Estimating Potential Safety Benefits of Pedestrian Crash Avoidance/ Mitigation Systems

Mikio Yanagisawa
Advanced Vehicle Technology Division
U.S. DOT/Volpe Center

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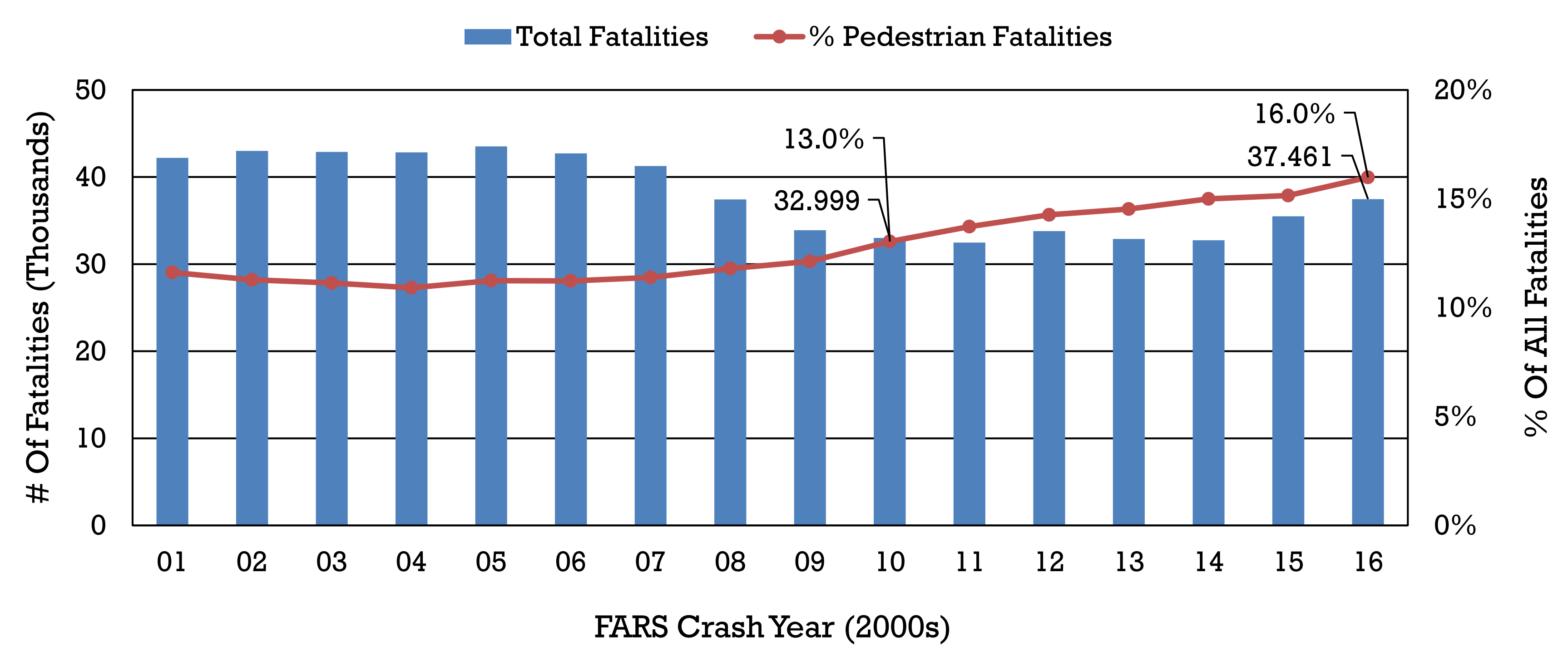
NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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%

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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

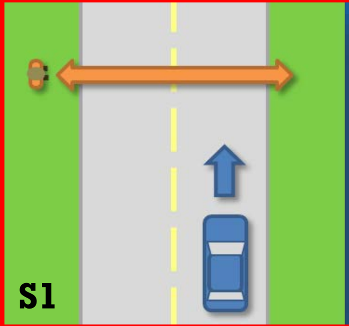
1. AEB Only
2. FIRST Come First Serve*
   - First brake reaction
3. BEST Braking*
   - Highest braking level

- Involves warning and impaired drivers
- Impaired = assume no reaction

Priority PCAM Pre-Crash Scenarios

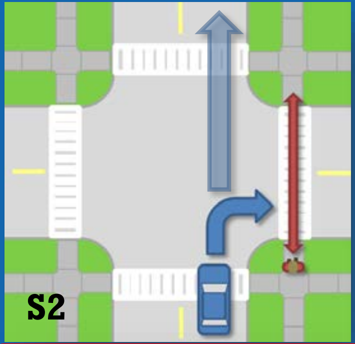
GES Average*
21,090

FARS Average*
2,193



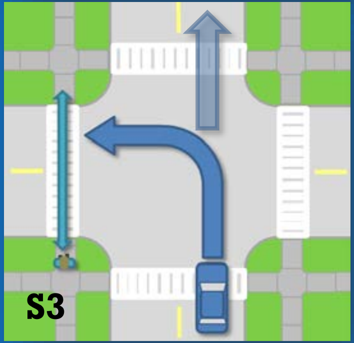
GES
36%

FARS
64%



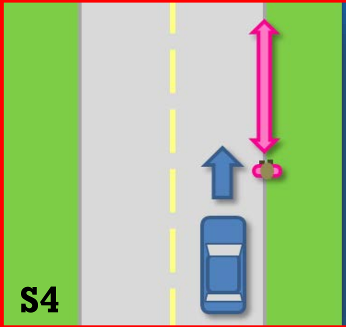
GES
11%

FARS
1%



GES
29%

FARS
4%



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

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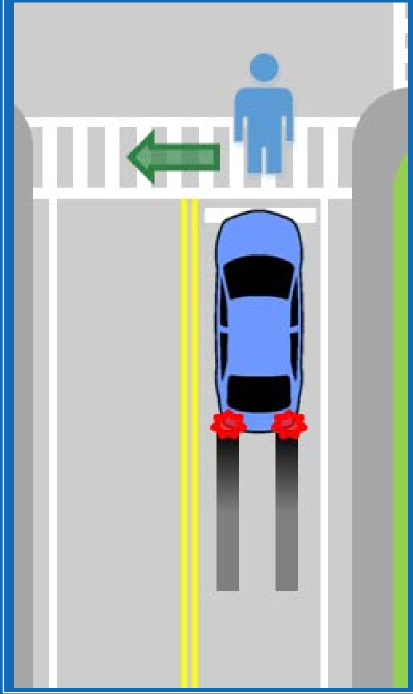
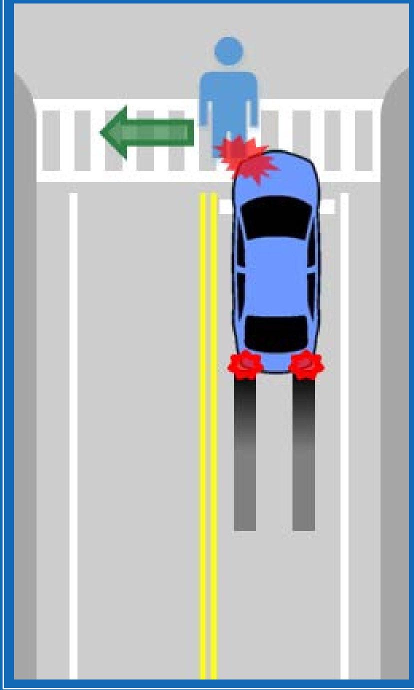
Safety Benefits – Reduction in Crashes and Injuries



Crash Avoidance

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

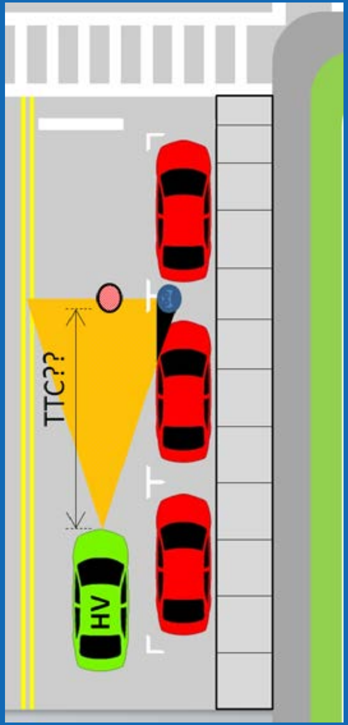


Crash Mitigation

- 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)

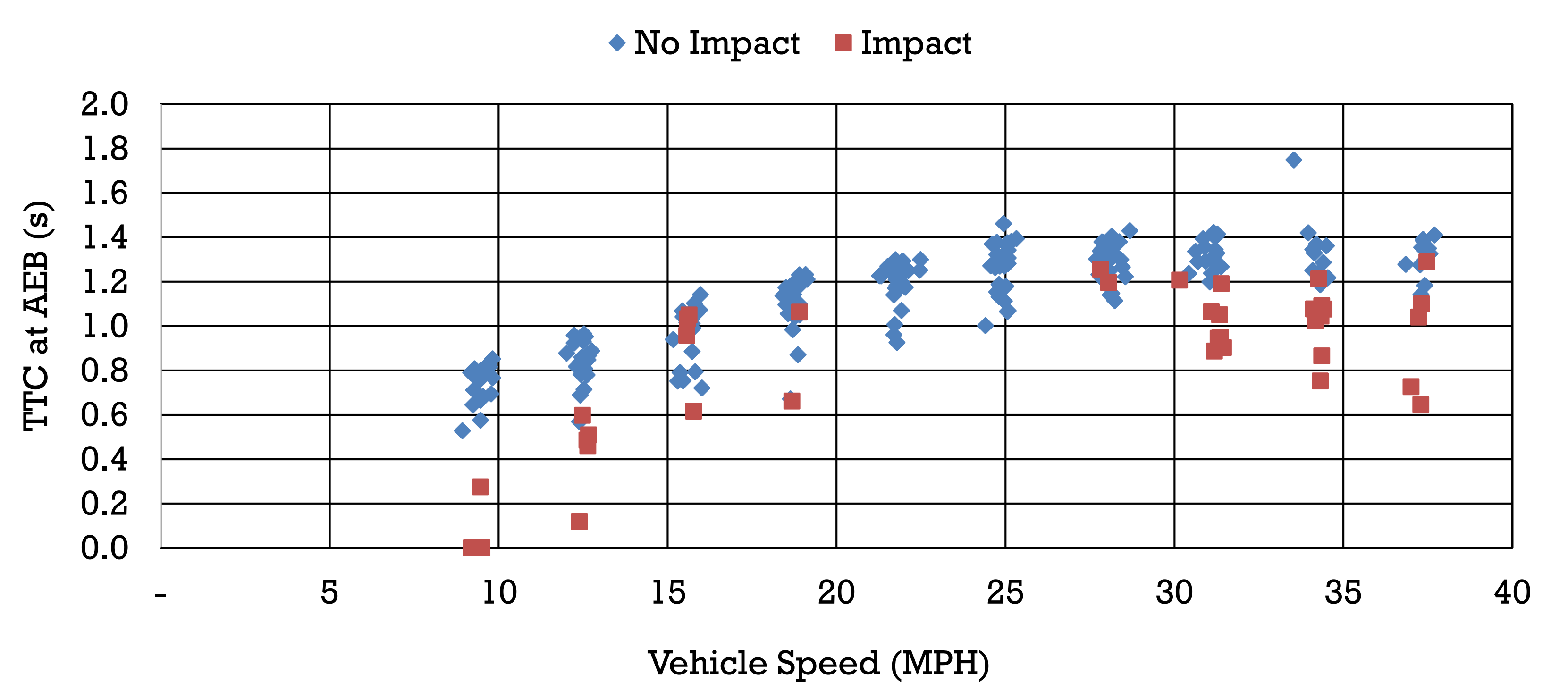
- TTC range from < 1 - 22 s
- Pedestrian distances range from 2 - 35 meters
- Vehicle distances range from <10 –200+ meters
- Improved impact point

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

Target Pedestrian	Pedestrian Speed (MPH)	Target Right-Left	Target Facing Vehicle	Target Away Vehicle	Day	Obstruction	
						Yes	No
Adult	3.1	X			X		X
	4.9	X			X		X
	Stationary		X	X	X		X
Child	3.1	X			X	X	X

Testing Results – Sample Data

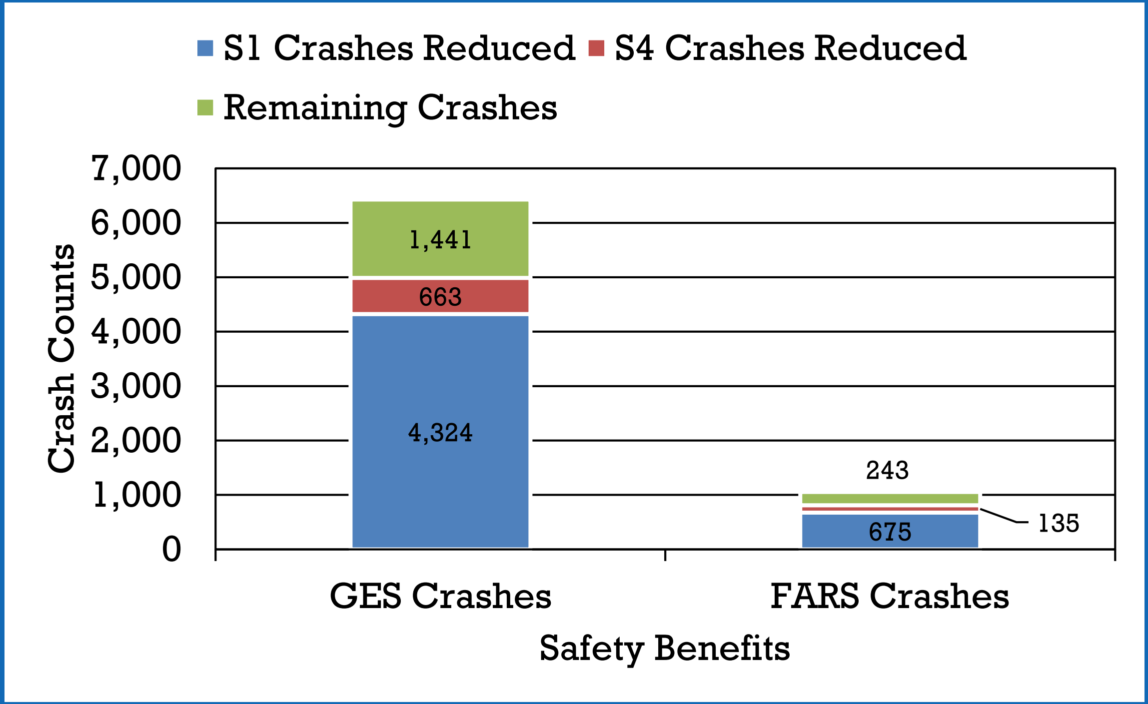


S1 - Adult - Walking - Day - No Obstruction

Simulation and Assumptions

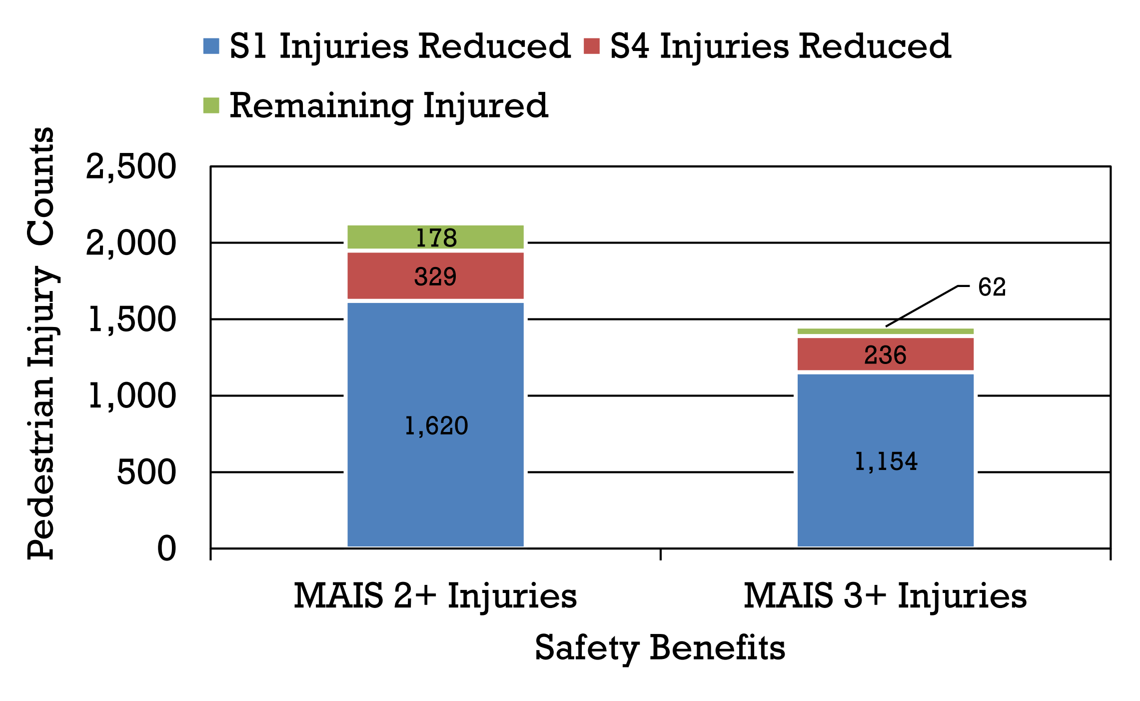
- Reconstructed FARS and GES cases to available test conditions
- Applied PCAM test data directly to cases
- Modeled human driver behavior and used injury risk curves
- OUTPUT = treatment crashes with PCAM and respective impact speeds
- Assumptions
  - No test data = no benefit estimation
  - Min/max 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 – 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

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THANK YOU

QUESTIONS?

Stephen Stasko
NHTSA
Intelligent Technologies Research
Stephen.Stasko@dot.gov

Mikio Yanagisawa
Volpe Center
Advanced Vehicle Technology
Mikio.Yanagisawa@dot.gov