

# Recent NHTSA Research on Rear Automatic Braking System Performance

Elizabeth Mazzae

National Highway Traffic  
Safety Administration

Co-Authors: Scott Baldwin  
and Adam Andrella  
Transportation Research  
Center, Inc.

## Backover Problem

- NHTSA has been testing rear object detection systems since the early 1990s to assess their ability to detect humans
- Performance in detecting humans has been unreliable
- Backover crashes have been estimated to cause (2014):
  - 210 fatalities
  - 15,000 injuries
- FMVSS No. 111 Rear Visibility 2014 final rule added a requirement to provide drivers with a rearview image showing a 10 ft side by 20 ft long area directly behind the vehicle.
  - Estimated to reduce fatalities to 141-152 annually
- Rear automatic braking systems could reduce those fatalities and injuries even further

## What is a Rear Automatic Braking System?

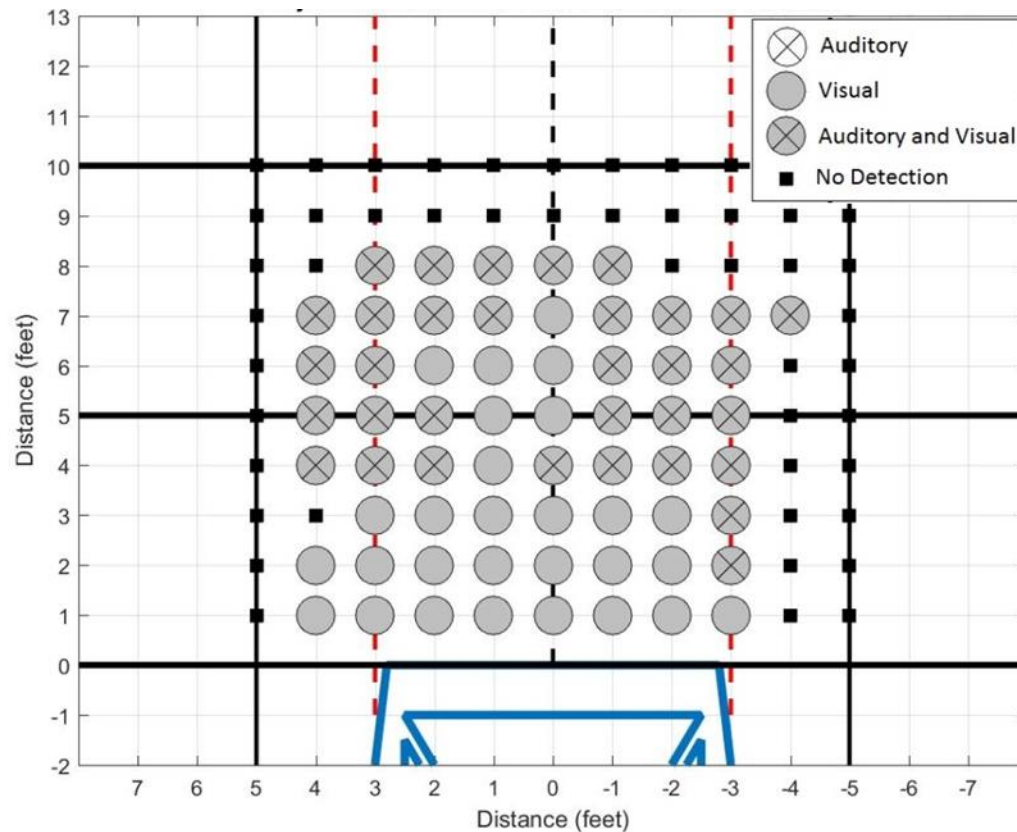
- Type of automatic emergency braking system
- Available when driving in Reverse at typically  $\leq 5$  mph
- Detects certain rear obstacles, warns the driver, and applies the vehicle's brakes automatically to bring the vehicle to a stop
- In existing systems, brake application is either:
  - **Brief** - Brings the vehicle to a stop automatically but **requires the driver to depress the brake pedal** to prevent the vehicle from continuing to move rearward
  - **Sustained** - Brings the vehicle to a stop automatically and **holds the brakes to keep the vehicle stopped** until the driver depresses the brake pedal

# NHTSA Automatic Braking Systems Testing

- Purpose:
  - Continue to monitor state of the art in technologies that may aid drivers in safely backing vehicles and avoiding pedestrians
  - Characterize performance of existing systems
    - » Detection performance as advertised?
    - » Ability to detect and avoid crashes with humans/pedestrians?
  - Develop objective test procedures for this type of system
- Testing involved:
  - Vehicle: Stationary or moving
  - Test objects: Stationary or moving
  - Variety of test objects including vehicle and human surrogates

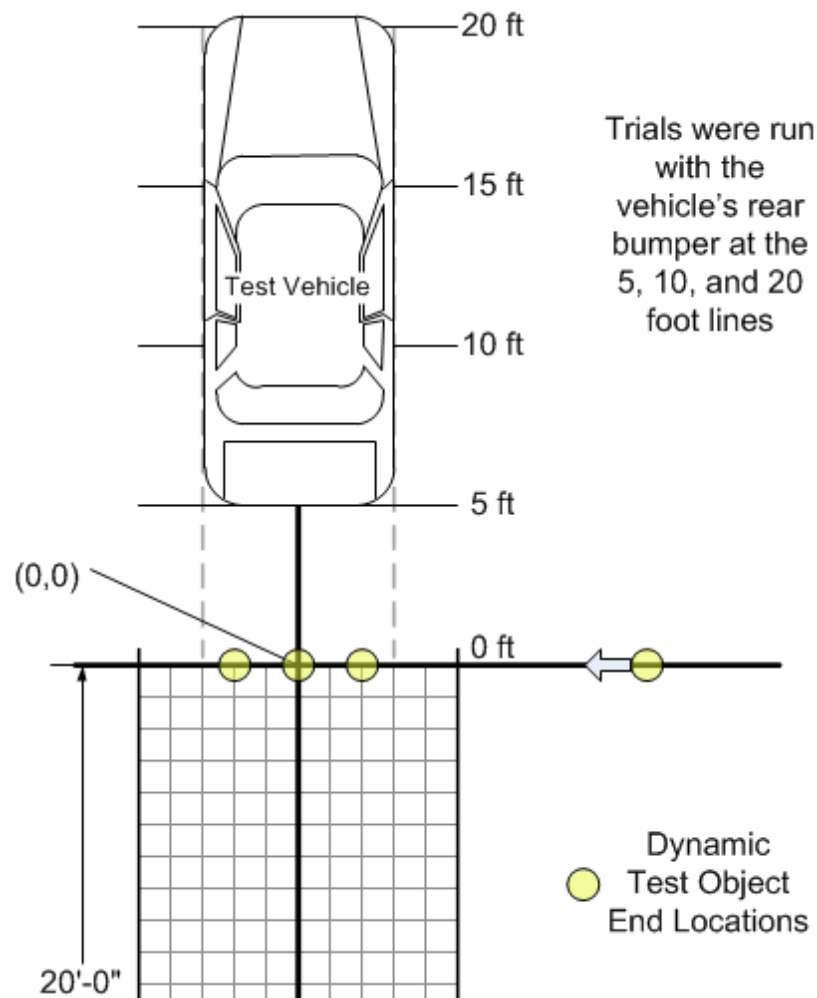
# Stationary Vehicle - Stationary Test Object

- Place test object over 10-ft wide area behind vehicle and rearward until observing 2 ft of no detections



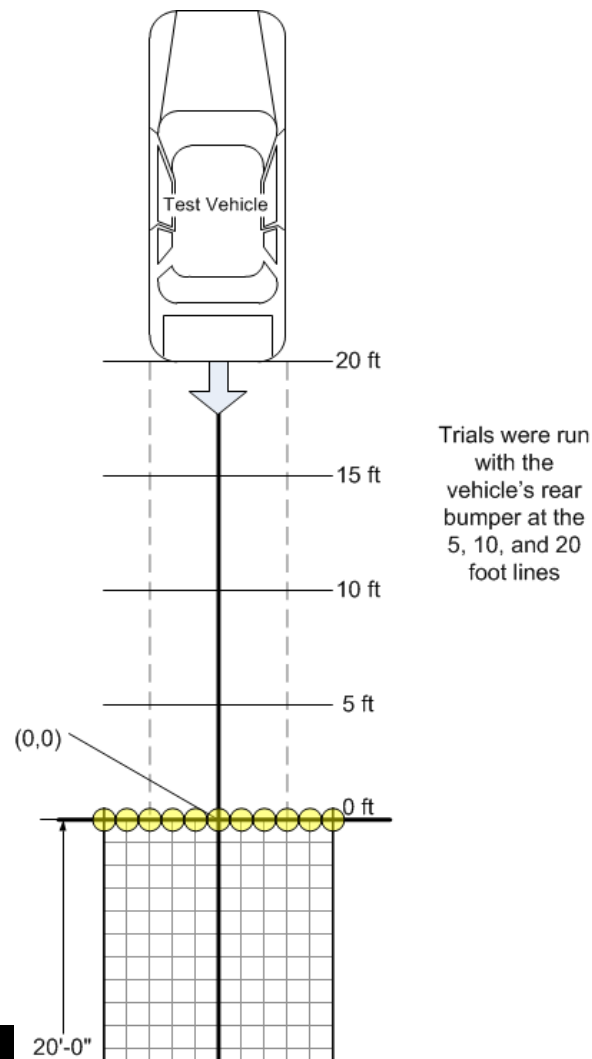
## Stationary Vehicle – Moving Test Object

- Vehicle positioned at 5 ft, 10 ft, or 20 ft from the test object
- Test object speeds 2, 3 mph
- Test object destinations  $(-2, 0)$ ,  $(0,0)$ ,  $(2,0)$



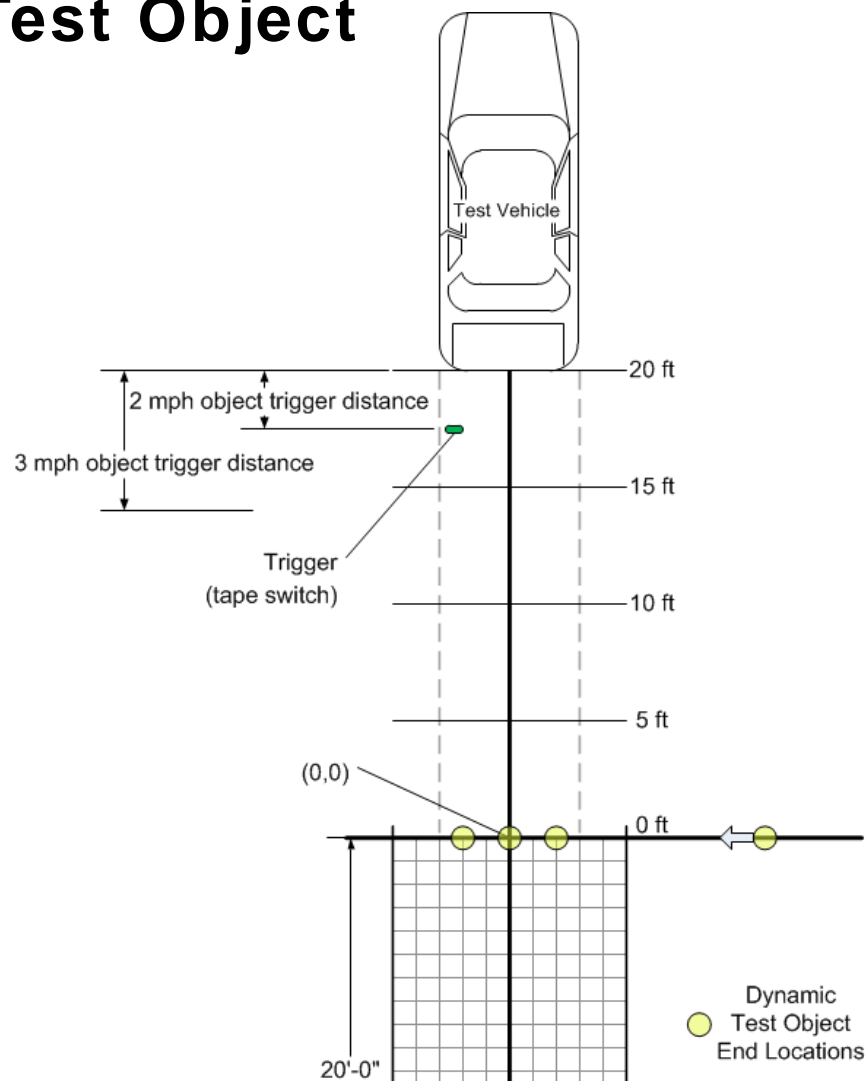
## Moving Vehicle – Stationary Test Object

- Vehicle starting position 5 ft, 10 ft, or 20 ft from the test object
- Test object locations(-5, 0) through (5,0)



## Moving Vehicle – Moving Test Object

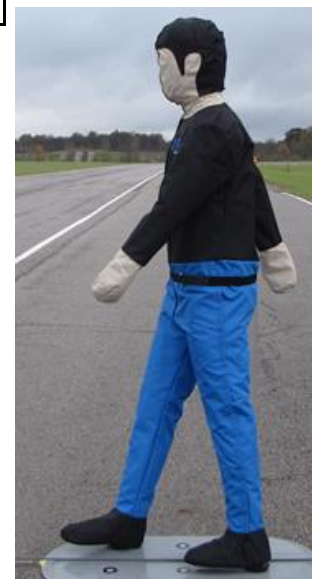
- Vehicle starting position 20 ft from the test object
- Test object speeds 2, 3 mph
- Test object destinations (-2, 0), (0,0), (2,0)
- Backing vehicle triggers test object motion
- Test object reaches destination location when vehicle reaches 0 ft (plane of test object motion)





# Test Objects

<b>Standard Test Object</b>	ISO 40-inch Pole
<b>Other</b>	Toy Convertible Ride-On Car (TC)
<b>Vehicle Surrogate</b>	NHTSA Strikable Surrogate Vehicle (SSV)
<b>Human Surrogates</b>	Toy Convertible with Small Child Clothing Mannequin (TC-SCCM)
	Small Child Clothing Mannequin (seated toddler) (SCCM)
	Posable Child Mannequin (PCM)
	Posable Child Mannequin "Short", 32-inch height (PCM 32")
<b>Human</b>	59 and 66-inch height adult females; 69 and 72-inch height adult males



## Data Collection

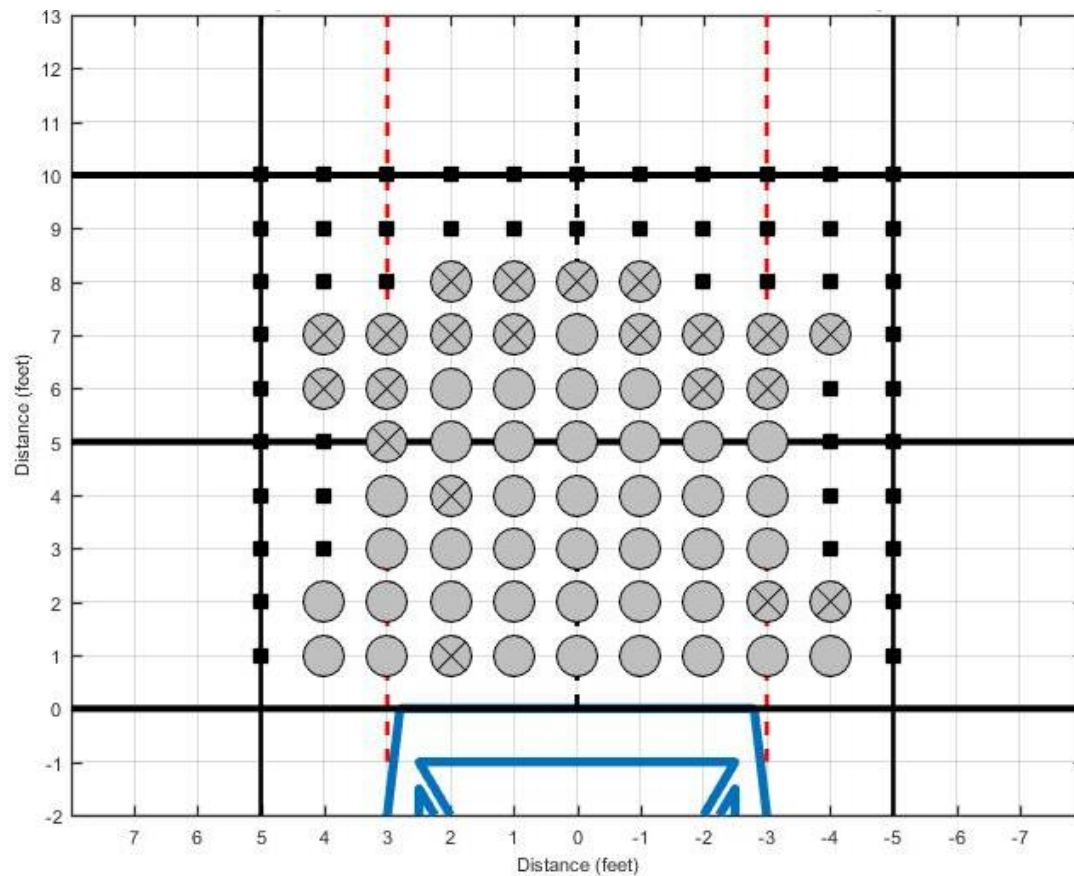
Instrumentation	Purpose/Data Recorded
Video cameras (4)	<ol style="list-style-type: none"><li>1. Rearview Image</li><li>2. Other visual warning location</li><li>3. Overhead view, from trunk-mounted camera</li><li>4. Overhead view, from high-mounted camera</li></ol>
Microphone	Document auditory obstacle detection warnings
PC	Record video and audio data
Accelerometer	Document decel produced by automatic braking
Laser pointers (2)	Front and rear pointing to aid driver in guiding vehicle along straight path during moving vehicle scenarios

# Performance Metrics Examined

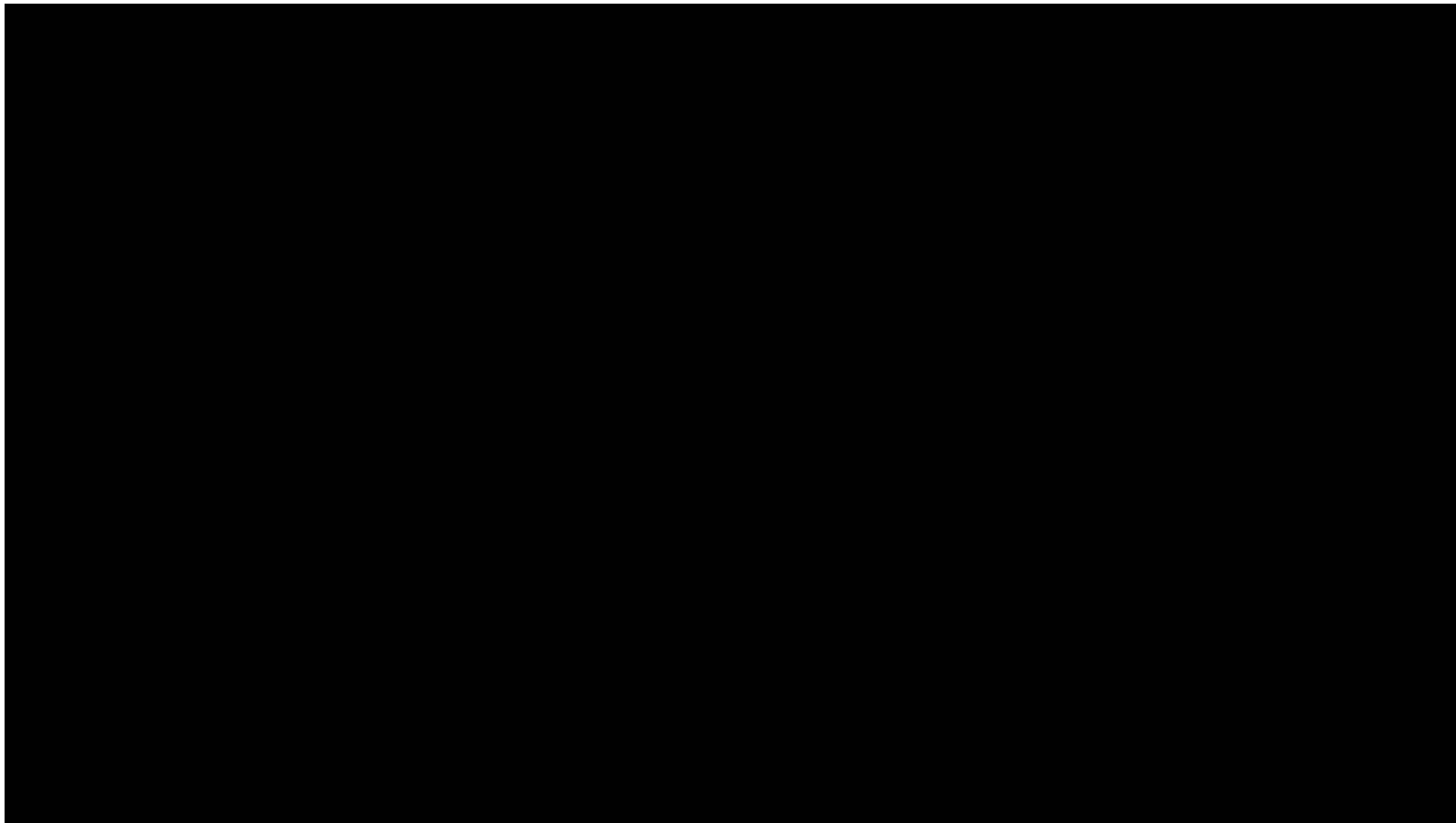
- Occurrence and timing of
  - Warning (any)
  - Warning, Auditory (onset)
  - Warning, Visual (onset)
  - Automatic Braking (onset)
  - Vehicle Stop
  - Crash?
- Average maximum deceleration (for x of n trials with automatic braking)

# Example Test Data: Stationary Vehicle, Static Test Object Outdoors

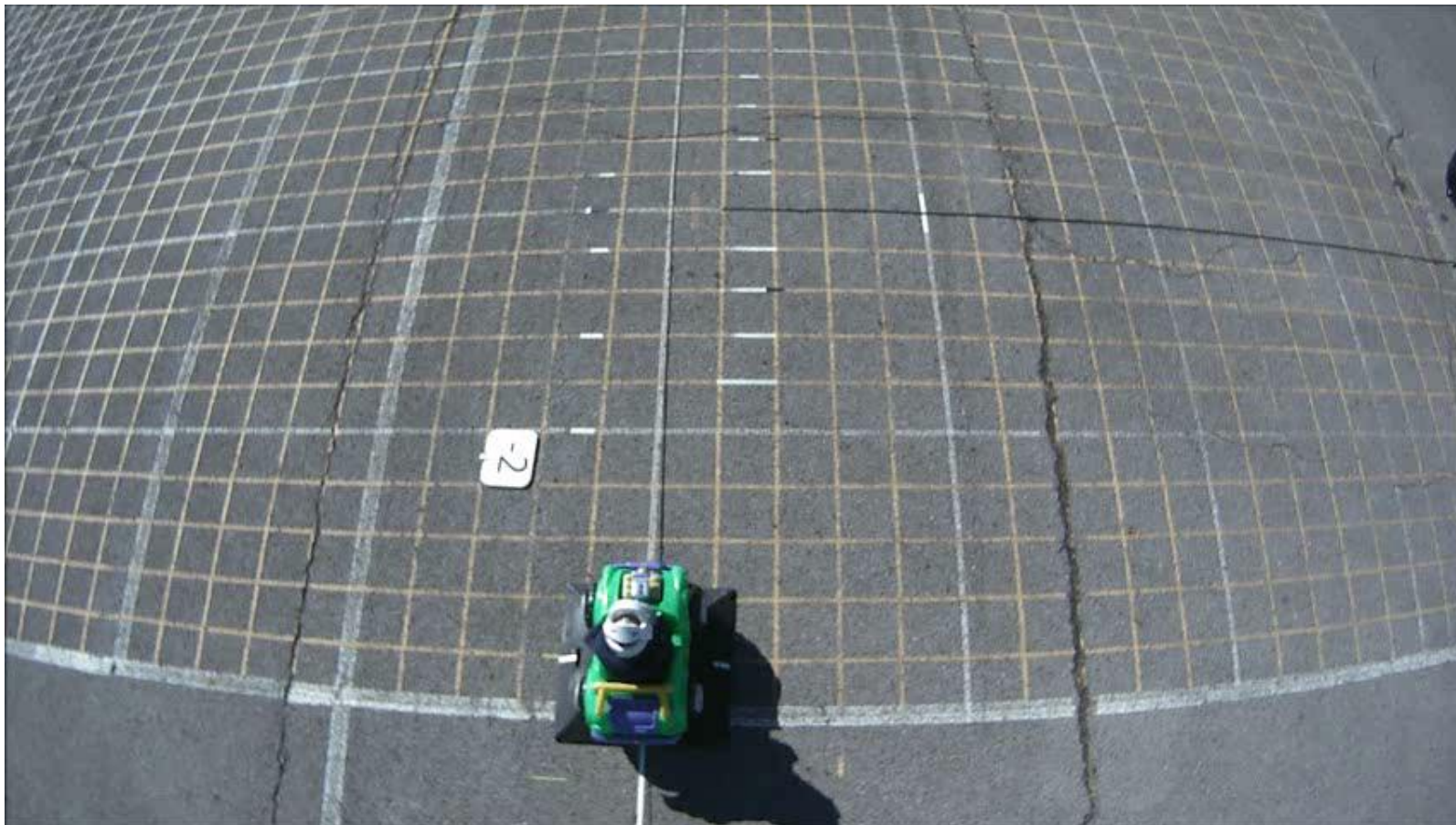
- Human male, 6 ft tall



# Example Test Data: Moving Vehicle, Stationary Test Object Outdoors



# Example Test Data: Moving Vehicle, Moving Test Object Outdoors



# Status

- All testing was completed in 2016
- Analyzing data to characterize system performance
- Preparing a NHTSA report
- Results will be used to inform future NHTSA efforts



**NHTSA**



**CONTACT:**  
**elizabeth.mazzae**  
**@dot.gov**