



Intersection Safety Assist Research and Testing

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AGENDA

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Research Objective

The tests described in today's presentation:

- Were assembled for research purposes
- Provide a way to objectively define, document, and disseminate how ISA tests may be performed on the test track
- Help assess the state-of-technology
- Will be useful for evaluating vehicles with higher levels of automation in the future

Intersection Safety Assist (ISA)

- Designed to actively help the driver avoid an intersection-based collision
 - Straight crossing path
 - Left turn across path
- Also referred to as “Intersection AEB”

Subject and Principal Other Vehicles (SV and POV)

SV: 2017 Mercedes-Benz E300

- Equipped with Active Brake Assist and Cross-Traffic Functionality
- Uses a combination of camera and radar sensors to detect intersection traffic
- Operational speed: 4 to 43 mph

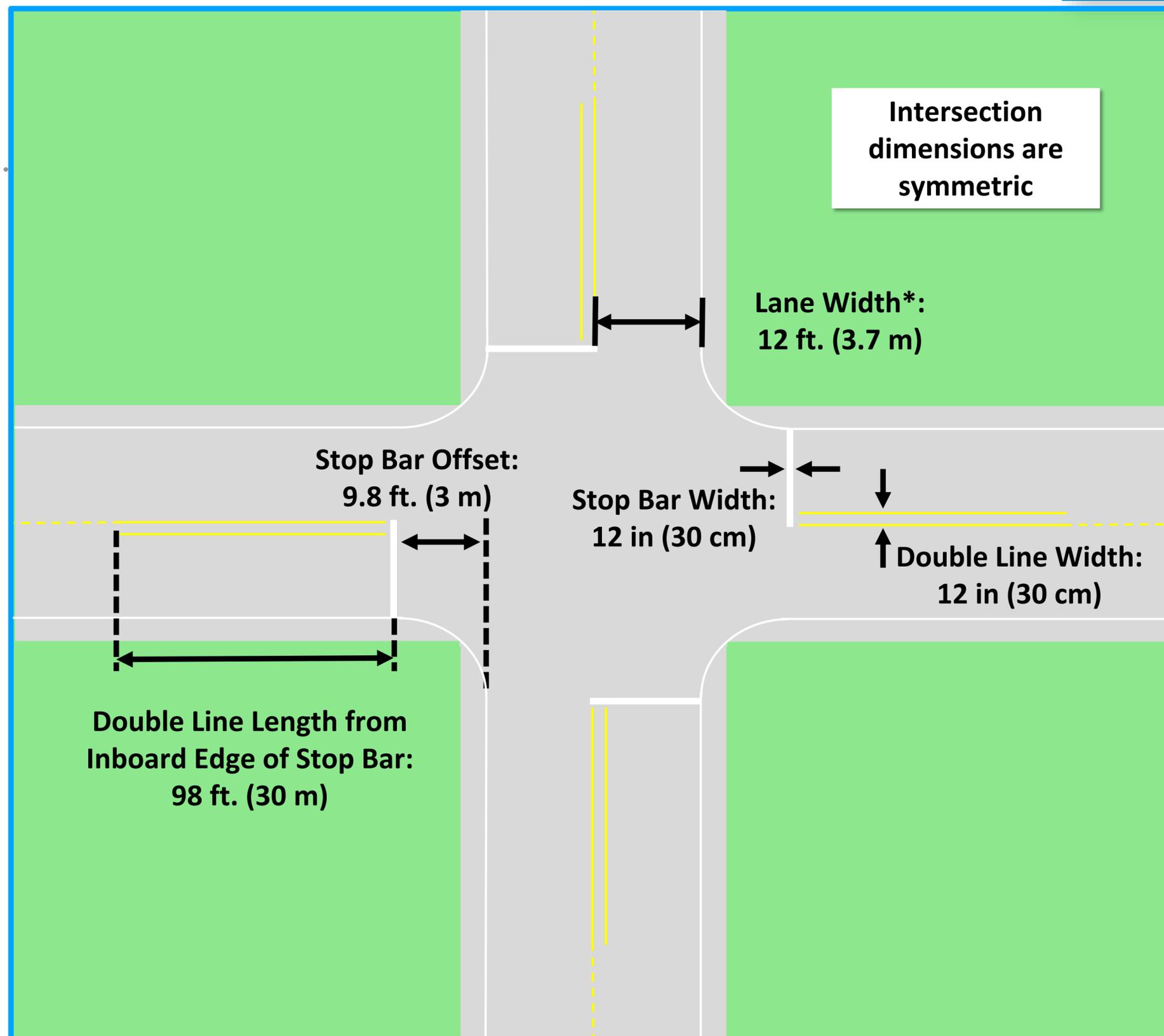
POV: Guided Soft Target (GST)

- Low Profile Robotic Vehicle
- Global Vehicle Target (GVT) Rev. F



Intersection Layout

- Four-way junction
- Dimensions and markings meet Federal Highway Administration guidelines, as defined in the Manual on Uniform Traffic Control Devices



Test Conditions

3 Test Scenarios

1. Straight Crossing Path
2. POV Left Turn Across Path
3. SV Left Turn Across Path

3 Sub-Scenarios

- A. Moving SV and POV
- B. Moving SV, POV accelerates from a stop
- C. Moving POV, SV accelerates from a stop

3 Automation Levels

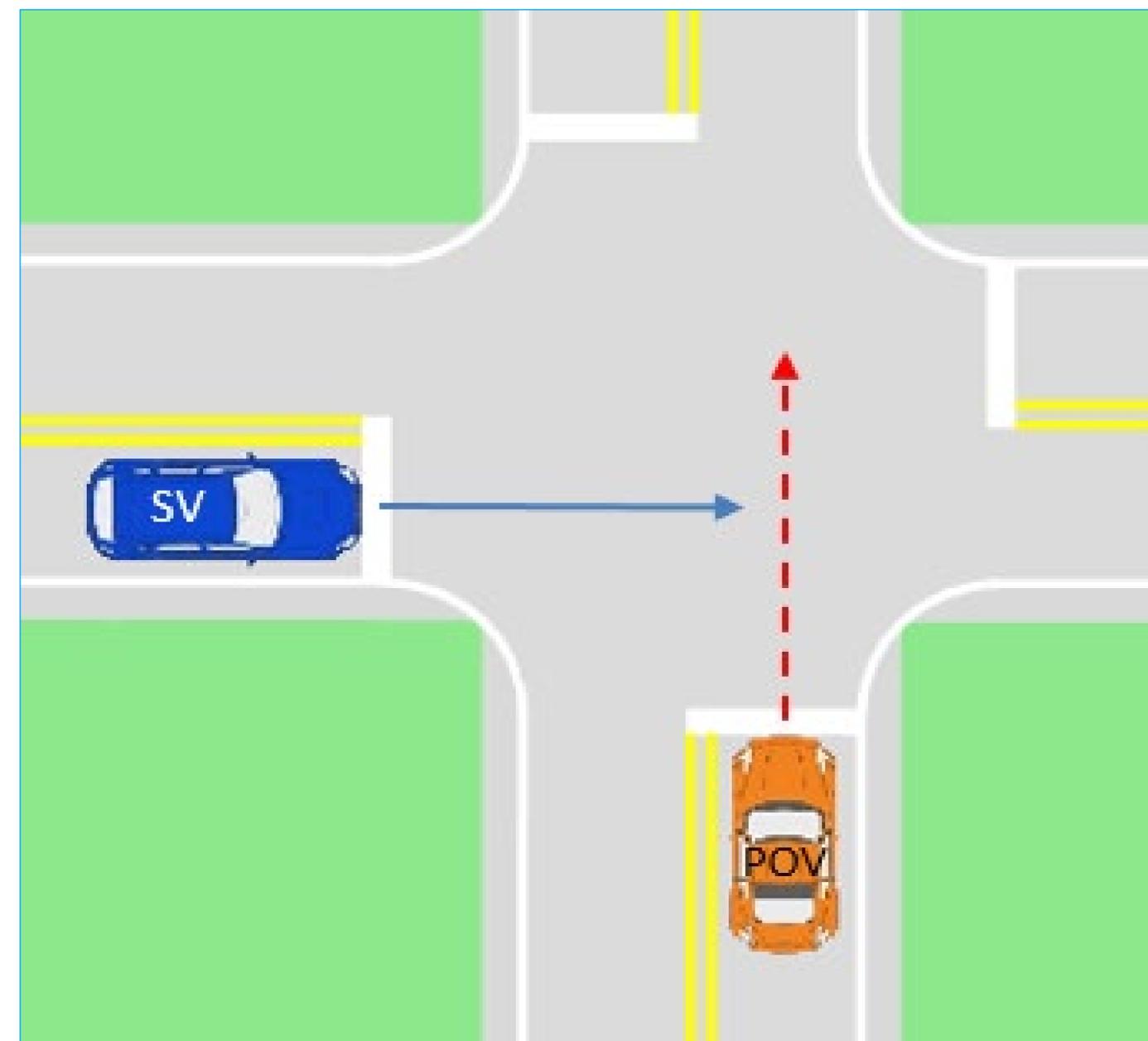
- L0
- L1 (ACC)
- L2 (ACC + Lane Centering)

2 Vehicle Relations

- Crash imminent
- Near miss

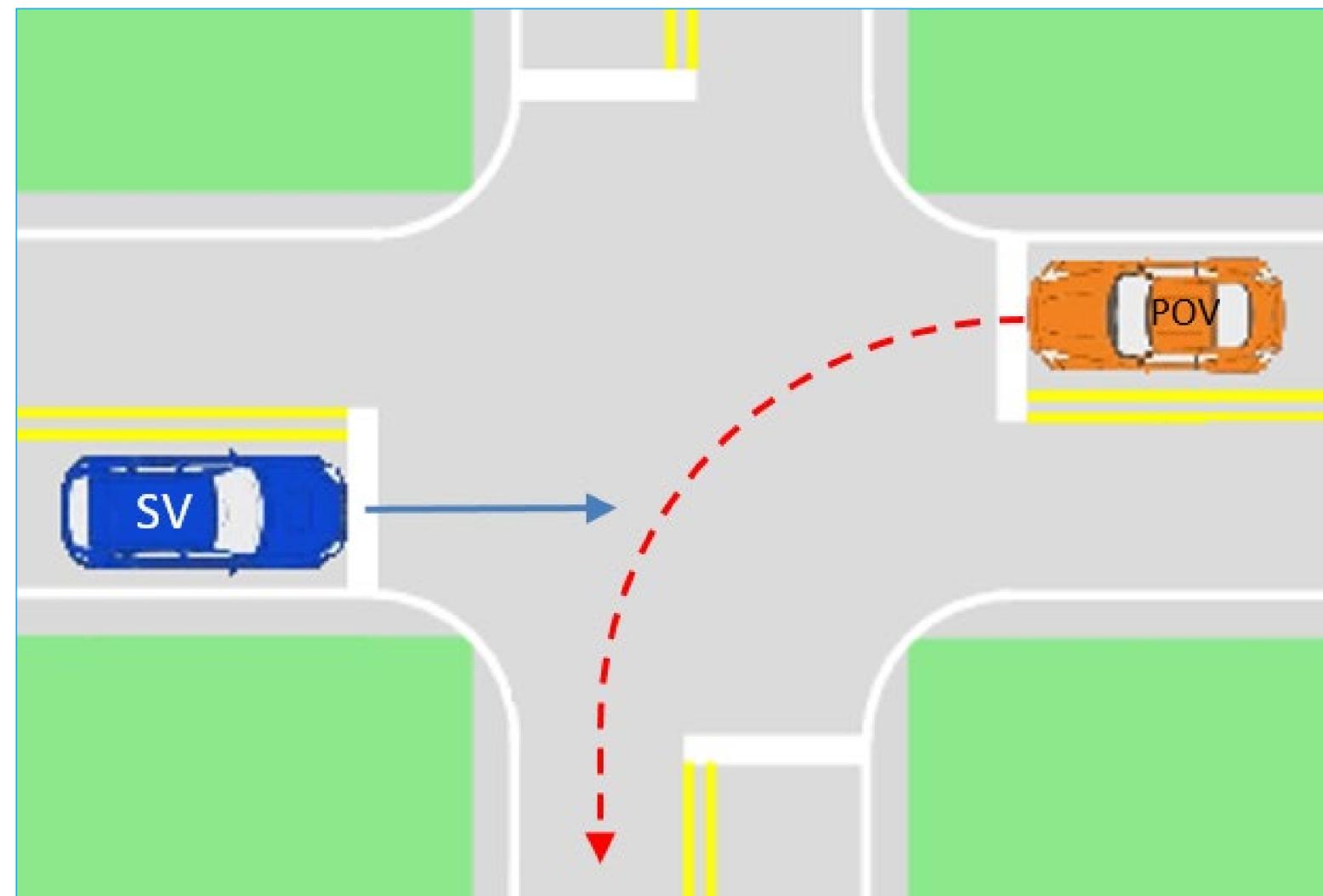
Straight Crossing Path (SCP)

ISA Scenario	Vehicle Speeds	
	SV	POV
A	25 mph	25 mph
B	25 mph	0 \Rightarrow 25 mph
C	0 \Rightarrow 25 mph	25 mph



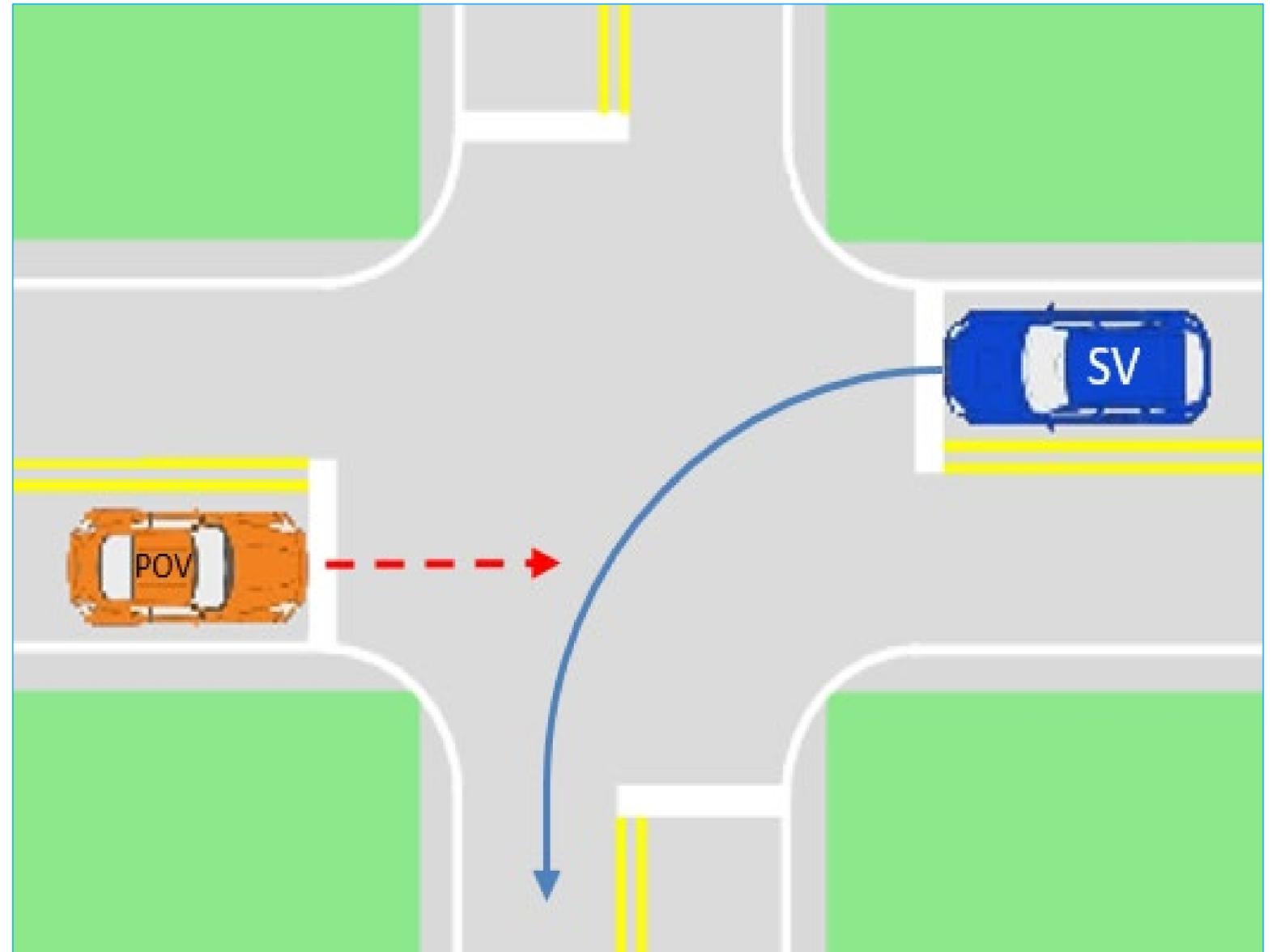
POV Left Turn Across Path (LTAP)

ISA Scenario	Vehicle Speeds	
	SV	POV
A	25 mph	25 \Rightarrow 15 mph
B	25 mph	0 \Rightarrow 25 mph
C	0 \Rightarrow 25 mph	25 \Rightarrow 15 mph



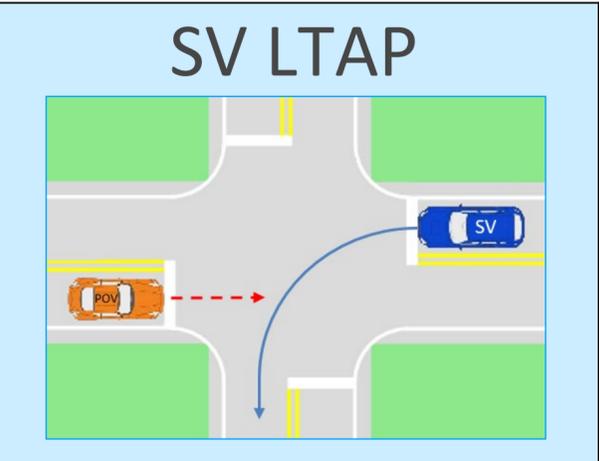
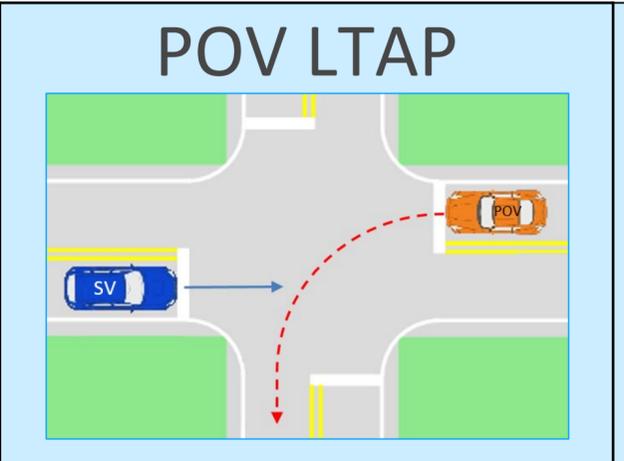
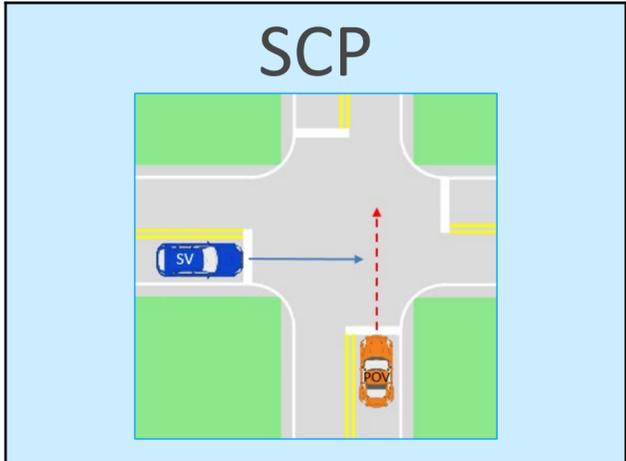
SV Left Turn Across Path (LTAP)

ISA Scenario	Vehicle Speeds	
	SV	POV
A	25 ⇒ 15 mph	25 mph
B	25 ⇒ 15 mph	0 ⇒ 25 mph
C	0 ⇒ 25 mph	25 mph

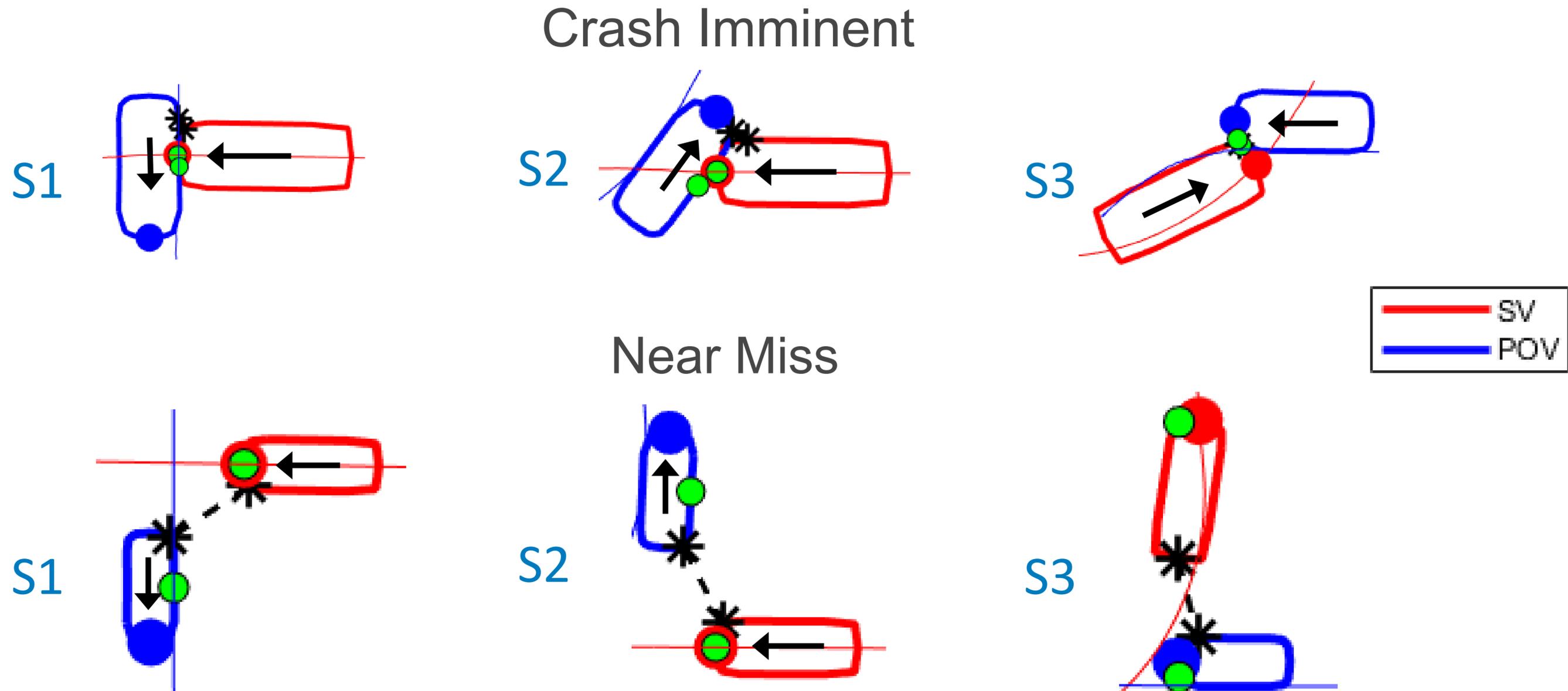


Test Matrix

		SCP			POV LTAP			SV LTAP		
Test Condition	Automation Level	A	B	C	A	B	C	A	B	C
Crash Imminent	0									
	1									
	2									
Near Miss	0									
	1									
	2									



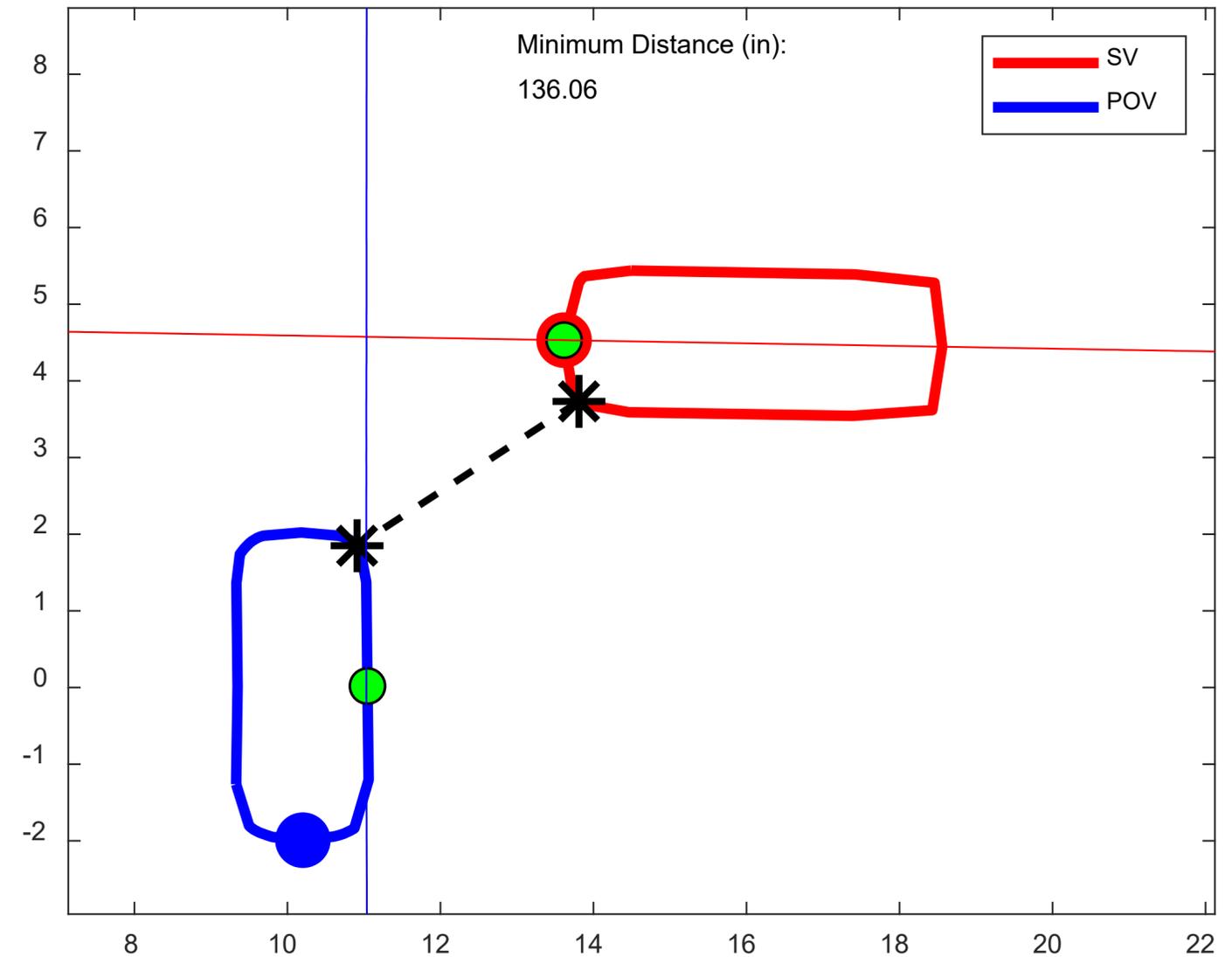
Near Miss and Crash Imminent Intersection Relations



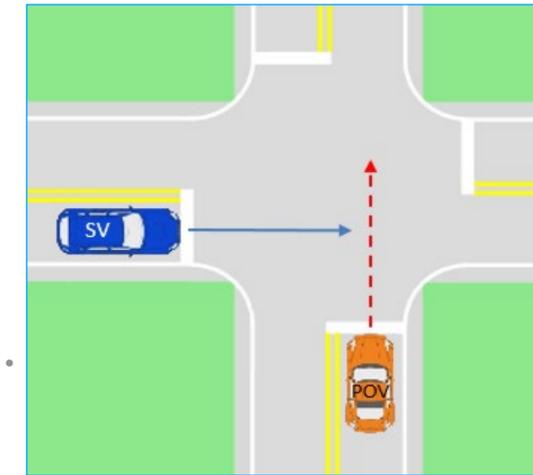
Calculating Vehicle-to-Vehicle Minimum Distance

Measurements to assess vehicle coordination and repeatability

- 45 point POV polygon
- 33 point SV polygon
- ●, ● = Vehicle front
- * = Points of minimum distance
- ● = Point-to-point measurement



Test Repeatability Example: Straight Crossing Path – Scenario A



Near Miss

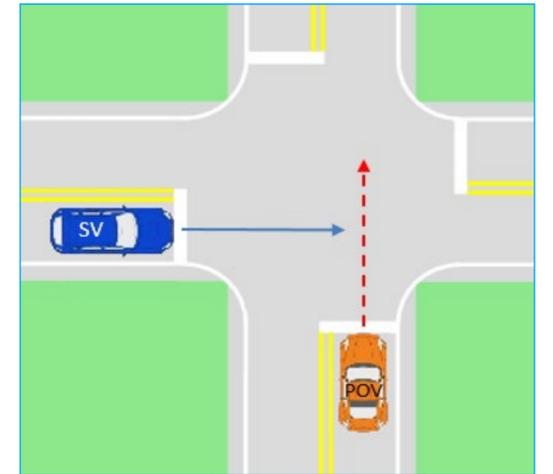
Run	Automation Level	Min Dist. (in)	Min Dist. Std. Dev. (in)
1*	0	95.7	20.57
2*		109.1	
3*		136.1	
1	1	113.8	2.65
2		118.9	
3		117.4	
1	2	120.4	1.06
2		122.2	
3		120.3	

Crash Imminent

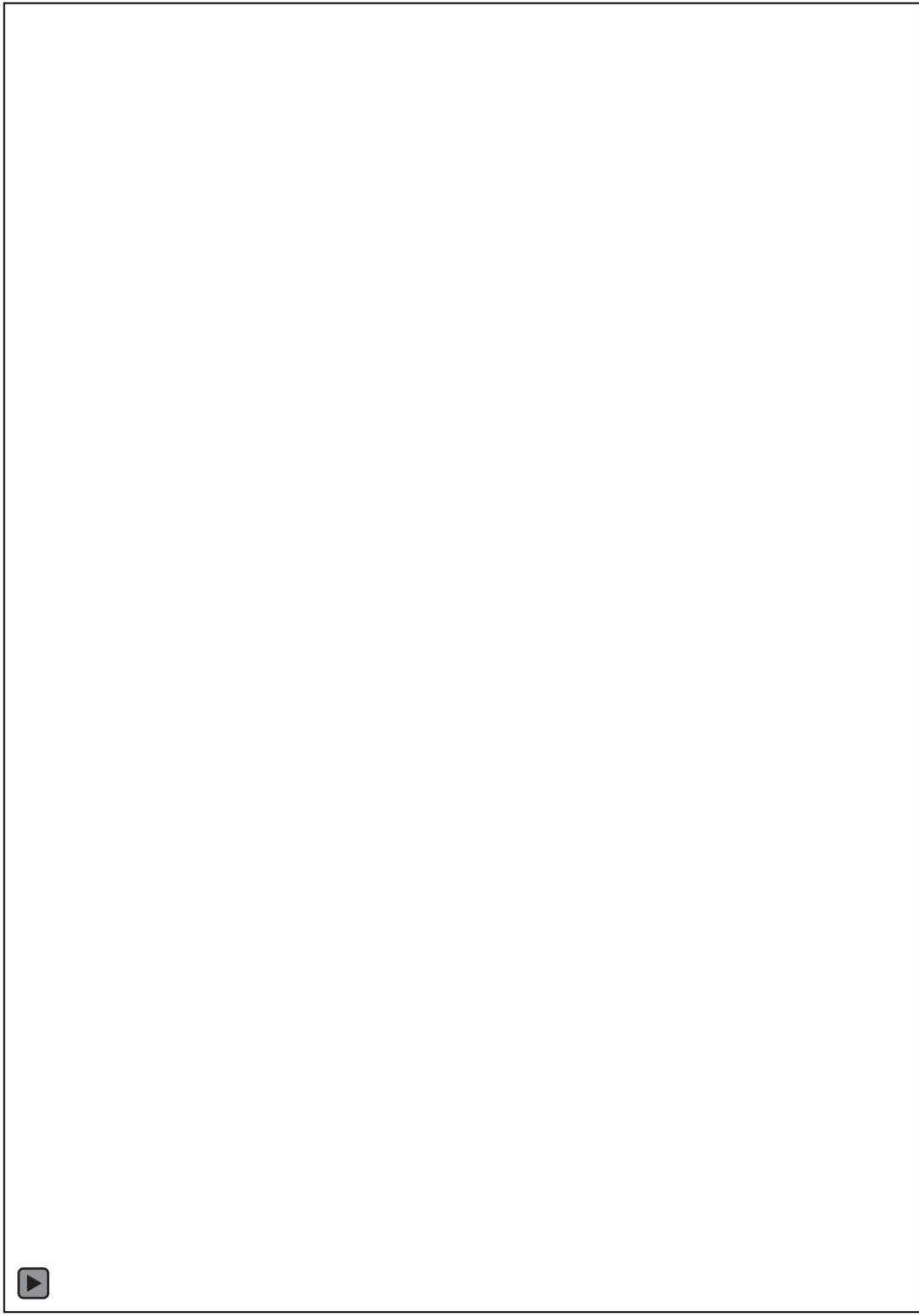
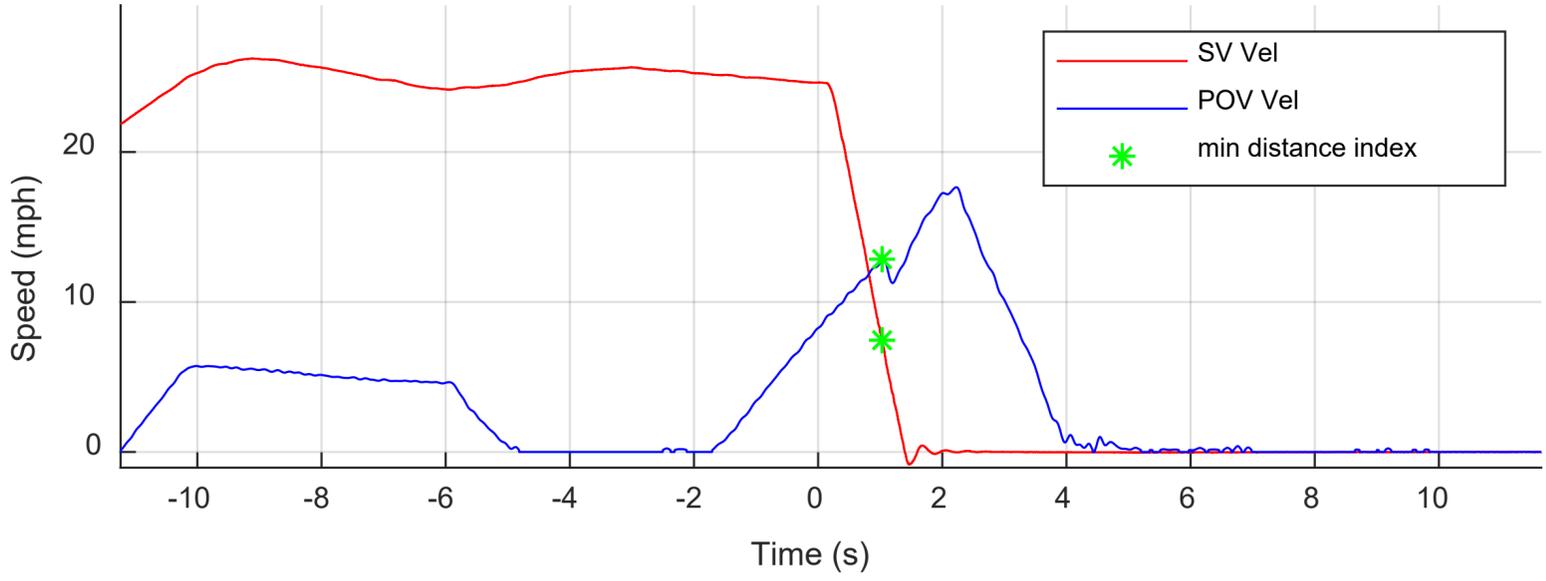
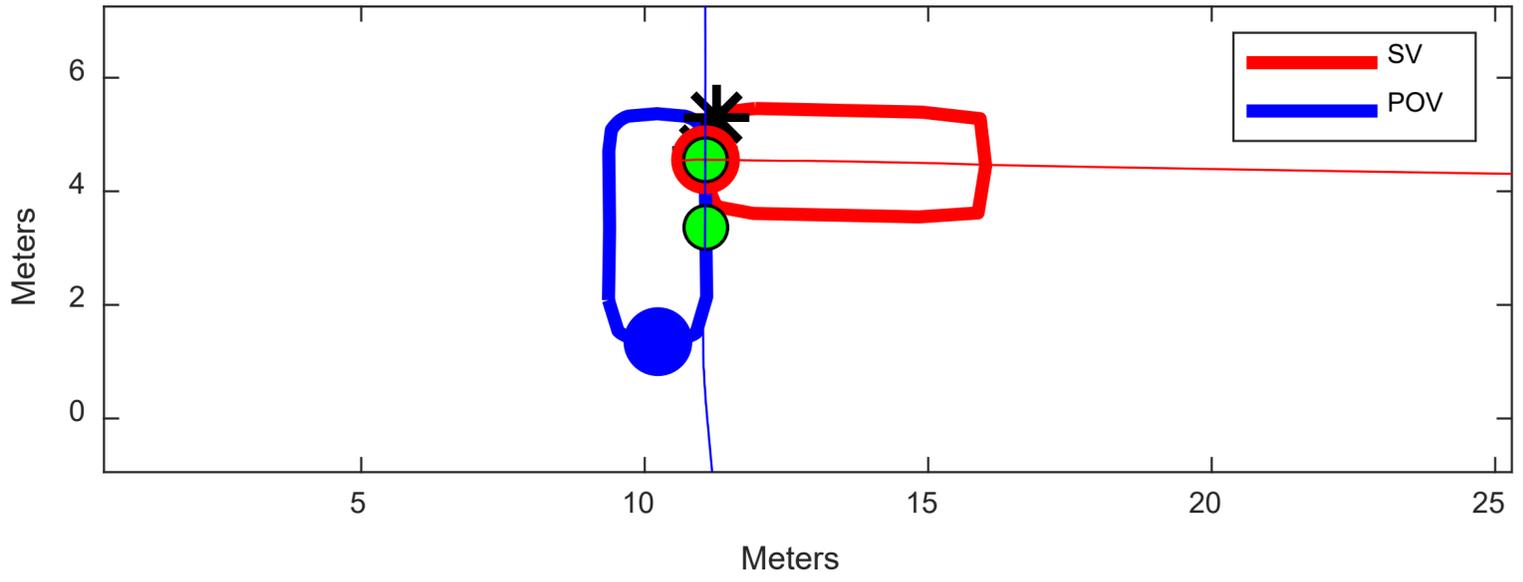
Run	Automation Level	SV Spd. Reduction?	Impact Speed	Point-to-Point Dist. (in)	PTP Dist. Std. Dev. (in)
1	0	No	25.0	18.3	2.9
2		No	24.7	13.1	
3		No	25.7	13.7	
1	1	No	25.2	18.4	7.9
2		No	25.1	3.2	
3		No	25.1	7.1	
1	2	No	25.0	10.6	6.7
2		No	24.9	23.7	
3		No	25.1	19.9	

*Driver-operated accelerator pedal

Test Repeatability Example: Straight Crossing Path: Scenario B Crash Imminent



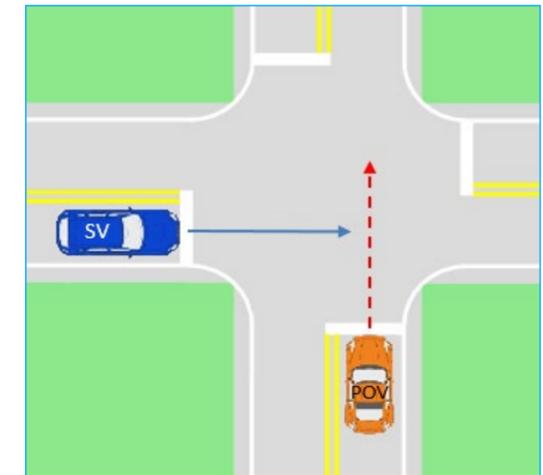
Test Repeatability Example: Straight Crossing Path: Scenario B Crash Imminent



Test Repeatability Example:

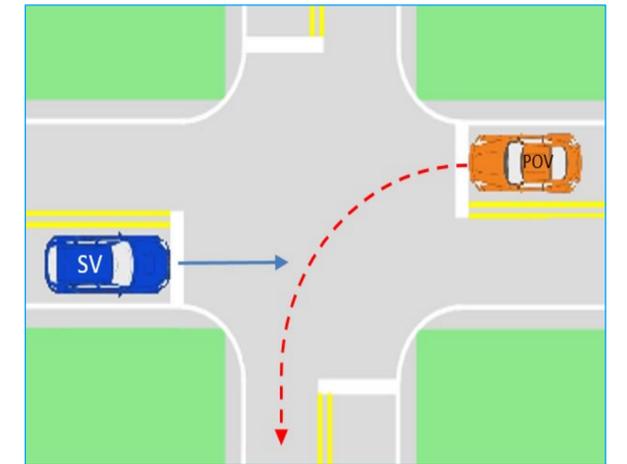
Straight Crossing Path: Scenario B Crash Imminent

Test File	Automation level	SV Speed Reduction?	SV Speed at Impact	Point-to-Point Dist. (in)
133	0	Y	7.4	46.9
135		Y	9.9	31.9
136		Y	10.8	23.1
142	1	Y	7.0	51.5
143		Y	13.8	5.3
144		N	23.8	17.8
145	2	Y	10.6	18.2
148		Y	14.6	1.3
149		N	25.0	21.4

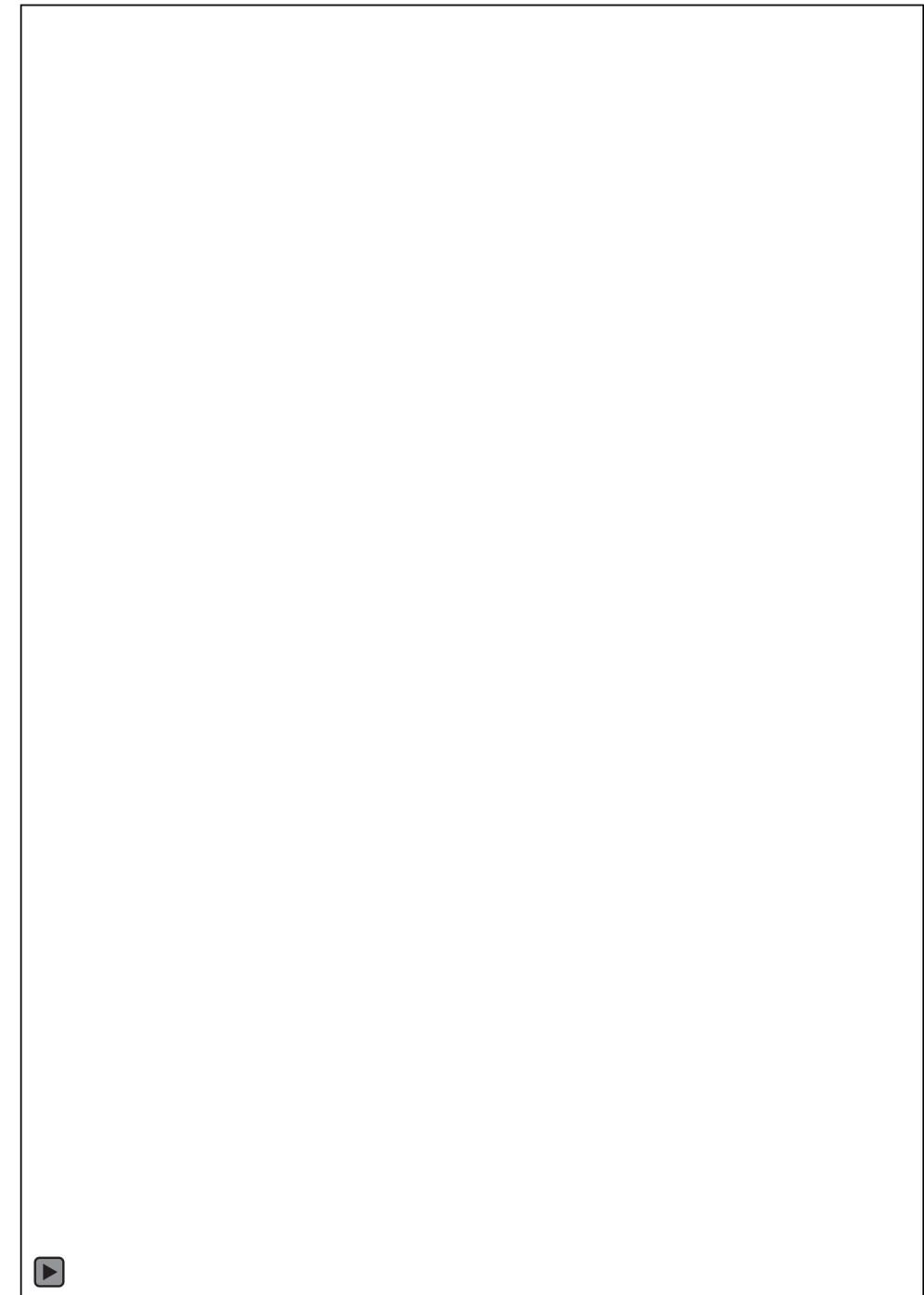
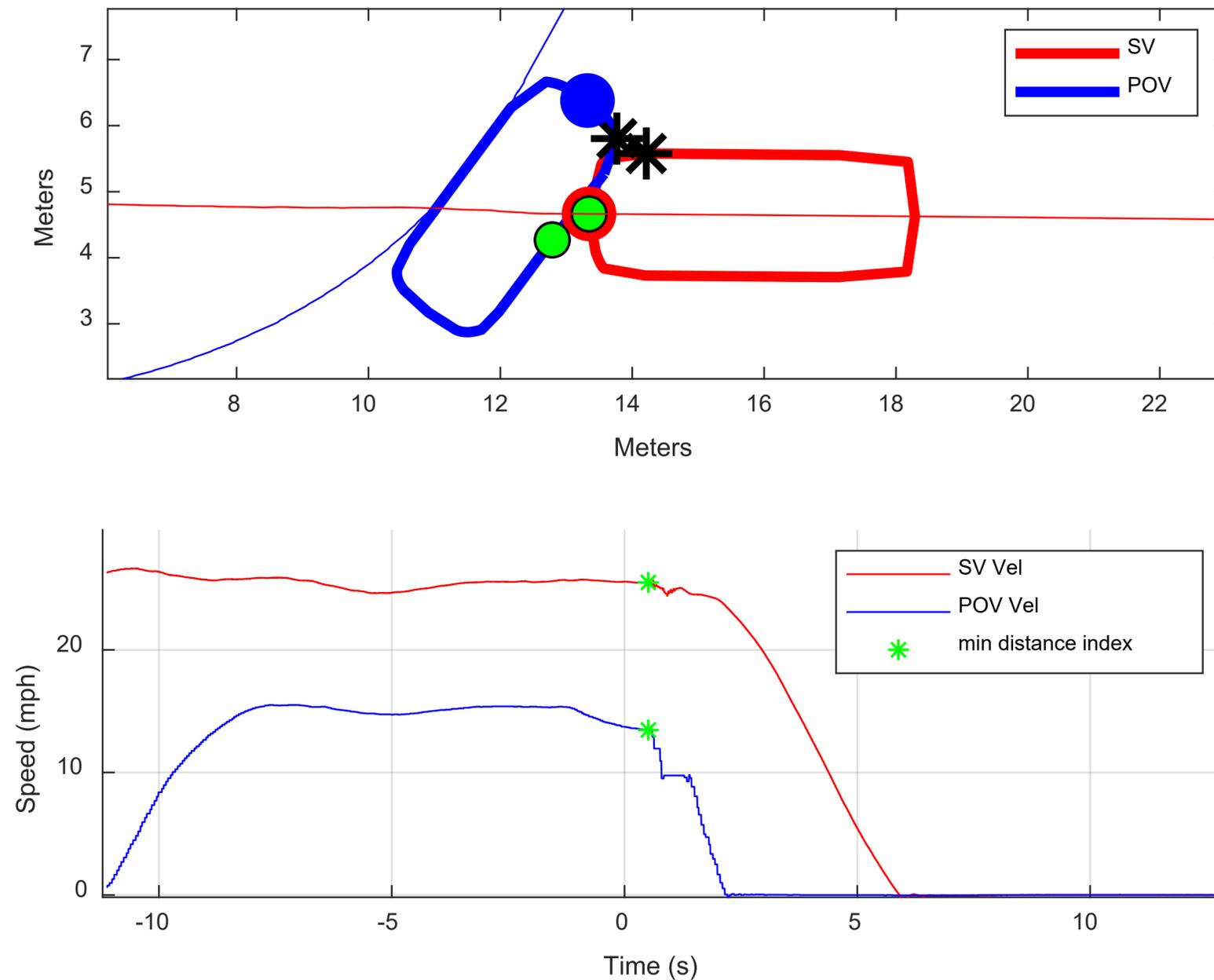


Note: ISA intervention was only observed in the SCP B crash imminent scenario

Test Repeatability Example: POV Left Turn Across Path: Scenario B Crash Imminent



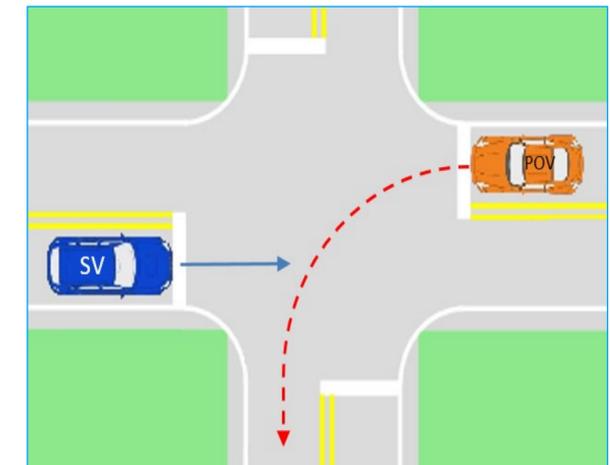
Test Repeatability Example: POV Left Turn Across Path: Scenario A Crash Imminent



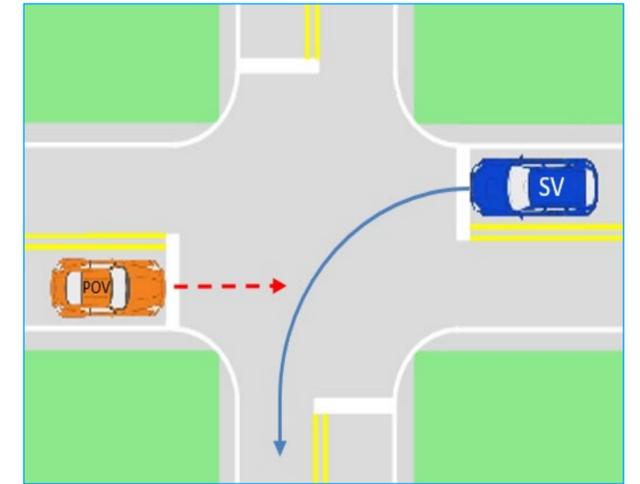
Test Repeatability Example:

POV Left Turn Across Path: Scenario A Crash Imminent

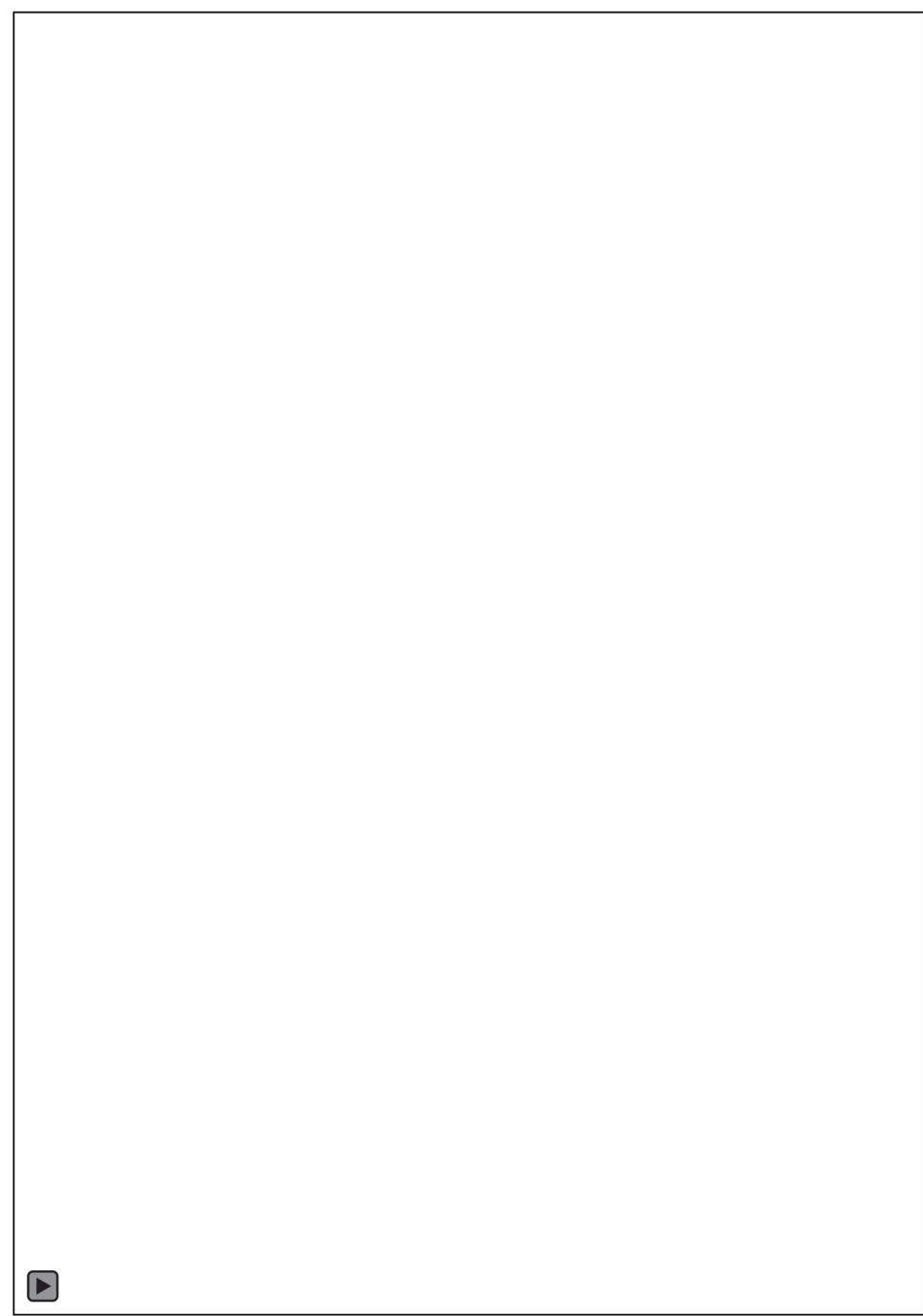
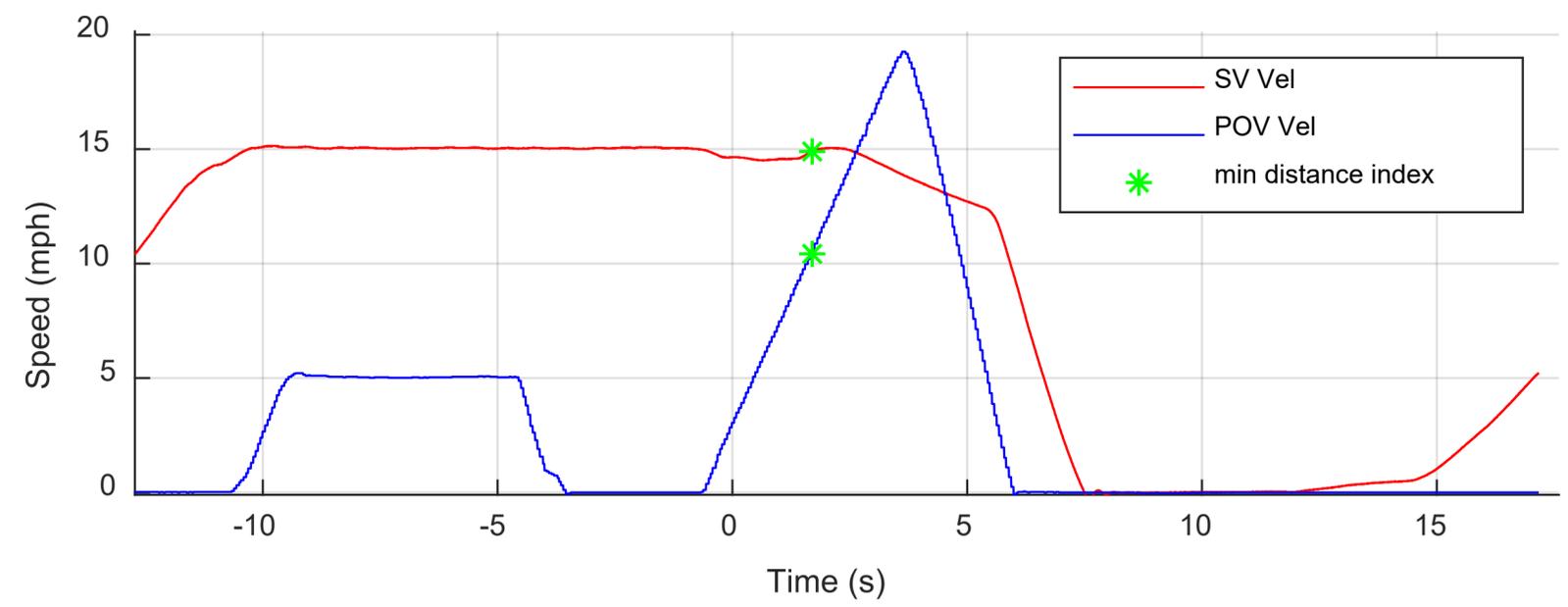
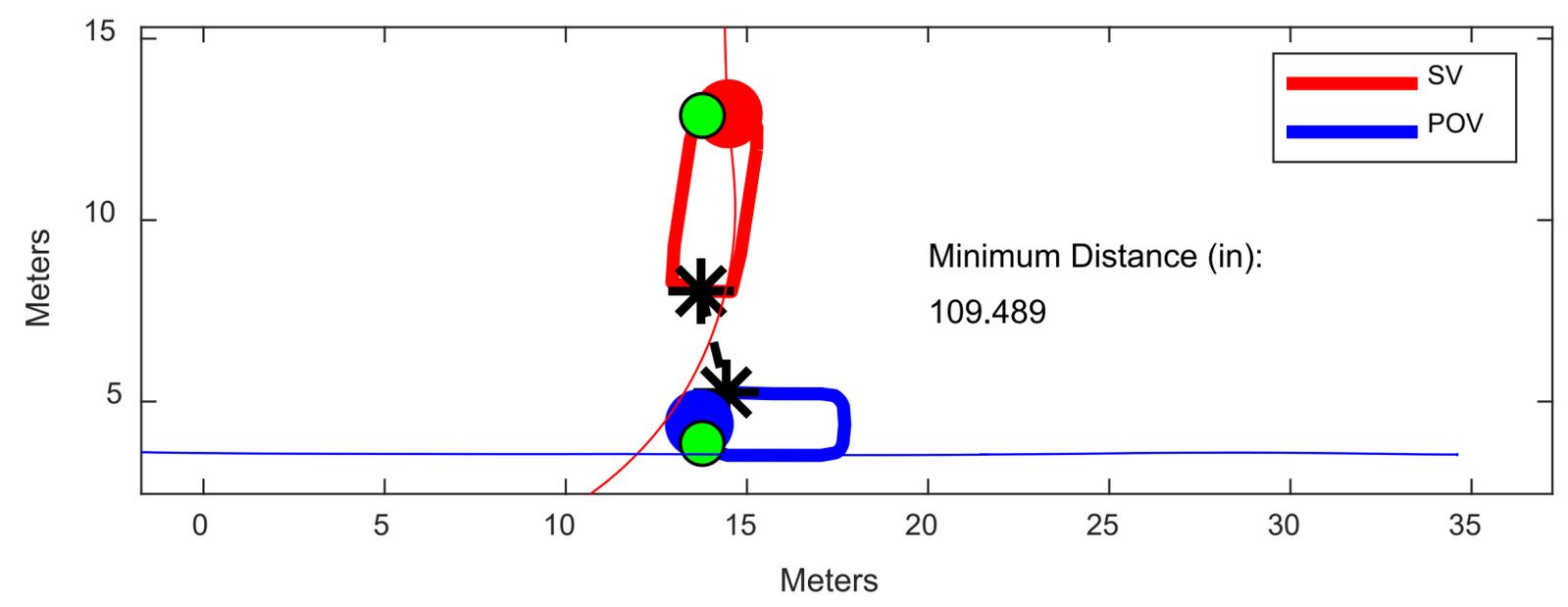
Run	Automation Level	SV Spd. Reduction?	Impact Speed (mph)	Point-to-Point Dist. (in)	PTP Dist Std. Dev. (in)
1	0	N	25.5	26.9	5.3
2		N	24.4	18.2	
3		N	24.8	27.9	



Test Repeatability Example: SV Left Turn Across Path: Scenario B Near Miss



Test Repeatability Example: SV Left Turn Across Path: Scenario B Near Miss



Concluding Remarks

- The test tolerances specified in draft ISA test procedures were satisfied
- The number of scenarios addressed by the SV's ISA was limited
 - Crash imminent tests: ISA activations only observed during straight crossing path B scenarios
 - Near miss tests: no ISA activations observed
- Release of the ISA test report and draft research TP is expected later this year

Additional Information

- The draft research ISA test procedure will be available from the National Transportation Library (NTL)
 - Link: <https://ntl.bts.gov/>
- Contacts:
 - Ian Davis: ian.davis.ctr@dot.gov
 - Garrick Forkenbrock: garrick.forkenbrock@dot.gov

An aerial photograph of a complex highway interchange with multiple overpasses and ramps. The scene is captured from a high angle, showing the flow of traffic and the geometric patterns of the roads. A large white rectangular box is superimposed over the center of the image, containing the text. The box is framed by blue L-shaped corner brackets at the top-left and bottom-right corners.

Questions?

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Thank you!