NHTSA

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Assessment of Light Vehicle ADAS in Response to Two Wheeled Vehicles

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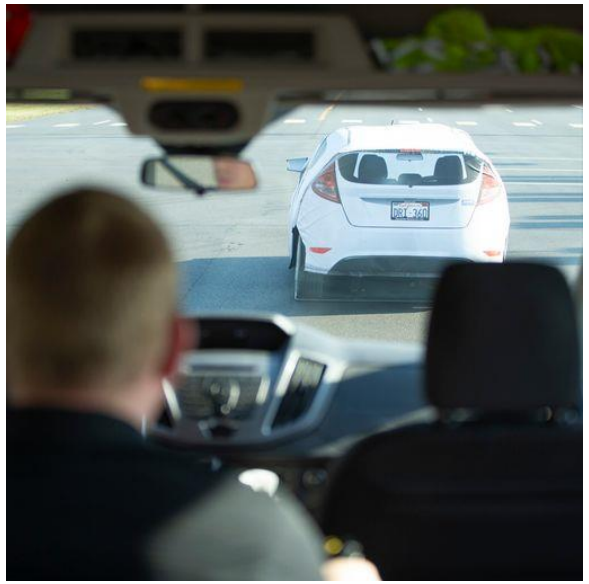
Transportation Research Center Inc.

Test Program Acknowledgment

The Assessment of Light Vehicle ADAS in Response to Two Wheeled Vehicles test program was fully funded by the National Highway Traffic Safety Administration.



Program Objectives

Primary Research Questions

1. How do ADAS crash avoidance systems from a variety of makes/models respond to motorcycles and bicycles in several crash conditions?

   - Rear-end crashes (lead motorcycle or bicycle stopped, lead motorcycle or bicycle stopping, and lead motorcycle or bicycle moving)

   - Lane change crashes (motorcycle and light vehicle traveling in the same direction)

Program Objectives

Primary Research Questions

2. How do the handling and driving characteristics of motorcycles affect test specifications (e.g. lane position, braking characteristics)?

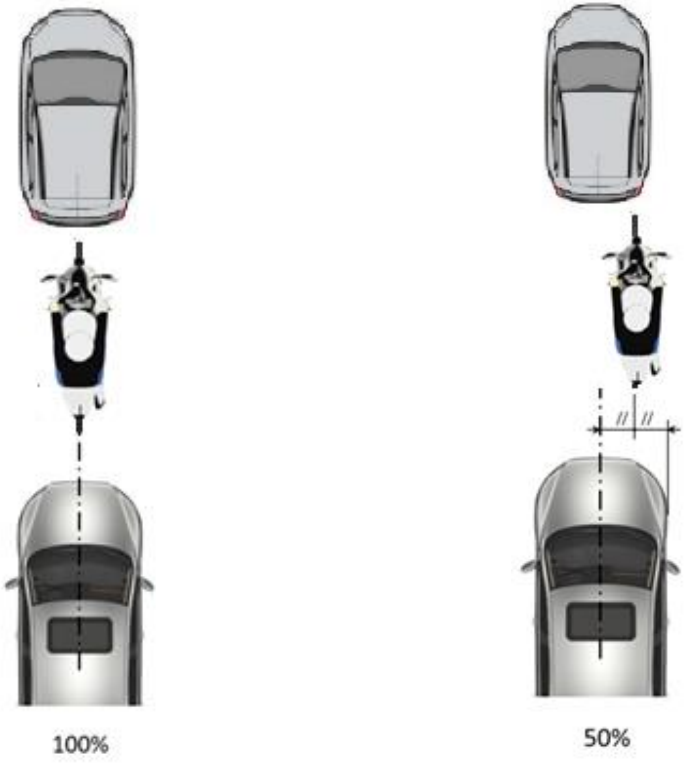
3. How do the results of the tests conducted with motorcycles and bicycles as POV compare with tests conducted with a light vehicle as POV?

4. How should the draft test procedures be adjusted to account for motorcycles and bicycles given the findings specific to the results of this study?

Rear-end Crash Test Scenarios

Motorcycle Lead Vehicle Stopped (LVS)

- Subject Vehicle Speeds: 10-80 km/h tested in 10 km/h increments
- Lighting Conditions: Day and Night



Motorcycle target positioned 2 meters behind car target

Rear-end Crash Test Scenarios

Bicycle Lead Vehicle Stopped (LVS)

- Subject Vehicle Speeds: 10-80 km/h tested in 10 km/h increments
- Lighting Conditions: Day and Night

100%

100%

25%

100%

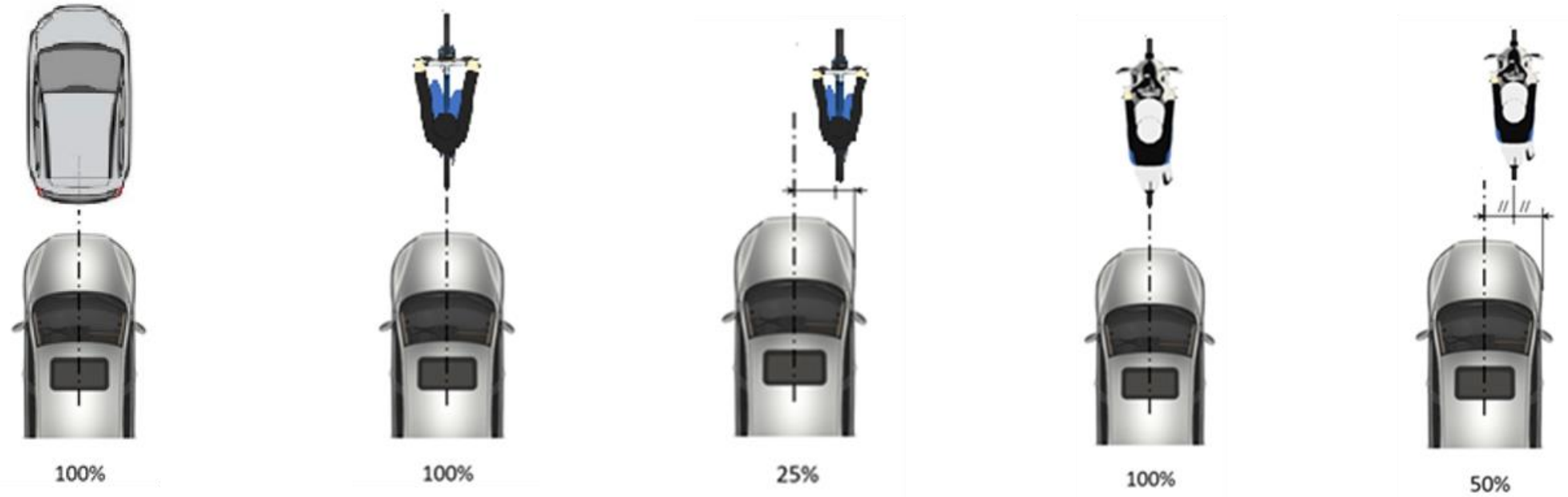
25%

Bicycle target positioned 2 meters behind car target

Rear-end Crash Test Scenarios

Motorcycle and Bicycle Lead Vehicle Moving (LVM)

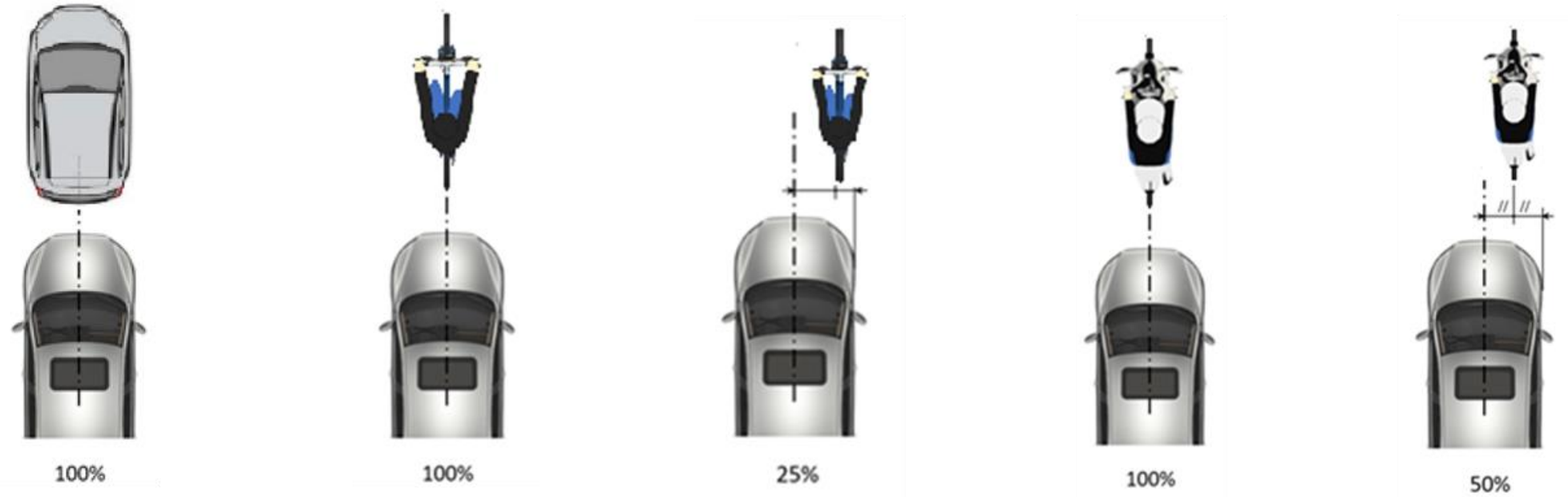
- Subject Vehicle Speeds: 30-100 km/h tested in 10 km/h increments
- POV Speed: 20 km/h
- Lighting Conditions: Day



Rear-end Crash Test Scenarios

Motorcycle and Bicycle Lead Vehicle Decelerating (LVD)

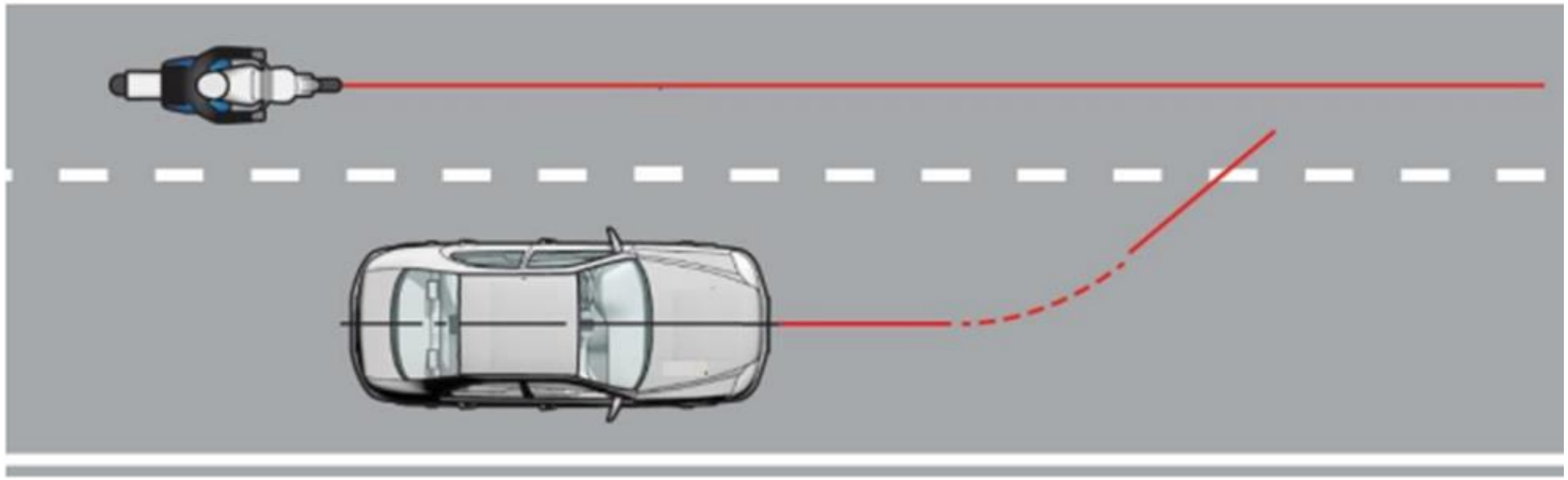
- Vehicle Speeds: 50-80 km/h (Motorcycle) and 20-30 km/h (Bicycle) tested in 10 km/h increments
- Headway: 12 m and 40 m
- POV Deceleration Rate: 5 m/s^2
- Lighting Conditions: Day



Lane Change Crash Test Scenarios

Motorcycle and Bicycle Blind Spot Intervention

- Motorcycle Constant Headway: 50-80 km/h tested in 10 km/h increments
- Motorcycle Closing Headway: POV Speed 80 km/h and SV Speed 40-70 km/h in 10 km/h increments
- Bicycle Constant Headway: 20-30 km/h tested in 10 km/h increments



Industry Standard Test Targets

Test Targets

- Global Vehicle Target (GVT) - Revision G
- 4active Motorcycle Target
- 4active Bicycle Target

Movement System

- Low Profile Robotic Platform

Test Equipment

Test Vehicle Equipment

- GPS/IMU
- Data Acquisition System
- Wireless Vehicle to Vehicle Communication
- Differential GPS Corrections
- Webcams
- FCW Alert Camera System
- FCW Alert Microphone
- Throttle Travel
- Brake Pedal Flag
- Brake Thermocouples

Vehicle Selection

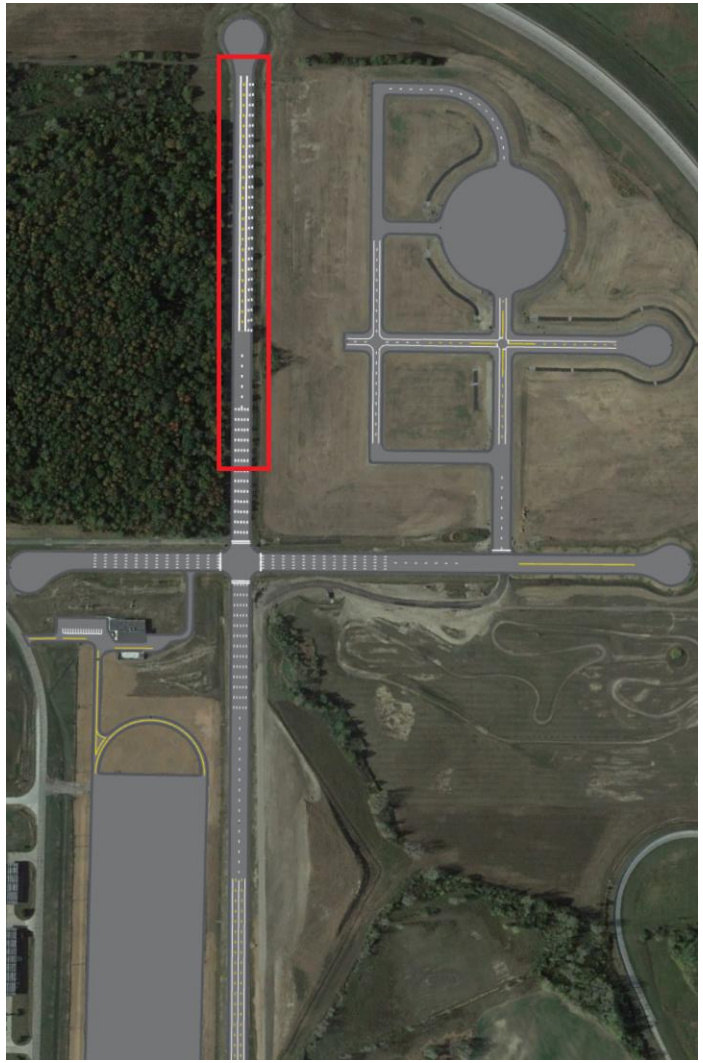
Test Vehicle	Body Type	Powered By	Max AEB Operation Speed Bicyclist (km/h)	Max AEB Operation Speed Vehicle (km/h)	BSI Operational Speeds (km/h)
Vehicle 1	SUV	Gasoline	80	120	No BSI
Vehicle 2	Sedan	Gasoline	100	100	No BSI
Vehicle 3	SUV	Gasoline	80	180	Not Specified
Vehicle 4	Sedan	Electric	80	150	30-140
Vehicle 5	Sedan	Gasoline	80	115	50-140

- Electric vehicle selected to evaluate performance differences due to regenerative braking
- Most vehicles did not specify motorcycle max operational speed in user manual
- Minimum operational speed for all vehicles noted in user manual was 5 km/h

Test Facility

Transportation Research Center SMARTCenter

- Dedicated ADAS and AV Testing Facility
- Required Space for Testing
  - 6 Lanes Wide
  - 2000 ft long
  - 1500 ft of Solid/Dash/Solid Lane Markings
  - Slope of 0.25%
  - Free of cracks, bumps and other irregularities



Preliminary Findings

Comparing target avoidance when vehicle target is centered vs offset

Offset Target Avoidance Compared to Centered		
Better	Worse	Same
13	18	27

Comparing avoidance when approaching bicycle target vs car target

Bicycle Target Avoidance Compared to Car		
Better	Worse	Same
6	36	6

Comparing avoidance when approaching motorcycle target vs car target

Motorcycle Target Avoidance Compared to Car		
Better	Worse	Same
8	36	4

Contact Information

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