NHTSA’s ESC Research Program: 2005 Activities and a Look to the Future

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Presentation Overview

- 2005 Testing
- Maneuver Reduction
- ESC Evaluation Metrics
- Repeatability Evaluation
- Future Research
- Concluding Remarks
2005 Testing

- **ESC Effectiveness**
  - Participated in a collaborative data collection with 11 vehicle manufacturers
  - 62 vehicles, 128 configurations evaluated

- **Sine with Dwell Repeatability**
  - Collaborative testing effort with the Alliance of Automobile Manufacturers
  - Two vehicles presently being evaluated at five proving grounds
**Maneuver Reduction**

- **Phase 1 (2004)**
  - 12 maneuvers, 21 steering combinations used
  - Four top candidates identified

- **Phases 2a and 2b (2005)**
  - Four Phase 1 maneuvers used for 24 vehicles
  - 0.7 Hz Sine with Dwell selected as preferred ESC effectiveness maneuver
0.7 Hz Sine with Dwell

- Requires use of a steering machine
- Based on a single cycle sinusoidal steering input
- Frequency is 0.7 Hz
- 500 ms pause after 3rd quarter cycle
- Performed at 50 mph (drop throttle only)
- Severity increased via steering angle increments
Many methods for evaluating lateral stability and responsiveness considered

Lateral stability:
- Vehicle must not spinout (oversteer mitigation)
- Requires yaw rate to decay in a reasonable manner

Responsiveness:
- Complements lateral stability
- Reflects NHTSA opinion that it is important for a vehicle retain reasonable avoidance capability
The outcome of a test used to evaluate minimum performance should not depend on where the test was performed.

Tests being performed at five locations:
- Ohio (VRTC)
- Michigan
- South Carolina (VRTC)
- Arizona
- California
Document/Presentation

- **Documentation**
  - ESV Paper 05-0221 *(Phase 1 research)*
  - DOT HS 809 875 *(human driver steering capability)*
  - Technical report summarizing 2005 ESC research in approval circulation

- **Presentations**
  - 2005 ESV
  - 2005 SAE Government / Industry
  - ESC docket 19951
Future Research
Understeer Mitigation

Research Objectives

- Determine common understeer events
- Identify a test maneuver(s) capable of quantifying understeer mitigation effectiveness
- Assess low friction test feasibility
Future Research
Understeer Mitigation

- Anticipated maneuvers
  - J-Turn
  - Closing Radius Turn
  - Slowly Increasing Steer
- Small, diverse test fleet
  - Sports car
  - Two SUVs
  - Two sedans
  - 15-passenger van
- One load configuration
  (Nominal load)

- Testing to begin winter 2005
- Winter proving grounds tests may be performed
  - Ice testing
  - Snow testing
  - Results could be compared to those produced on the TRC wet Jennite pad

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Future Research

Understeer Mitigation – Testing Concerns

- ESC benefits on low friction surfaces have been documented, but are based on crash data and subjective test track evaluations

- Results from tests performed on low friction surfaces are prone to high test variability

- NHTSA would like to objectively quantify the effects of understeer mitigation so that minimum performance criteria can be developed

- NHTSA would greatly appreciate suggestions on how to resolve this problem!
Future Research
Roll Stability Control (RSC)

- **Research Objectives**
  - Gain an increased awareness of RSC functionality and effectiveness
  - Determine metrics capable of identifying whether a vehicle is equipped with RSC
  - Assess whether improved dynamic rollover resistance is achieved at the expense of lateral stability and/or responsiveness

- **Results will be documented in a technical report**
Future Research
Roll Stability Control (RSC)

- Maneuvers to evaluate rollover, lateral stability, and responsiveness
  - NHTSA Fishhook
  - 0.7 Hz Sine with Dwell
- Four SUVs
- Four load configurations (presented on next slide)
- Testing to begin early spring of ’06 at VRTC
Future Research

Anticipated RSC Load Configurations

- **Nominal Load**
  - Instrumentation, driver, and outriggers

- **Multi-Passenger Load**
  - Three 175 lb water dummies

- **Rear Trunk Load**
  - Vehicle weight at GVWR, rear GAWR

- **Roof Load**
  - SSF lowered by 0.1
Future Research
Brake Assist (BA)

- **Research Objectives**
  - Reveal and document BA thresholds
  - Compare thresholds to existing human factors based brake data

- **Test Variables**
  - Rate of pedal apply
  - Force of apply
  - Pedal displacement
  - Other vehicle factors *(i.e., adaptive algorithms)*
Future Research
Brake Assist (BA)

- Anticipated maneuvers to include:
  - Straight line braking
  - Brake in-a-curve

- Small fleet of diverse test vehicles

- All steering and braking will be automated via a programmable controller

- Testing to begin late spring of ’06 at VRTC

- Results will be documented in a technical report
Concluding Remarks

- NHTSA has identified the 0.7 Hz Sine with Dwell as a good maneuver for evaluating the lateral stability and responsiveness of ESC-equipped vehicles.
- Future testing will include the evaluation of understeer mitigation, RSC, and BA.
- Any suggestions on how to best evaluate these technologies would be appreciated!
Questions?