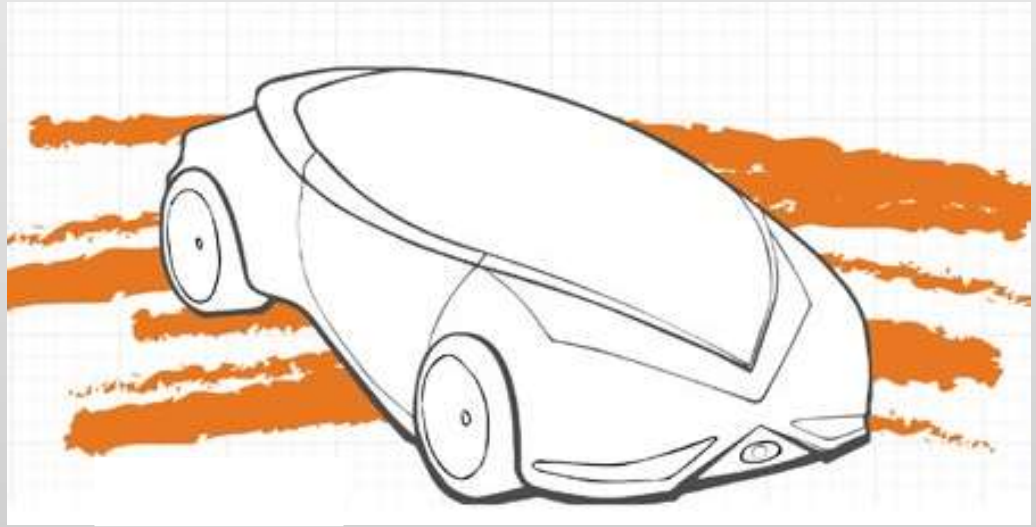
Stakeholder Meeting: FMVSS Considerations for Automated Driving Systems



WiFi Login Information

Network: MediaCntr_Net

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Opening Remarks

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Crash Avoidance Breakout Debrief

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Crashworthiness and Occupant Protection Breakout Debrief

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Test Procedures

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Testing of FMVSS with Automated Vehicles

- Research Question
  - How do you test "minimum safety performance requirements for motor vehicles or items of motor vehicle equipment" (49 C.F.R. §571) that may lack key components?
- Research Scope
  - Develop and demonstrate methods to show how the technical translations could be implemented with and ADS-DV
- "Test the test"

Testing Considerations

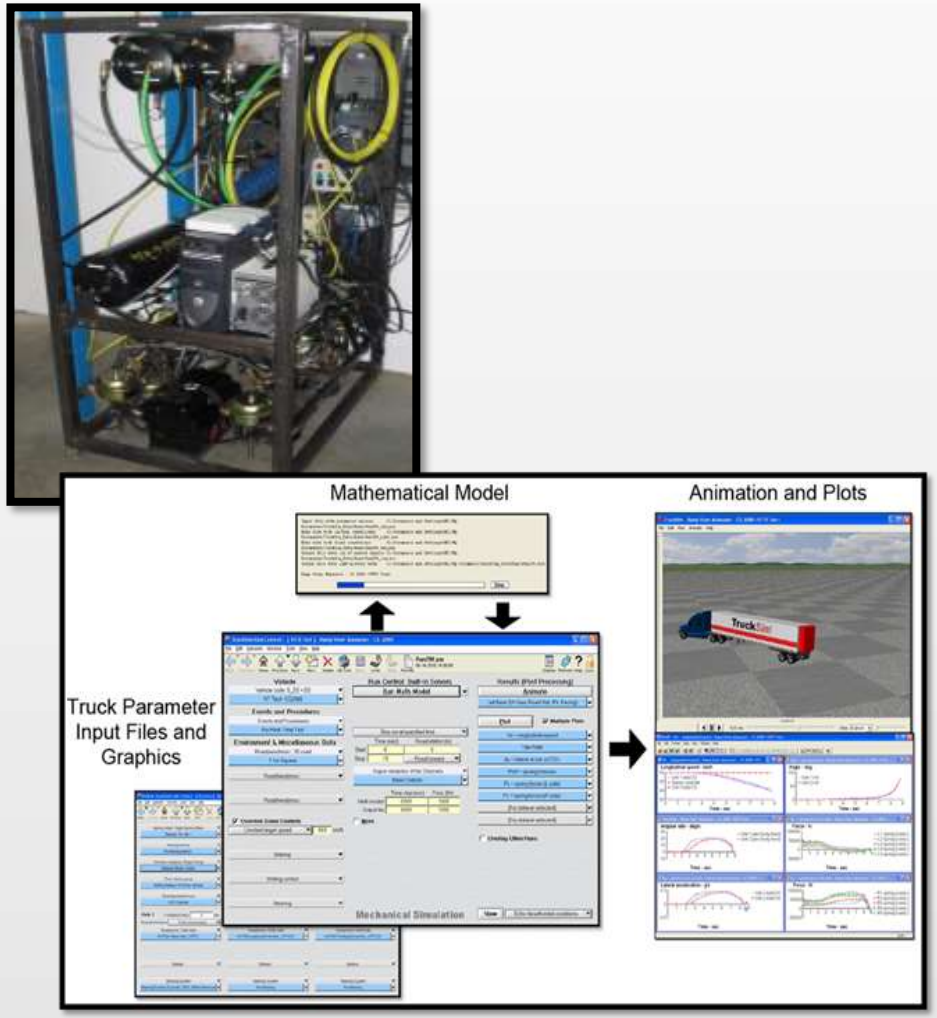
- Instrument to execute testing procedures
- Cybersecurity should be part of the design criteria
- OEM participation and/or adaptability
- Safety and repeatability

Possible Solutions

- Human Control
  - Control interface for inside the vehicle
  - Remote control of vehicle to run tests
- Programmed
  - Preprogrammed routine for each test
  - OEM programs capability and tester creates scripts to run tests

Possible Solutions (cont.)

- "Normal" ADS functionality
- Simulation
  - Hardware-in-the-loop (HIL)
- Design documentation



General Approach

- Classification of standards
- Select subset of standards
- Implement and execute test methods
- Evaluate
- Iterate
- Validate

Classification of Standards

- Classification of standards based on:
  - Applicability modes of conformance
  - Test procedure complexity
    - FMVSS 126 – Electronic Stability Control
    - FMVSS 141 – Quiet Car
  - Test procedure translation requirements
    - FMVSS 126 (ESC): specific steering wheel inputs
    - FMVSS 138 (TPMS): drive 20-22 min at 31-62 mph
  - Opportunities to include normal ADS functionality

Classification: General Themes

- **Vehicle control**
  - Steering inputs
  - Speed control
  - Brake activation
  - Gear selection
- **Key actions**
  - Insertion/removal
  - Start/stop of power plant
  - Accessory mode
- **Vehicle state monitoring**
  - Telltales
  - Warnings
  - Door open/closed
  - Transmission gear/state

Phase 1.1 Standards Selection

Standard	Select	General Comments	Mode*
102: Shift Sequence	No	No test procedures	n/a
108: Lamps	No	Primarily lab tests and/or visual inspection	n/a
114: Theft and Rollaway	Yes	Start/stop with precise positioning requirements	HC, P, DD

* HC = Human control; P = Programmed; ADS = ADS normal operation; S = Simulation; DD = Design documentation

Phase 1.1 Standards Selection (cont.)

Standard	Select	General Comments	Mode*
118: Power Windows	No	Controls for windows and panels with ignition lock system engaged/disengaged	DD
138: TPMS	Yes	Ignition lock system (for telltale); “simple” driving task at normal speeds for given duration	HC, P, ADS, DD
141: Quiet Car	Opt.	Simple driving task (drive along straight line at precise speed)	HC, P, ADS, DD

* HC = Human control; P = Programmed; ADS = ADS normal operation; S = Simulation; DD = Design documentation

Other Standards for Consideration

Standard	Select	General Comments	Mode*
126: ESC	Yes	Very involved procedure requiring iterative action and precise, repeatable control at human interface	HC(?), P, ADS(?), S
135: Brakes	Yes	Lengthy procedure; input defined at brake pedal	HC, P, ADS(?), S

* HC = Human control; P = Programmed; ADS = ADS normal operation; S = Simulation; DD = Design documentation

Implementation: Vehicle Based Modes

- VTTI test platform is conventional vehicle with:
  - Integrated ADS functionality
  - Human control console
  - Ability to script ADS functions
- Allows baseline testing (current test procedures) and ADS testing with different test modes

Implementation: Non-vehicle Based Modes

- Simulation
  - Provides the opportunity to test functionality with vehicles that do not meet current standards
  - Validation critical
  - Implementation challenges
    - Software platform
    - Access to hardware for HIL
- Design Documentation
  - Demonstrate design conforms to standard

Implementation: Example – 114 (Rollaway)

S6.2.2

(a) Drive the vehicle forward up a 10% grade and stop it with the service brakes.
(b) Apply the parking brake (if present).
(c) Move the gear selection control to “park.”
(d) Note the vehicle position.
(e) Release the parking brake. Release the service brakes.
(f) Remove the key.
(g) Verify that the gear selection control or transmission is locked in “park.”
(h) Verify that the vehicle, at rest, has moved no more than 150 mm from the position noted prior to release of the brakes.

Implementation: Example – 114 (Rollaway)

	Option 1: Human Control	Option 2: Programmed
S6.2.2	Use interface to vehicle to provide human control of vehicle function --> test procedures as written apply.	Initiate test procedure for 6.2.2: 1. Activate engine/motor. 2. Drive forward fixed distance to position vehicle on 10% slope (up). 3. Change transmission state to “park.” 4. Deactivate engine/motor (key action). 5. Display/record transmission state. 6. Measure vehicle displacement.

Evaluation

- Comparison to baseline
  - Results
  - Time to set up
  - Time to execute
  - Repeatability
- Ease of execution
  - Vehicle preparation
  - Execution of test
  - Cycle time
  - Data access
- General considerations
  - Safety
  - Cost
  - Sensitivity
  - Cybersecurity

Validation

- Test with other platforms
- Test at other locations
- DOT and partner engagement
  - NHTSA VRTC (Vehicle Research and Test Center)
  - GM
  - Nissan
  - DRI (Dynamic Research, Inc.)

Next Steps for Testing

- Phased approach follows translation of standards
- Apply methodology to subsequent sample of standards
- Iterative process

Thank You!

Next Steps

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Closing Remarks

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Thank You!

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