Previous G&I Sessions (2014)

NHTSA’s PCAM Testing and Dummy Development

• Test Maneuvers (Scenarios)
• Test Mannequin Development
• Test Apparatus (Motion Control)
• Test Results (CAMP and Production Vehicles)

This Session

• Discuss UPDATED PCAM performance results from testing production level vehicles and engineering prototypes.
PCAM – Pedestrian Crash Avoidance/Mitigation

NHTSA Initiated PCAM Research in 2011

Volpe –
• Crash analyses and assess the potential safety benefits of PCAM technology
• Completed
• Final Report – DOT HS 811 998 (April 2014)

CAMP – GM, Ford, Mercedes-Benz, Continental, and Delphi
• Develop preliminary test methods (Scenarios, Mannequins, Motion Control, etc.)
• Completed
• Final Report - DOT HS 812 040 (June 2014)

NHTSA Internal Research – (ongoing)
• Further Refinement of Test Scenarios, Mannequins, Motion Control, etc.
• Development of Objective Test Procedures and Metrics
What is Pedestrian Crash Avoidance/Mitigation?

The diagram illustrates the concept of pedestrian crash avoidance/mitigation through a time-based event timeline. It categorizes different states into:

- **Avoidance Zone**:
  - Normal State
  - Warning State
  - Avoidable State

- **Unavoidable State**
  - Pre-Crash Zone
  - Crash Zone

- **Post-Collision State**

The diagram highlights critical points such as:

- **Pre-crash event**
- **Crash avoidance action**
- **Crash warning alert**

Additionally, it mentions active safety systems activated to reduce injury risk and passive occupant protection countermeasures. The graph also includes general risk for crash while driving.

*Slide from CAMP PCAM*
4,743 Pedestrian Fatalities (14% of total fatalities)

<table>
<thead>
<tr>
<th>Pedestrians Killed</th>
<th>2011 (% Killed)</th>
<th>2012 (% Killed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>26%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Urban</strong></td>
<td><strong>73%</strong></td>
<td><strong>73%</strong></td>
</tr>
<tr>
<td>Intersection</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Non-Intersection</strong></td>
<td><strong>68%</strong></td>
<td><strong>70%</strong></td>
</tr>
<tr>
<td>Other</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Daytime</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Nighttime</strong></td>
<td><strong>69%</strong></td>
<td><strong>70%</strong></td>
</tr>
<tr>
<td>Clear/Cloudy</td>
<td>88%</td>
<td>88%</td>
</tr>
<tr>
<td>Rain</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Snow</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Fog</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Top 20 pre-crash scenarios by functional years lost (FYL) can be grouped into 4 general scenarios (N = 139,000 Crashes)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Cases</th>
<th>% Total FYL</th>
<th>Fatalities</th>
<th>%Fatalities ** (67% of the top 20 scenarios)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>115,000</td>
<td>84%</td>
<td>7,000</td>
<td>88%</td>
</tr>
<tr>
<td>S2</td>
<td>2,000</td>
<td>1%</td>
<td>16</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>S3</td>
<td>9,000</td>
<td>1%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>S4</td>
<td>13,000</td>
<td>10%</td>
<td>1,000</td>
<td>12%</td>
</tr>
</tbody>
</table>

** Note: Top 20 Scenarios represent 67% of estimated pedestrian fatalities
<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Production</th>
<th>Sensor Technology</th>
<th>CIB/AEB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle 1</td>
<td>Y</td>
<td>RADAR, LIDAR, and Mono Camera</td>
<td>Up to Full Braking</td>
</tr>
<tr>
<td>Vehicle 2</td>
<td>Y</td>
<td>Stereo Camera</td>
<td>Up to Full Braking</td>
</tr>
<tr>
<td>Vehicle 3</td>
<td>Y</td>
<td>Stereo Camera</td>
<td>Up to Full Braking</td>
</tr>
<tr>
<td>Vehicle 4</td>
<td>Y</td>
<td>RADAR and Stereo Camera</td>
<td>Up to Full Braking</td>
</tr>
<tr>
<td>Vehicle 5</td>
<td>Y</td>
<td>RADAR(s) and Mono Camera</td>
<td>Up to Full Braking</td>
</tr>
</tbody>
</table>
S1 - Scenario
S1 – 25 MPH – Adult – Walking – 50 % Overlap

The graph shows the speed reduction (mph) for different test runs. The x-axis represents the test run number, while the y-axis shows the speed reduction in miles per hour (mph). The data is color-coded with purple, blue, red, and black bars representing different categories or conditions.
S1 – 10 MPH – Adult – Running – 50 % Overlap

S1: SV = 10MPH Ped = AdultRun Impact 50%

Test Run

Speed Reduction (mph)

0 2 4 6 8 10 12 14 16 18 20 22
S1 – 25 MPH – Adult – Running – 50% Overlap

S1:SV = 25MPH Ped = AdultRun Impact 50%
Euro Obstructed Test: Ped = ChildWalk Impact 50%
Euro NCAP Obstructed Child Test - Running

Euro Obstructed Test: Ped = ChildRun Impact 50%
Stationary Pedestrian – Increasing Speed

![Graph showing speed reduction over test runs for stationary pedestrians.](image)
Test data supports:

• PCAM can avoid and mitigate common pedestrian crashes.
  • Data suggests technology is improving.
• PCAM data shows better performance for slower moving pedestrians
  • “Running” Pedestrian scenarios remain challenging for the PCAM systems tested.
• Obstructed pedestrian tests still challenging for PCAM systems.
  • Pedestrian speed a major factor.
• Performance differences can be observed using the objective test conditions described in this presentation.
Planned Research

- Continue testing production vehicles with PCAM. (Sept 2015)
- Refine a PCAM target population to assess system effectiveness and benefit estimates (Dec 2015).
- Refine and further investigate false positive tests. (Oct 2015)
- Complete development adult and child mannequin designs. (May 2015)
  - Select a standard design for objective testing.
- Complete objective test development and procedure (Dec 2015).
Animated Pedestrian
Night Testing
QUESTIONS?

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