Recent NHTSA Research on Rear Automatic Braking System Performance

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Backover Problem

- NHTSA has been testing rear object detection systems since the early 1990s to assess their ability to detect humans.
- Performance in detecting humans has been unreliable.
- Backover crashes have been estimated to cause (2014):
  - 210 fatalities
  - 15,000 injuries
- FMVSS No. 111 Rear Visibility 2014 final rule added a requirement to provide drivers with a rearview image showing a 10 ft side by 20 ft long area directly behind the vehicle.
  - Estimated to reduce fatalities to 141-152 annually.
- Rear automatic braking systems could reduce those fatalities and injuries even further.
What is a Rear Automatic Braking System?

• Type of automatic emergency braking system
• Available when driving in Reverse at typically <= 5 mph
• Detects certain rear obstacles, warns the driver, and applies the vehicle’s brakes automatically to bring the vehicle to a stop
• In existing systems, brake application is either:
  – Brief - Brings the vehicle to a stop automatically but requires the driver to depress the brake pedal to prevent the vehicle from continuing to move rearward
  – Sustained - Brings the vehicle to a stop automatically and holds the brakes to keep the vehicle stopped until the driver depresses the brake pedal
NHTSA Automatic Braking Systems Testing

• **Purpose:**
  – Continue to monitor state of the art in technologies that may aid drivers in safely backing vehicles and avoiding pedestrians
  – Characterize performance of existing systems
    » Detection performance as advertised?
    » Ability to detect and avoid crashes with humans/pedestrians?
  – Develop objective test procedures for this type of system

• **Testing involved:**
  – Vehicle: Stationary or moving
  – Test objects: Stationary or moving
  – Variety of test objects including vehicle and human surrogates
Stationary Vehicle - Stationary Test Object

- Place test object over 10-ft wide area behind vehicle and rearward until observing 2 ft of no detections
Stationary Vehicle – Moving Test Object

- Vehicle positioned at 5 ft, 10 ft, or 20 ft from the test object
- Test object speeds 2, 3 mph
- Test object destinations (-2, 0), (0,0), (2,0)
Moving Vehicle – Stationary Test Object

- Vehicle starting position 5 ft, 10 ft, or 20 ft from the test object
- Test object locations (-5, 0) through (5, 0)
Moving Vehicle – Moving Test Object

• Vehicle starting position 20 ft from the test object
• Test object speeds 2, 3 mph
• Test object destinations (-2, 0), (0,0), (2,0)
• Backing vehicle triggers test object motion
• Test object reaches destination location when vehicle reaches 0 ft (plane of test object motion)
# Test Objects

<table>
<thead>
<tr>
<th>Standard Test Object</th>
<th>ISO 40-inch Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Toy Convertible Ride-On Car (TC)</td>
</tr>
<tr>
<td>Vehicle Surrogate</td>
<td>NHTSA Strikable Surrogate Vehicle (SSV)</td>
</tr>
<tr>
<td>Human Surrogates</td>
<td>Toy Convertible with Small Child Clothing Mannequin (TC-SCCM)</td>
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<tr>
<td></td>
<td>Small Child Clothing Mannequin (seated toddler) (SCCM)</td>
</tr>
<tr>
<td></td>
<td>Posable Child Mannequin (PCM)</td>
</tr>
<tr>
<td></td>
<td>Posable Child Mannequin “Short”, 32-inch height (PCM 32”)</td>
</tr>
<tr>
<td>Human</td>
<td>59 and 66-inch height adult females; 69 and 72-inch height adult males</td>
</tr>
</tbody>
</table>
## Data Collection

<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>Purpose/Data Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video cameras (4)</td>
<td>1. Rearview Image</td>
</tr>
<tr>
<td></td>
<td>2. Other visual warning location</td>
</tr>
<tr>
<td></td>
<td>3. Overhead view, from trunk-mounted camera</td>
</tr>
<tr>
<td></td>
<td>4. Overhead view, from high-mounted camera</td>
</tr>
<tr>
<td>Microphone</td>
<td>Document auditory obstacle detection warnings</td>
</tr>
<tr>
<td>PC</td>
<td>Record video and audio data</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>Document decel produced by automatic braking</td>
</tr>
<tr>
<td>Laser pointers (2)</td>
<td>Front and rear pointing to aid driver in guiding vehicle along straight path during moving vehicle scenarios</td>
</tr>
</tbody>
</table>
Performance Metrics Examined

• Occurrence and timing of
  – Warning (any)
  – Warning, Auditory (onset)
  – Warning, Visual (onset)
  – Automatic Braking (onset)
  – Vehicle Stop
  – Crash?

• Average maximum deceleration (for x of n trials with automatic braking)
Example Test Data:
Stationary Vehicle, Static Test Object Outdoors

- Human male, 6 ft tall
Example Test Data: Moving Vehicle, Stationary Test Object Outdoors
Example Test Data:
Moving Vehicle, Moving Test Object Outdoors
Status

- All testing was completed in 2016
- Analyzing data to characterize system performance
- Preparing a NHTSA report
- Results will be used to inform future NHTSA efforts
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