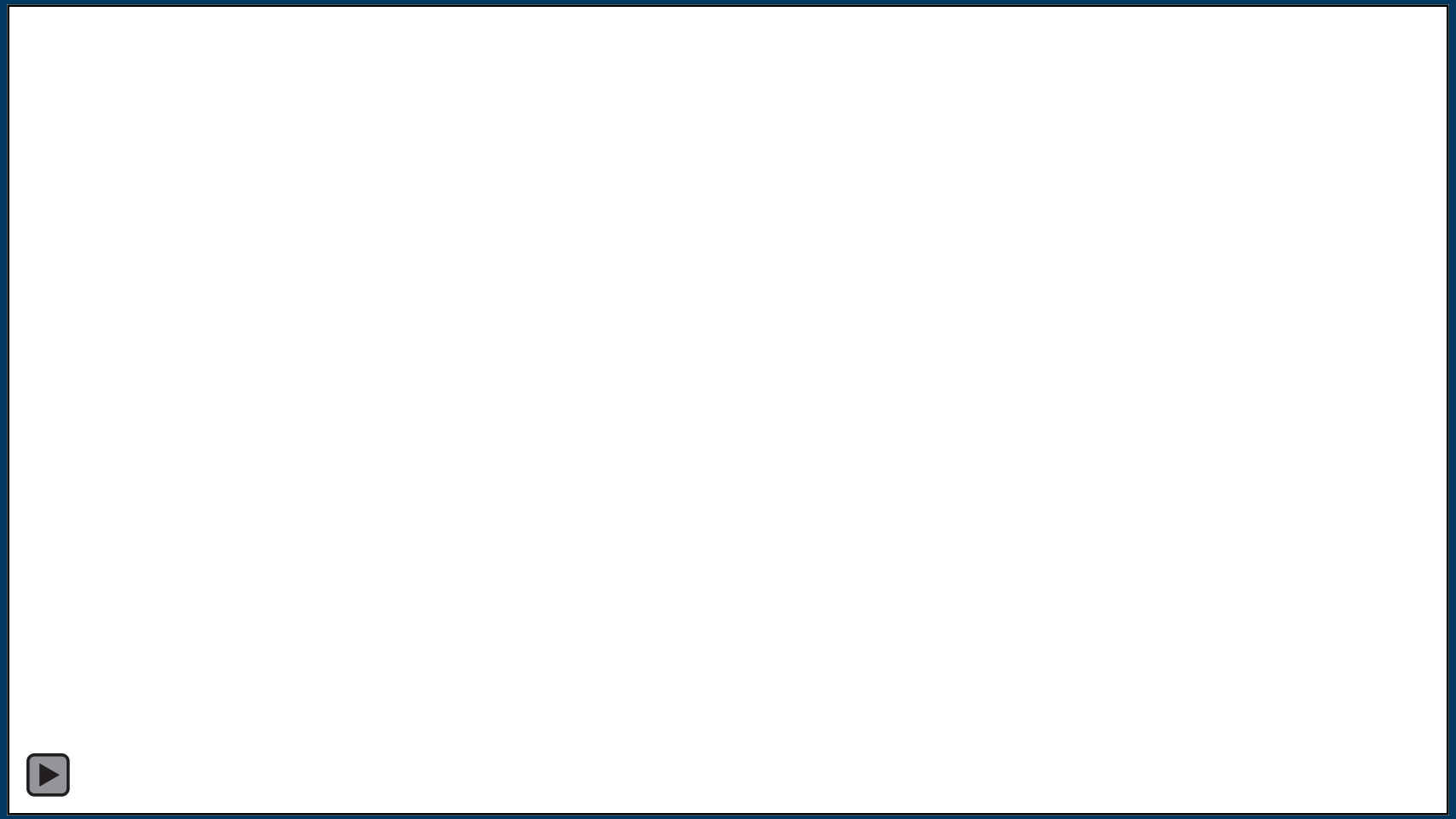
CIS Work

- 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

Preliminary BSI Evaluations

- 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

BSI Evaluation Example



Harmonization

- 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

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garrick.forkenbrock@dot.gov

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