

# PCAM VALIDATION TESTING

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# Acknowledgements

**The presenter would like to thank the many individuals who contributed to this research.**

**Mikio Yanagisawa, Volpe**

**Wassim Najm, Volpe**

**Michael Carpenter, General Motors**

**Tim Zwicky, Ford**

**Todd Moury, Delphi**

**Jeff Skvarce, Continental**

**Matthias Struck, Mercedes-Benz**

**John Martin, NHTSA**

**Eric Gerdis, TRC, Inc.**

### Previous Session (Crash Avoidance I – Near Term Technologies)

#### *NHTSA's PCAM Testing and Dummy Development*

- Test Maneuvers (Scenarios)
- Test Mannequin Development
- Test Apparatus (Motion Control)

#### **This Session**

- Discuss preliminary PCAM results from testing production level vehicles and some engineering prototypes.

## **NHTSA Initiated PCAM Research in 2011**

### **Volpe –**

- Crash analyses and assess the potential safety benefits of PCAM technology
- Completed
- Final Report – Pending NHTSA Review (FY14 – 2<sup>nd</sup> Quarter)

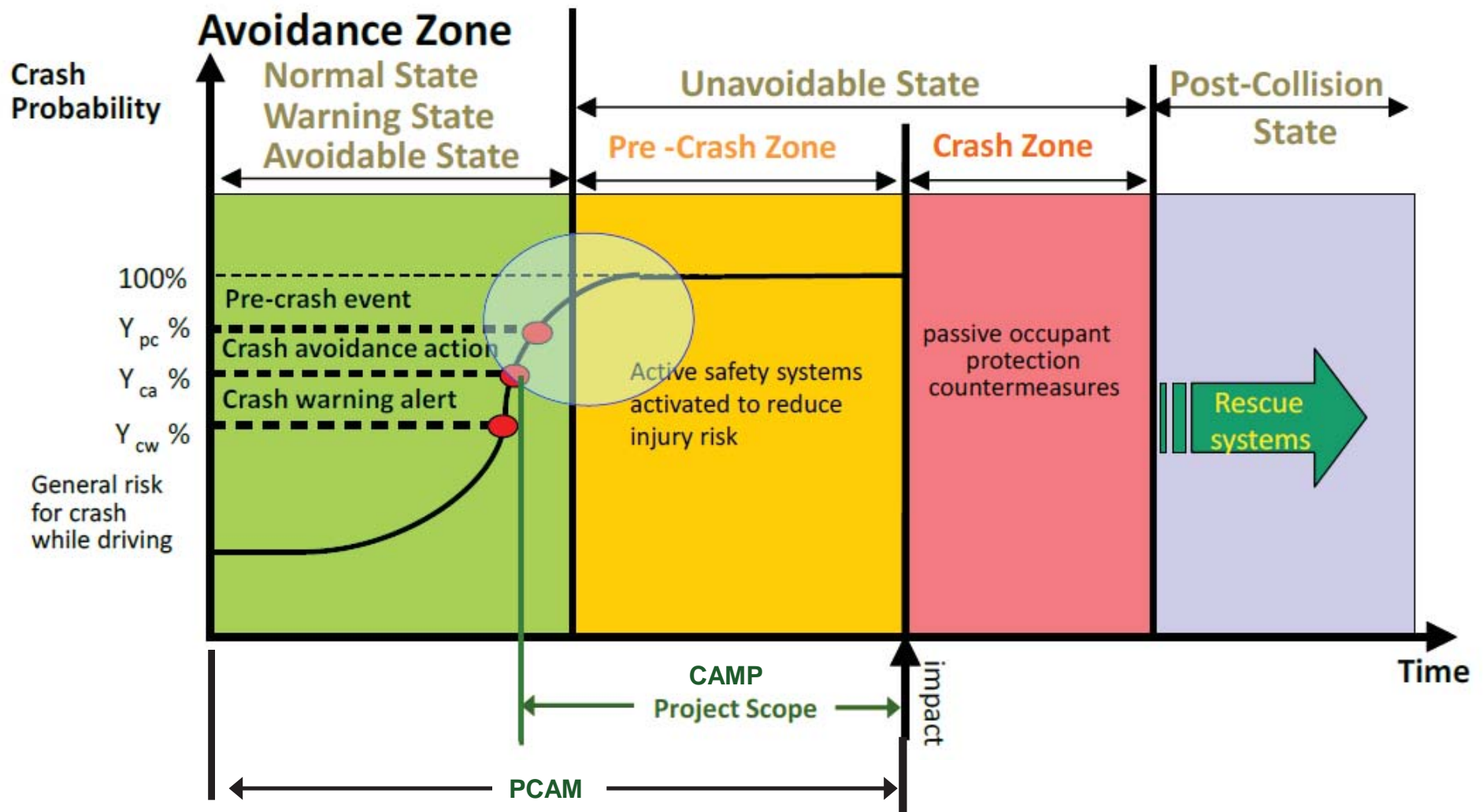
### **CAMP – GM, Ford, Mercedes-Benz, Continental, and Delphi**

- Develop preliminary test methods (Scenarios, Mannequins, Motion Control, etc.)
- Completed
- Final Report - Pending NHTSA Review (FY14 – 2<sup>nd</sup> Quarter)

### **NHTSA Internal Research – (ongoing)**

- Baseline PCAM equipped production vehicles.
- Further Refinement of Test Scenarios, Mannequins, Motion Control, etc.
- Development of Objective Test Procedures

# What is Pedestrian Crash Avoidance/Mitigation?



\* Slide from CAMP PCAM

## Crash Problem

2011 Data- Traffic Safety Facts (DOT HS 811 748 – 8/2013)

### 4,432 Pedestrian Fatalities (14% of total fatalities)

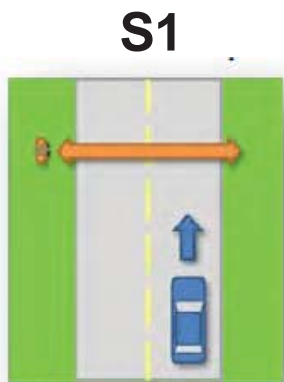
Pedestrians Killed	2010 (% Killed)	2011 (% Killed)
Rural	27%	27%
<b>Urban</b>	<b>73%</b>	<b>73%</b>
Intersection	21%	19%
<b>Non-Intersection</b>	<b>68%</b>	<b>70%</b>
Other	10%	10%
Daytime	32%	30%
<b>Nighttime</b>	<b>68%</b>	<b>70%</b>
<b>Clear/Cloudy</b>	<b>88%</b>	<b>88%</b>
Rain	9%	9%
Snow	1%	1%
Fog	1%	1%

# Test Scenarios

## Volpe Analysis – (2005–2009 GES Data)

Top 20 pre-crash scenarios by functional years lost (FYL) can be grouped into 4 general scenarios (N = 139,000 Crashes)

Scenario	Cases	% Total FYL	Fatalities	%Fatalities ** (67% of the top 20 scenarios)
S1	115,000	84%	7,000	88%
S2	2,000	1%	16	<1%
S3	9,000	1%	0	0%
S4	13,000	10%	1,000	12%



\*\* Note: Top 20 Scenarios represent 67% of estimated pedestrian fatalities

# Test Matrix

Test Scenarios	Pedestrian Direction				Light Conditions		Obstructions		Test Vehicle Speeds (mph)			Mannequin Speeds			PCAM Functions	
	Right to Left	Left to Right	Toward Car	Away from Car	Day	Night	No	Yes	5	10	15/25	Static	Walk	Run	CIB	DBS
S1	x	x			x	x	x	x		x	x		x	x	x	x
S2		x			x		x		x	x			x		x	
S3	x	x			x		x		x	x			x		x	
S4			x	x	x		x			x	x	x	x	x	x	
S1-VRTC		x			x		x			x	x		x	x	x	
S4-VRTC			x	x	x		x					x	x	x	x	

- Some vehicles did not perform all planned combinations due to observed sensing/performance limitations.
- Limited number of Dynamic Brake Support (DBS) tests were conducted.
- Conducted 7 different False Positive tests that will not be discussed today.



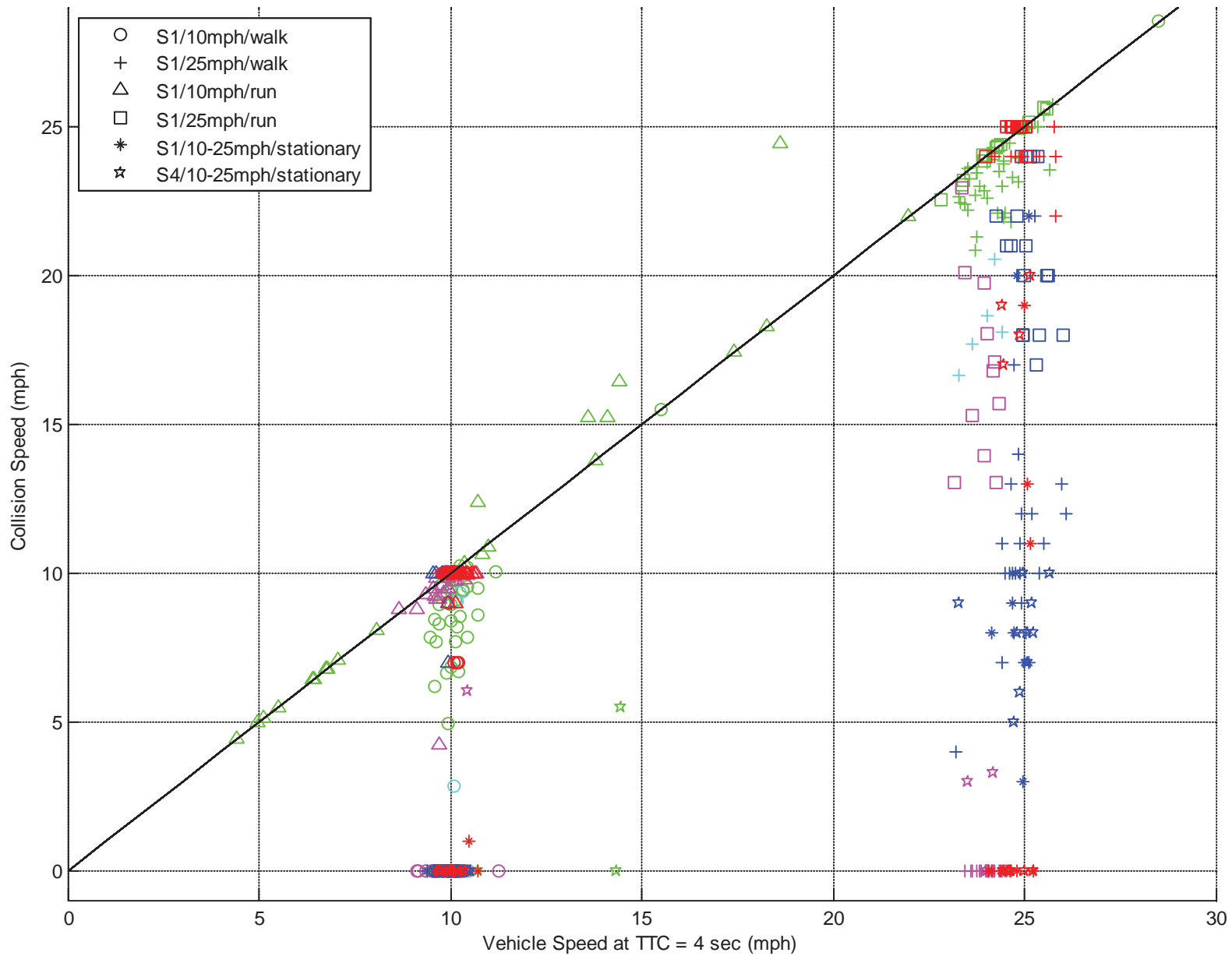
# Test Vehicles

Vehicle	Production	Sensor Technology	FCW	CIB/AEB
Vehicle 1	N	RADAR and Stereo Camera	Visual and Audible	Up to 0.6g of Braking
Vehicle 2	N	RADAR and Mono Camera	Visual and Audible	Up to Full Braking
Vehicle 3	N	Stereo Camera	Haptic and Audible	Up to Full Braking
Vehicle 4	Y	RADAR, LIDAR, and Mono Camera	Visual and Audible	Up to Full Braking
Vehicle 5	Y	Stereo Camera	Visual and Audible	Up to Full Braking

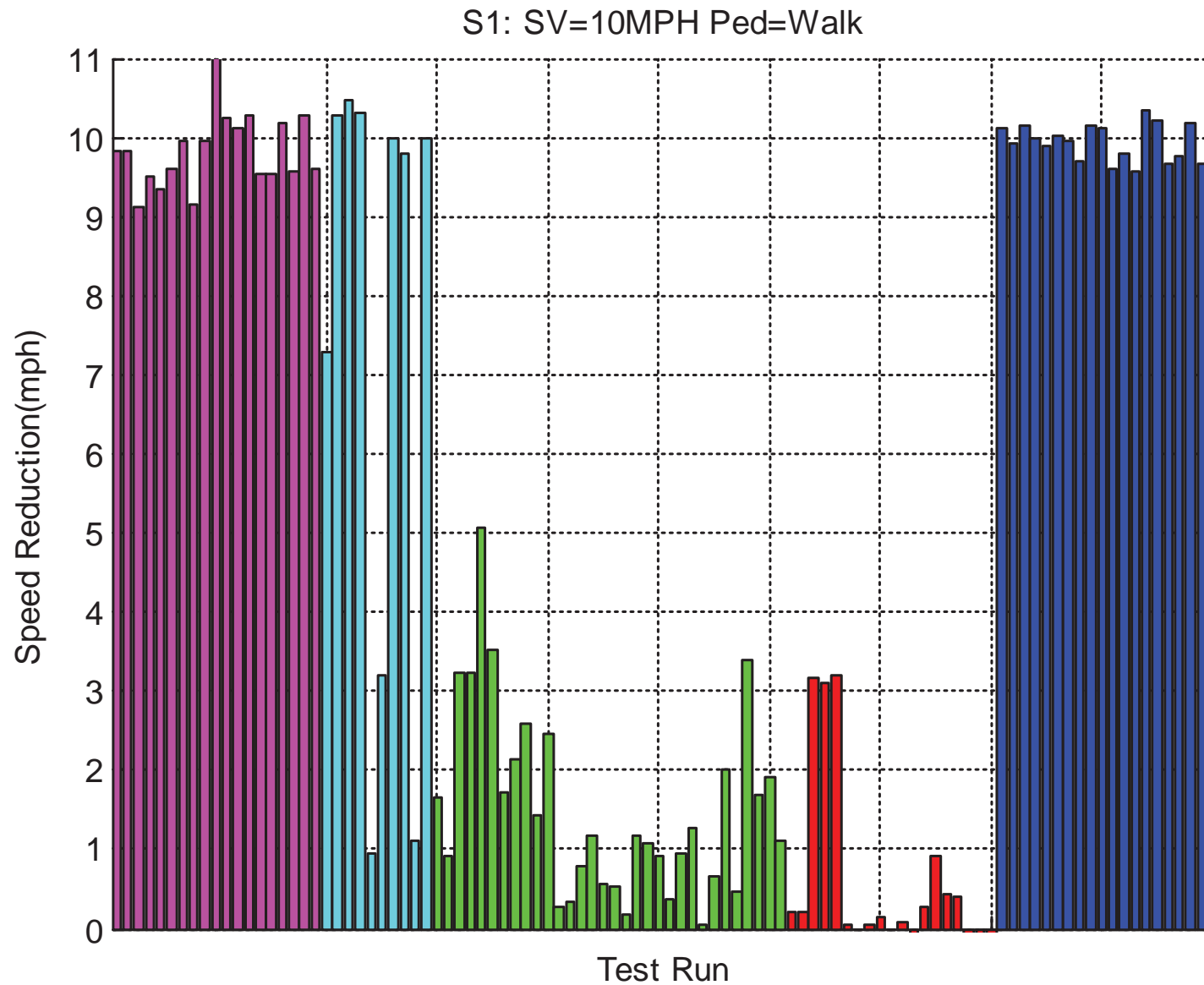
Vehicles 1 – 3 were supplied by member of CAMP

Vehicles 4 – 5 were purchased from a car dealer by NHTSA

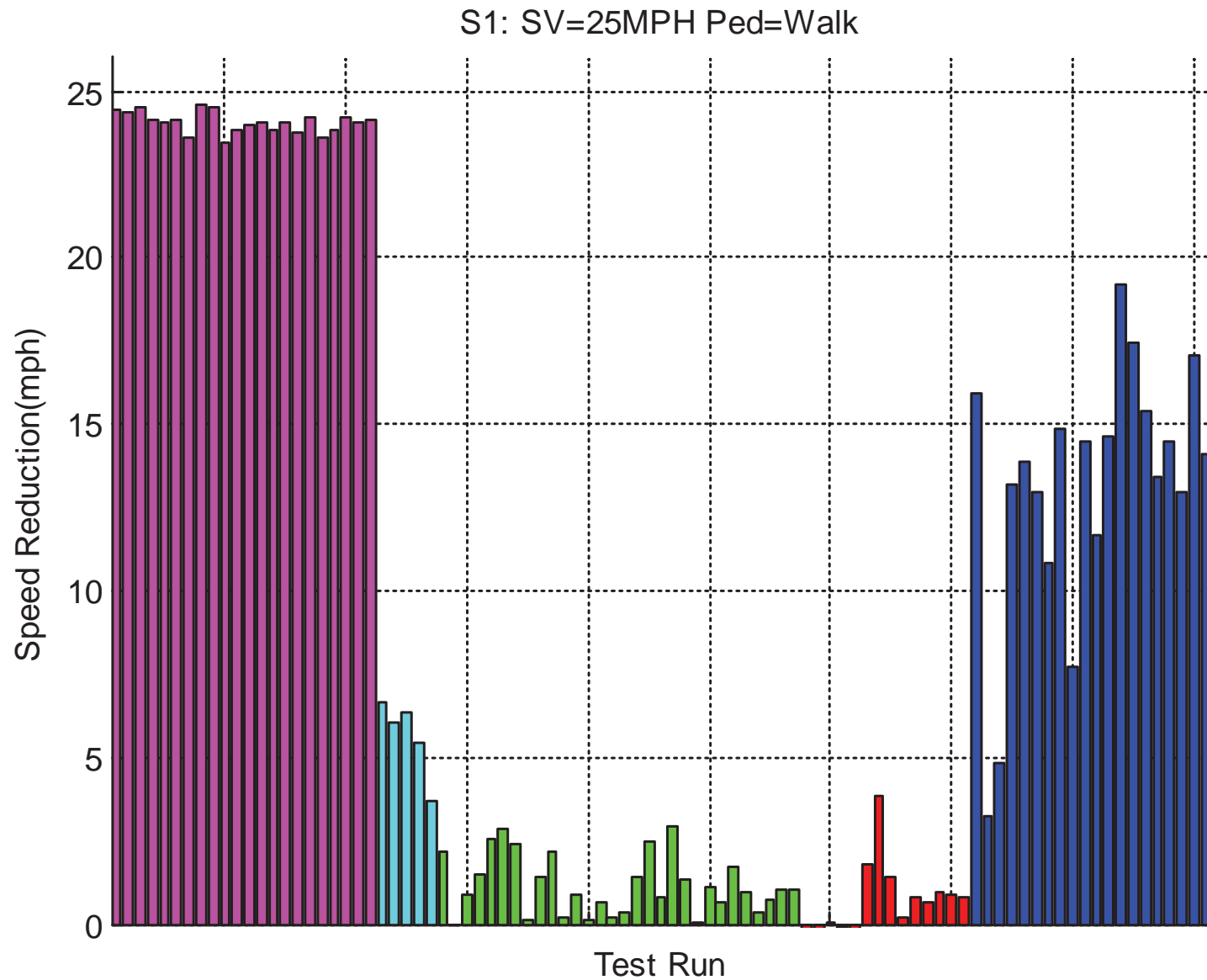
# S1 Scenario – All Tests



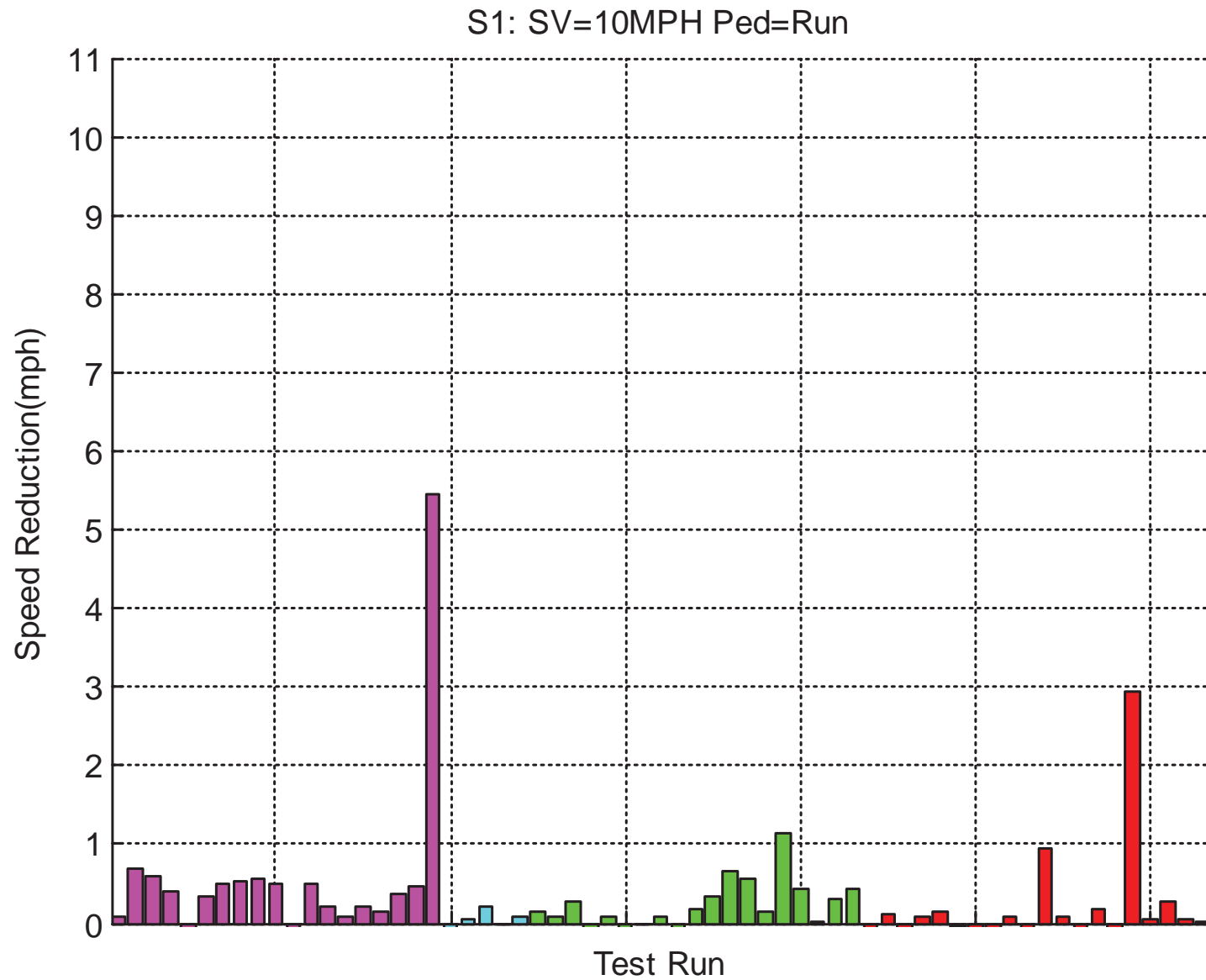
# S1 Scenario – 10 MPH SV – Ped Walk – R to L



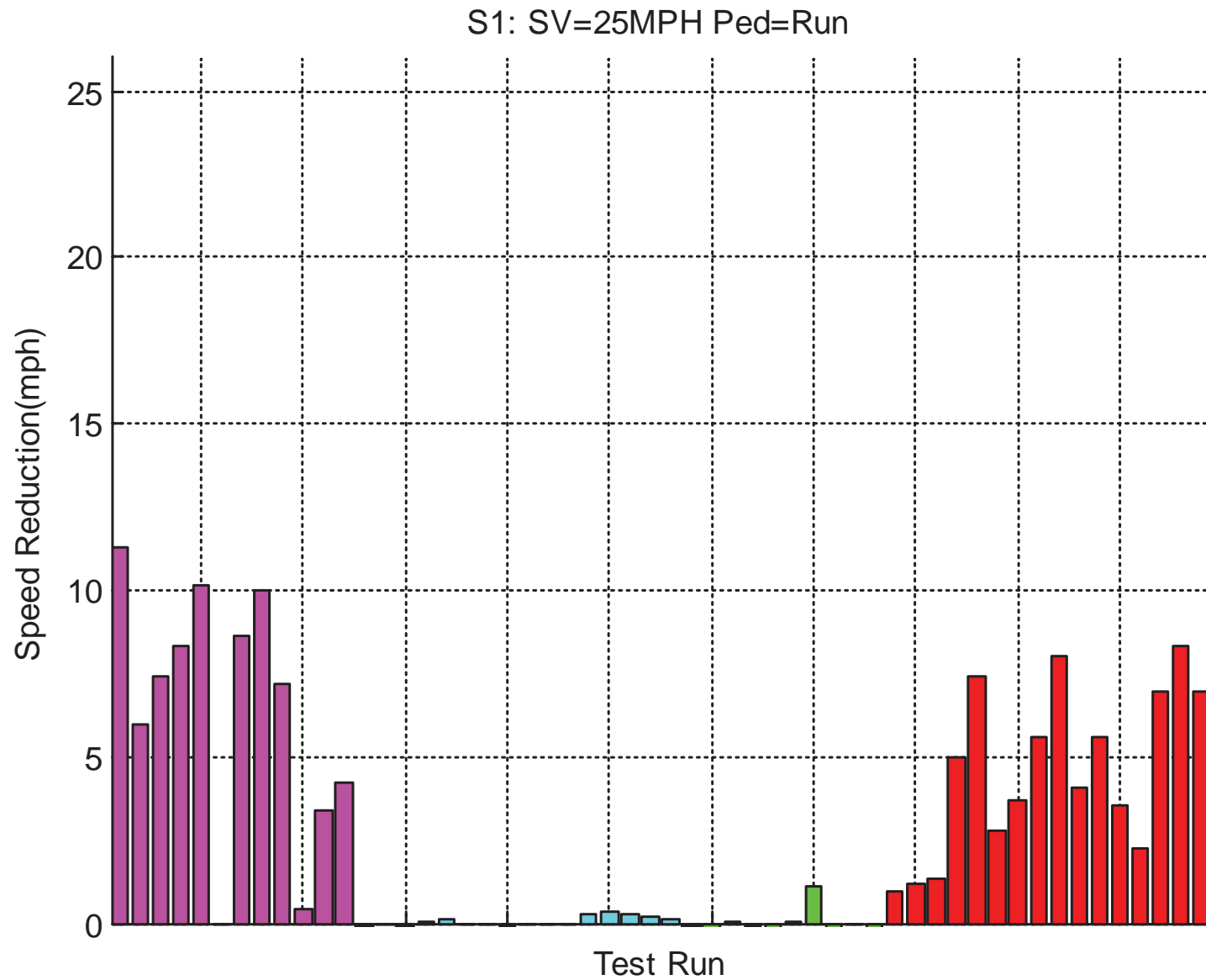
# S1 Scenario – 25 MPH SV – Ped Walk – R to L



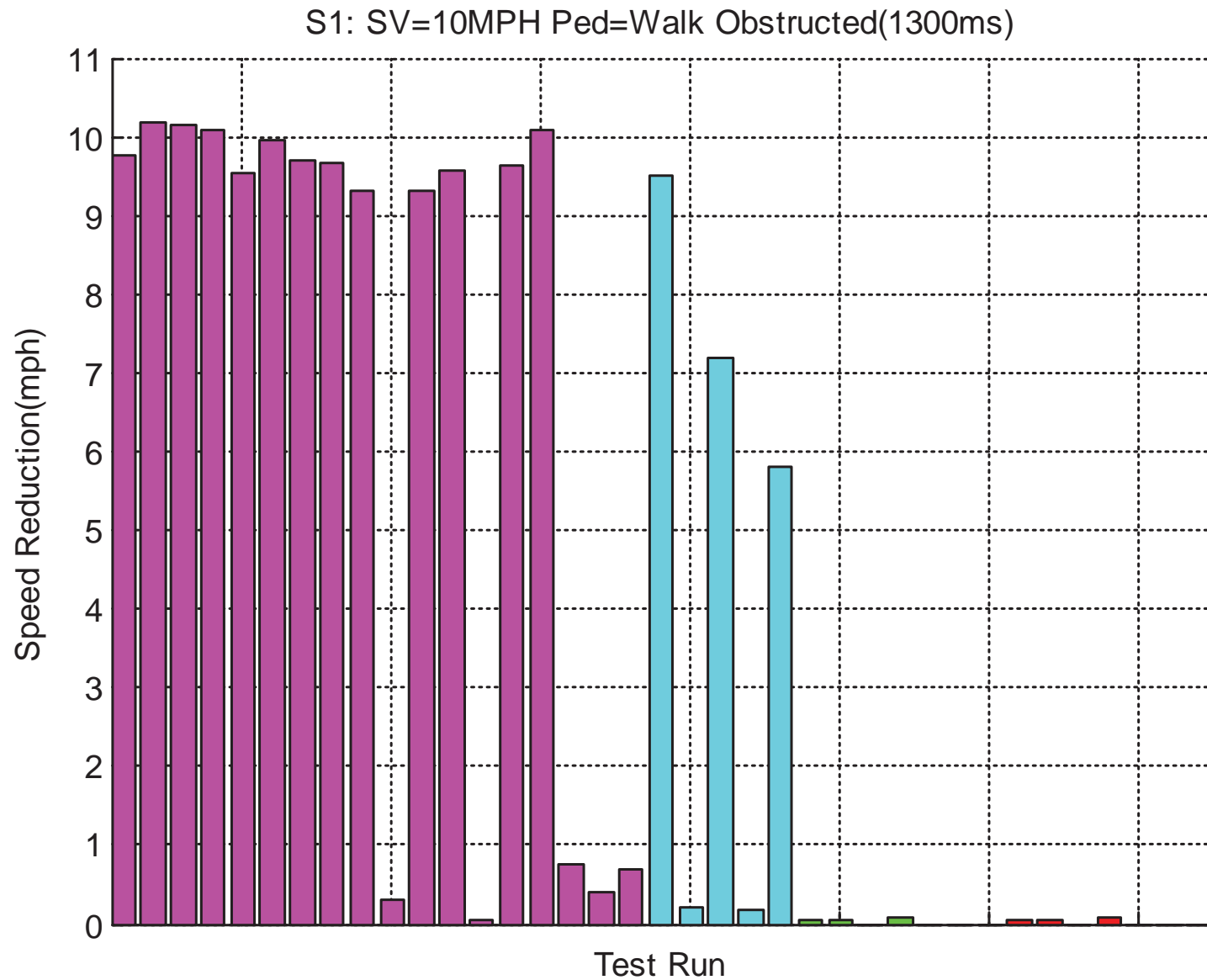
# S1 Scenario – 10 MPH SV – Ped Run – R to L



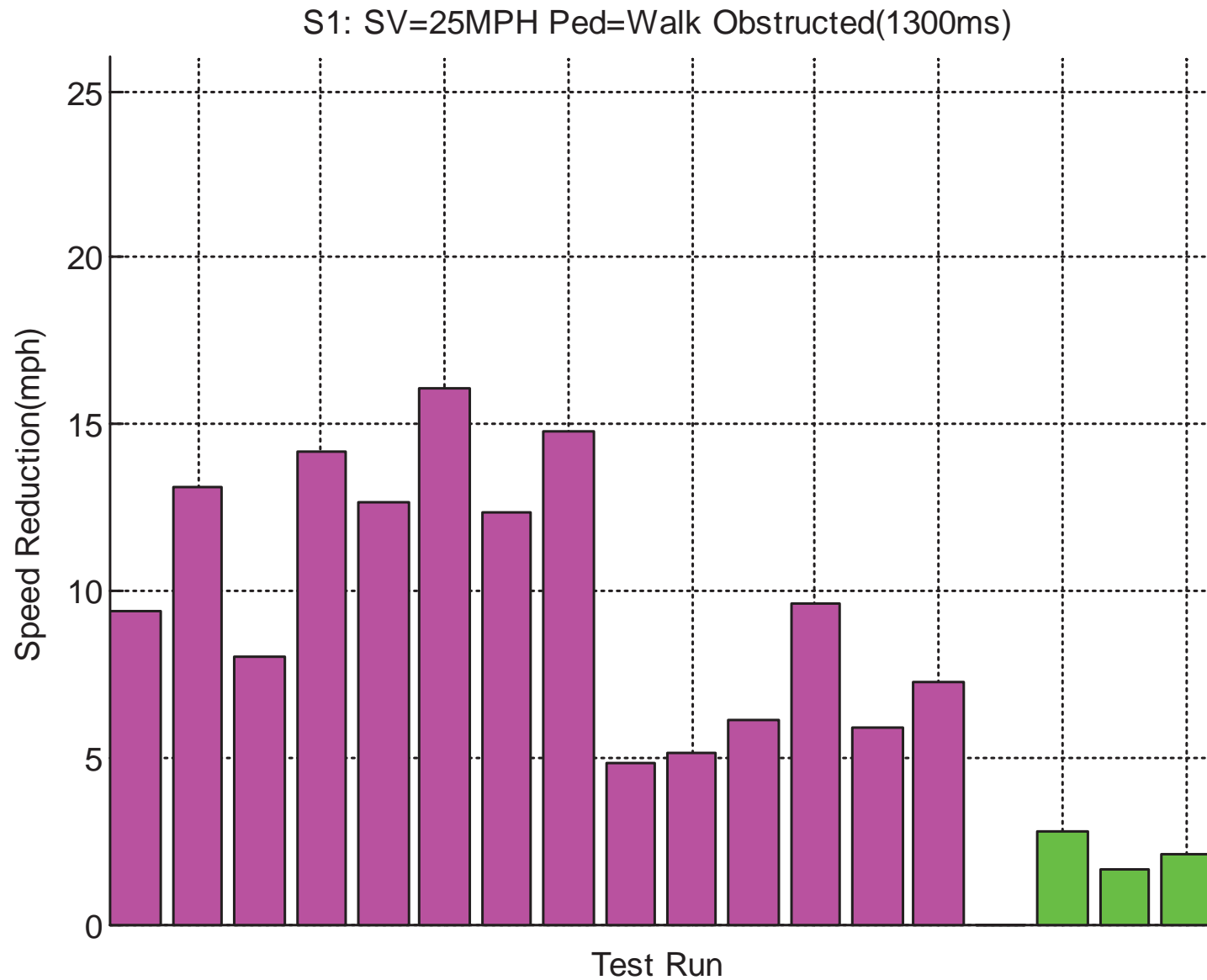
# S1 Scenario – 25 MPH SV – Ped Run – R to L



# S1 Scenario – 10 MPH SV – Ped Walk – R to L OBSTRUCTED – 1.3s reveal time

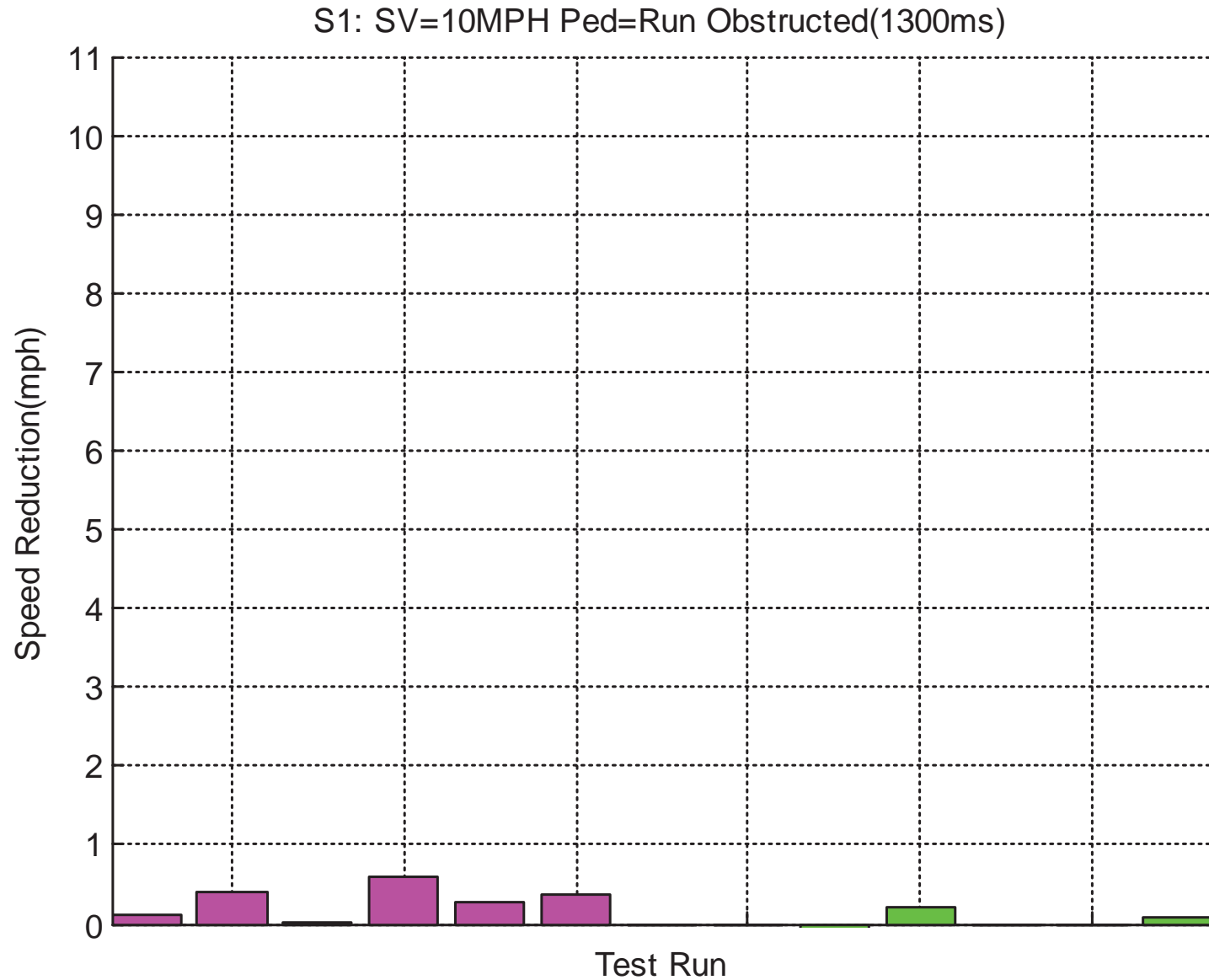


# S1 Scenario – 25 MPH SV – Ped Walk – R to L OBSTRUCTED – 1.3s reveal time

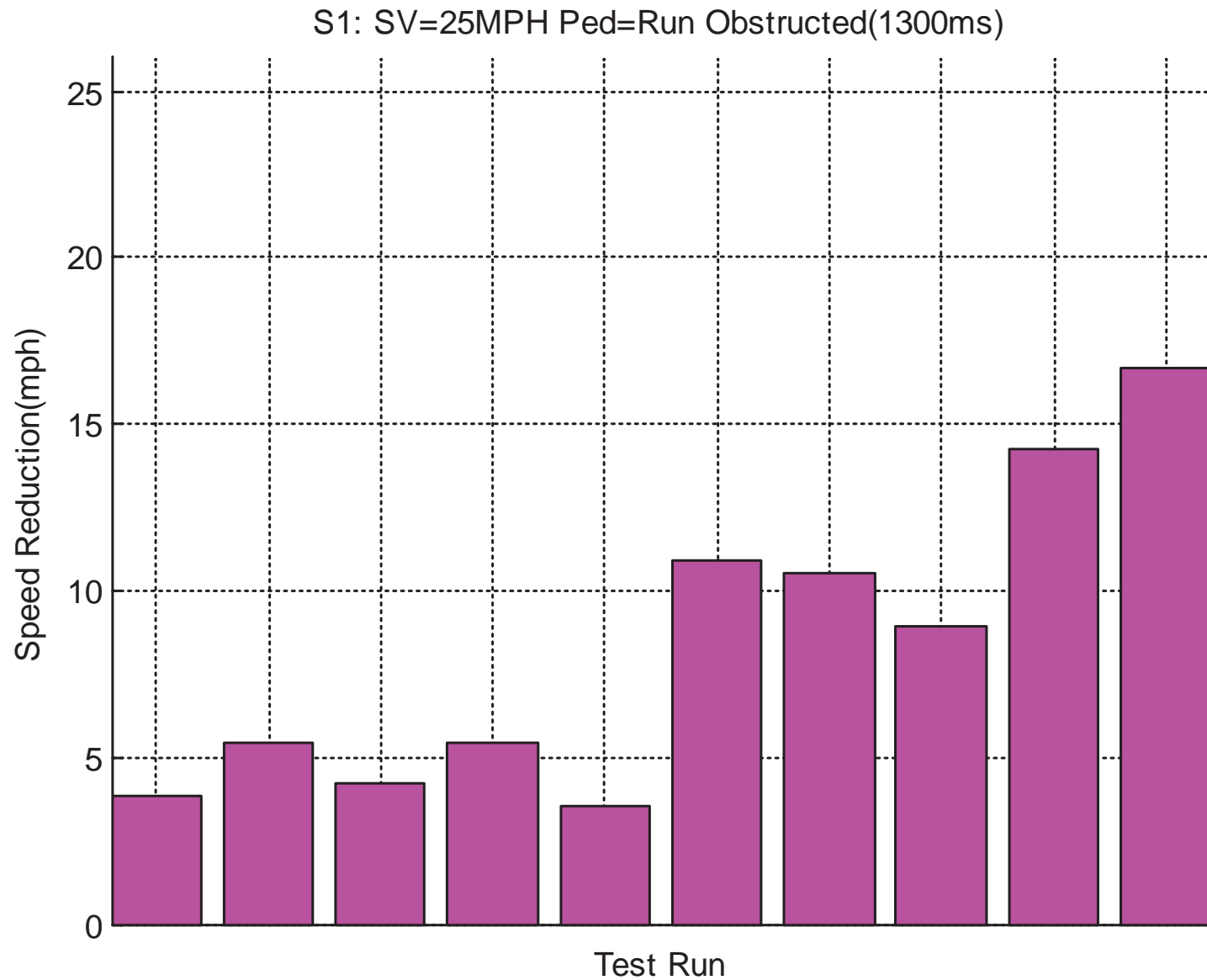




# S1 Scenario – 10 MPH SV – Ped Run – R to L OBSTRUCTED – 1.3s reveal time



# S1 Scenario – 25 MPH SV – Ped Run – R to L OBSTRUCTED – 1.3s reveal time



### Test Data Shows:

- PCAM can avoid and mitigate many common pedestrian crashes.
  - PCAM does not prevent all pedestrian crashes.
- PCAM data shows better performance for slower moving pedestrians
  - “Running” Pedestrian scenarios are challenging for all PCAM systems tested.
- Obstructed tests with short reveal times (1300msec) can be challenging for PCAM systems.
  - Obstructed tests with longer reveal times (2700msec) were no different than unobstructed tests.
- Performance differences can be observed using the objective test conditions described in this presentation.

- Test additional production vehicles with PCAM.
- Refine test maneuvers.
- Refine a PCAM target population to assess system effectiveness.
- Further develop adult and child mannequin designs.
  - Discussed in Crash Avoidance I – Near Term Technologies Session

**QUESTIONS?**

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