Estimating Potential Safety Benefits of Pedestrian Crash Avoidance/Mitigation Systems

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Steps to Estimate Potential Safety Benefits

- Identify operational envelope and functions of Pedestrian Crash Avoidance/Mitigation (PCAM) systems
- Determine target crash population for identified PCAM systems
- Identify data needs and gaps
  - Propose methods to obtain supplemental data
- Adapt and exercise method to estimate potential national benefits
- DOT HS 812 400 - Estimation of Potential Safety Benefits for Pedestrian Crash Avoidance/Mitigation Systems (April 2017)
Fatality Trends on US Roadways

From 2015 to 2016: All trafficway ↑ 5.6% & Pedestrians ↑ 9%
Defining PCAM Systems

Operational Envelope

- Forward moving light vehicle
- Vehicle-based sensing suite
- Struck pedestrian with the front of vehicle in 1st event of crash
- Driver warning
- Automatic Emergency Braking (AEB)

System Functions

1. AEB Only

2. FIRST Come First Serve*
   - First brake reaction

3. BEST Braking*
   - Highest braking level

- Involves warning and impaired drivers
- Impaired = assume no reaction
Priority PCAM Pre-Crash Scenarios

GES Average*  
21,090

FARS Average*  
2,193

S1  
GES 36%  
FARS 64%

S2  
GES 11%  
FARS 1%

S3  
GES 29%  
FARS 4%

S4  
GES 14%  
FARS 28%

*Annual average of 2011-2012 crash data and PCAM applicable crashes

DOT HS 811 998 - Target Crashes and Safety Benefits Estimation Methodology For Pedestrian Crash Avoidance/ Mitigation Systems
Safety Benefits – Reduction in Crashes and Injuries

Crash Avoidance
- Considers target crashes and PCAM effectiveness
- Multiple methods to avoid
- All crashes, fatal crashes, costs, equivalent lives

Crash Mitigation
- Considers target injuries and reduced impact speed
- Includes crash avoidance effectiveness
- MAIS 2+, MAIS 3+, costs, Equivalent lives
Additional Crash Data Collection

- Understand the exact dynamics of S1
  - Time-To-Collision (TTC)

- NHTSA special crash investigation

- Detailed crash information

Results (43 cases)

- TTC range from <1 - 22 s
- Pedestrian distances range from 2 - 35 meters
- Vehicle distances range from <10 - 200+ meters
- Improved impact point
# PCAM Testing

- 3 production OEM systems
  - A. 2015 Radar, Lidar, and Stereo Camera
  - B. 2015 Stereo Camera
  - C. 2016 Radar and Stereo Camera

- Tested at NHTSA’s Vehicle Research Testing Center

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<th>Target Pedestrian</th>
<th>Pedestrian Speed (MPH)</th>
<th>Target Right-Left</th>
<th>Target Facing Vehicle</th>
<th>Target Away Vehicle</th>
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SAE G/I 2017 - Objective Test Procedures for Pedestrian Automatic Emergency Braking Systems
Testing Results – Sample Data

S1 - Adult - Walking - Day - No Obstruction
Simulation and Assumptions

- Reconstructed FARS and GES cases to available test conditions
- Applied PCAM test data directly to cases
- Modeled human driver behavior and used injury risk curves
- OUTPUT = treatment crashes with PCAM and respective impact speeds
- Assumptions
  - No test data = no benefit estimation
  - Min/max test speeds were extrapolated
  - Conflict starts are dependent on technology limit as seen in testing
Safety Benefits – Crash Avoidance

- 4,987 crashes reduced
- 810 fatal crashes reduced
- Minimal differences between warning and system brake logic (FIRST, BEST)
- Other measures include comprehensive costs and equivalent lives

![Safety Benefits Chart]

- GES Crashes: 4,324
- S1 Crashes Reduced: 1,441
- S4 Crashes Reduced: 663
- Remaining Crashes: 675
- FARS Crashes: 243
- Safety Benefits: 135
Safety Benefits – Crash Mitigation

- 1,949 MAIS 2+ injuries reduced
- 1,390 MAIS 3+ injuries reduced
- Minimal differences between warning and system brake logic (FIRST, BEST)
- Other measures include comprehensive costs and equivalent lives
THANK YOU

QUESTIONS?

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