Indirect Visibility Safety Research for Heavy Vehicles

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Conducted by:

Center for Truck and Bus Research (CTBS)

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Sponsored by:
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National Highway Traffic Safety Administration
Our Mission: Save lives, prevent injuries, reduce vehicle-related crashes

Background

- Large trucks involved in over 28,000 lane change/merge crashes between April 2001 – December 2003 *(Starnes, 2006)*.
- Data from crash data base studies and naturalistic studies indicate lane change/merge crashes to be a big problem, particularly between light vehicles and heavy vehicles
- Camera/Video Imaging Systems (C/VISs) are becoming more prevalent on heavy vehicles

Indirect Visibility Safety Research

- Three research phases in this program
  1. Development of a Performance Specification for Indirect Visibility Systems on Heavy Trucks
  2. Enhanced Camera/Video Imaging Systems (E-C/VISs) for Heavy Trucks
  3. Field Demonstration of an Advanced Heavy Vehicle Indirect Visibility System

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Camera/Video Imaging Systems

- Enhancements & Surrogates
- Daytime
- Highway and Backing Tasks
- Investigated 9 Configurations

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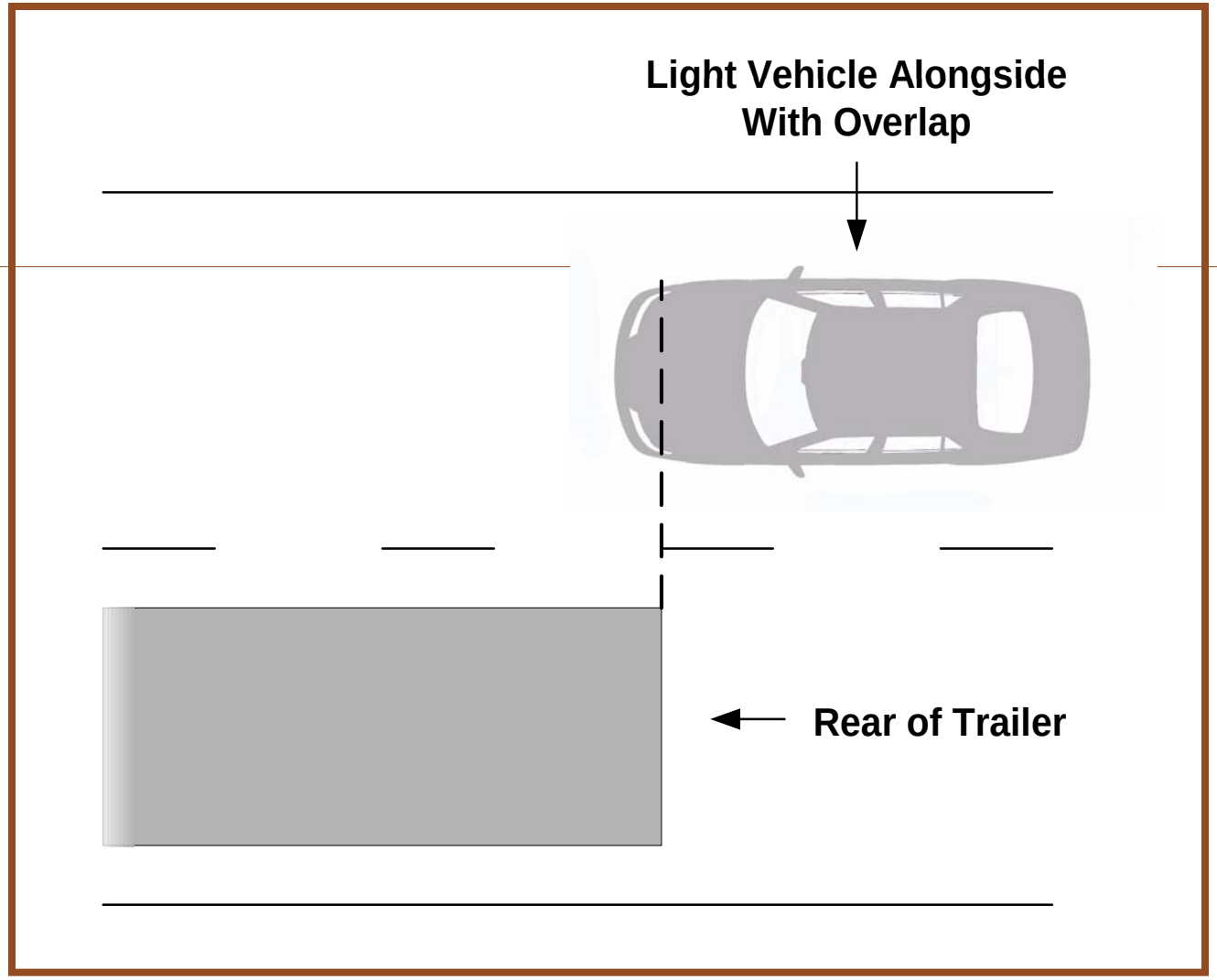
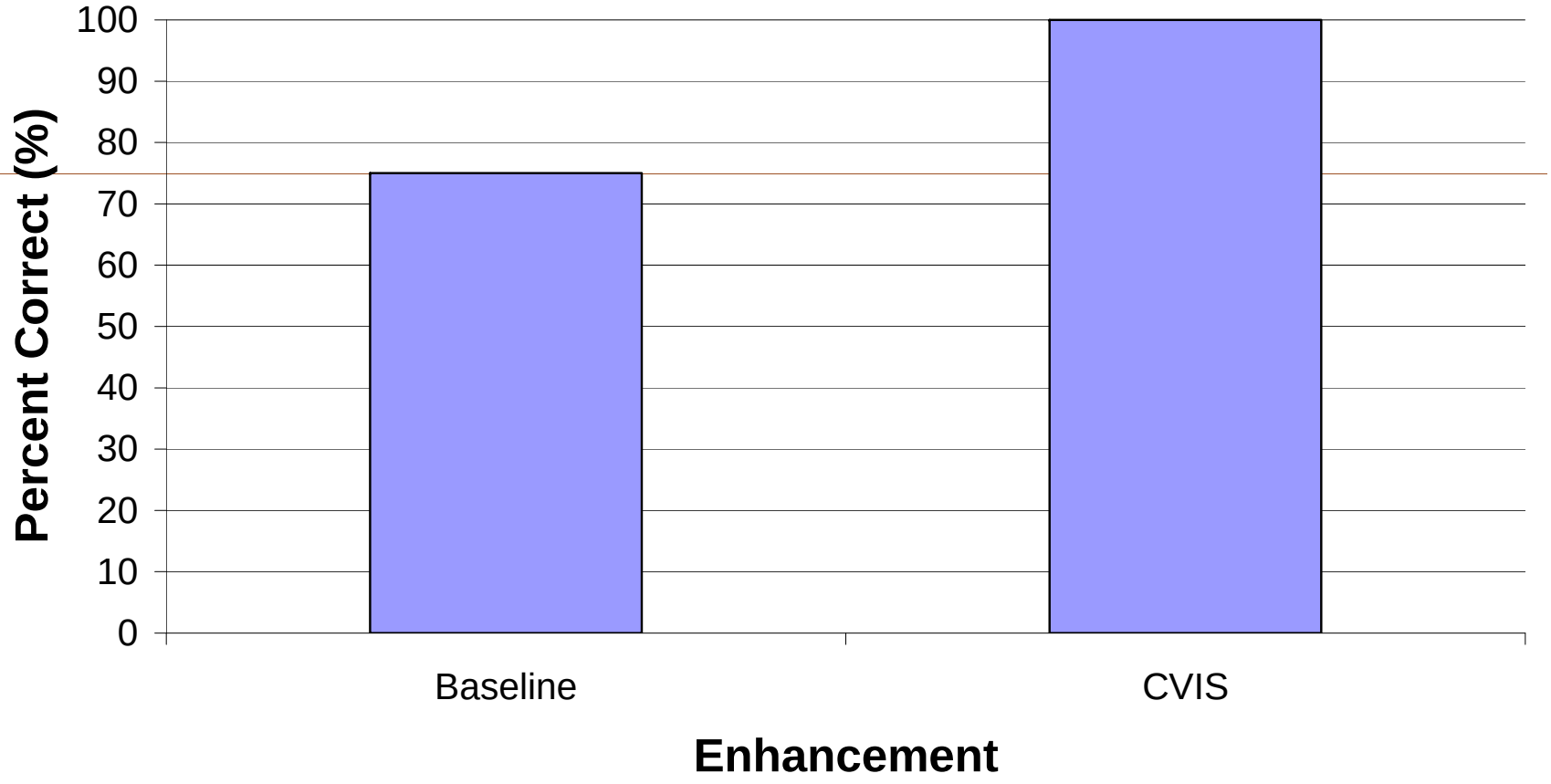
Highway Task



Clearance/Overlap Task

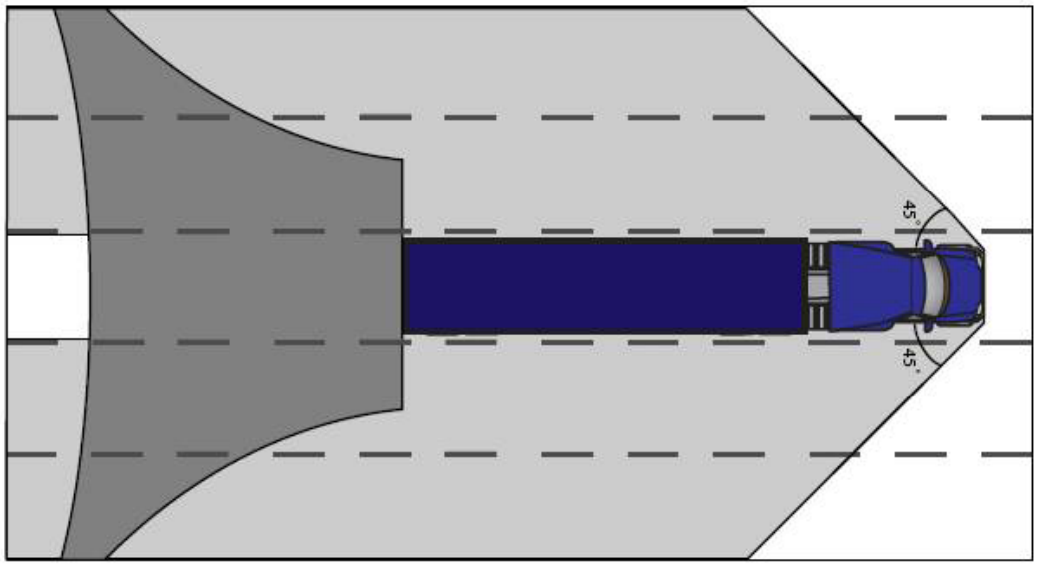


Summary

- Great promise for the enhancements tested and show that surrogates are by-and-large capable of competing with mirrors
- Enhancements generally provided improvements
- Convex C/VISs can be recommended without hesitation because they are capable of producing results similar to actual convex mirrors
- Systems were well-accepted and received high ratings

Enhanced Camera/Video Imaging Systems

- Objective: Better visibility and better situation awareness for heavy vehicle drivers, along sides and to the rear, using Enhanced Camera/Video Imaging systems. Emphasis on nighttime and inclement weather.



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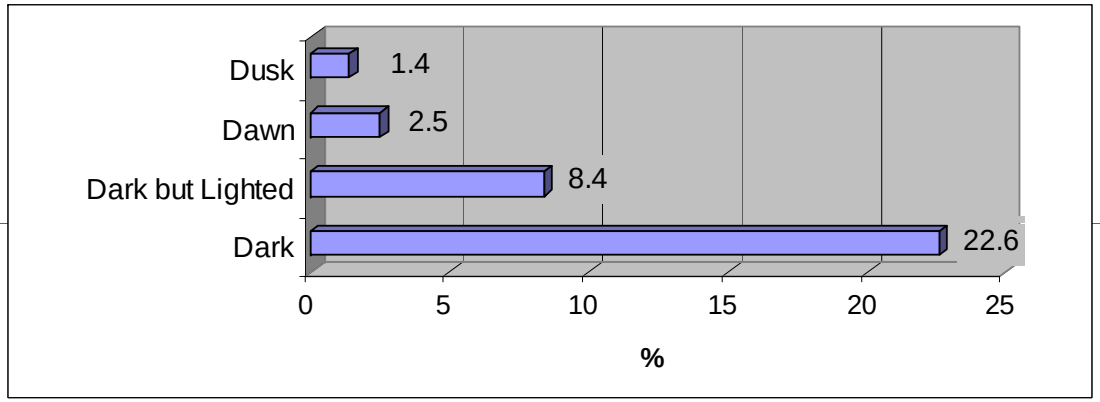
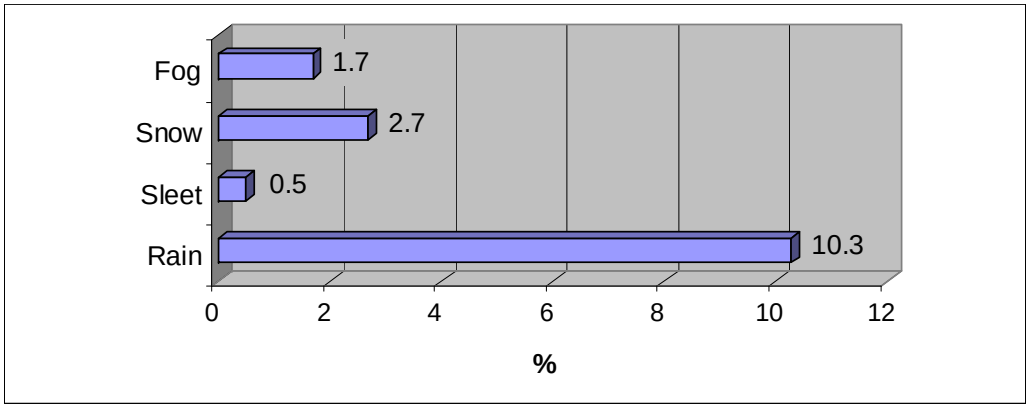
Nighttime and Inclement Weather?

- Nearly 35% during low ambient light conditions



- 15.2% during inclement weather



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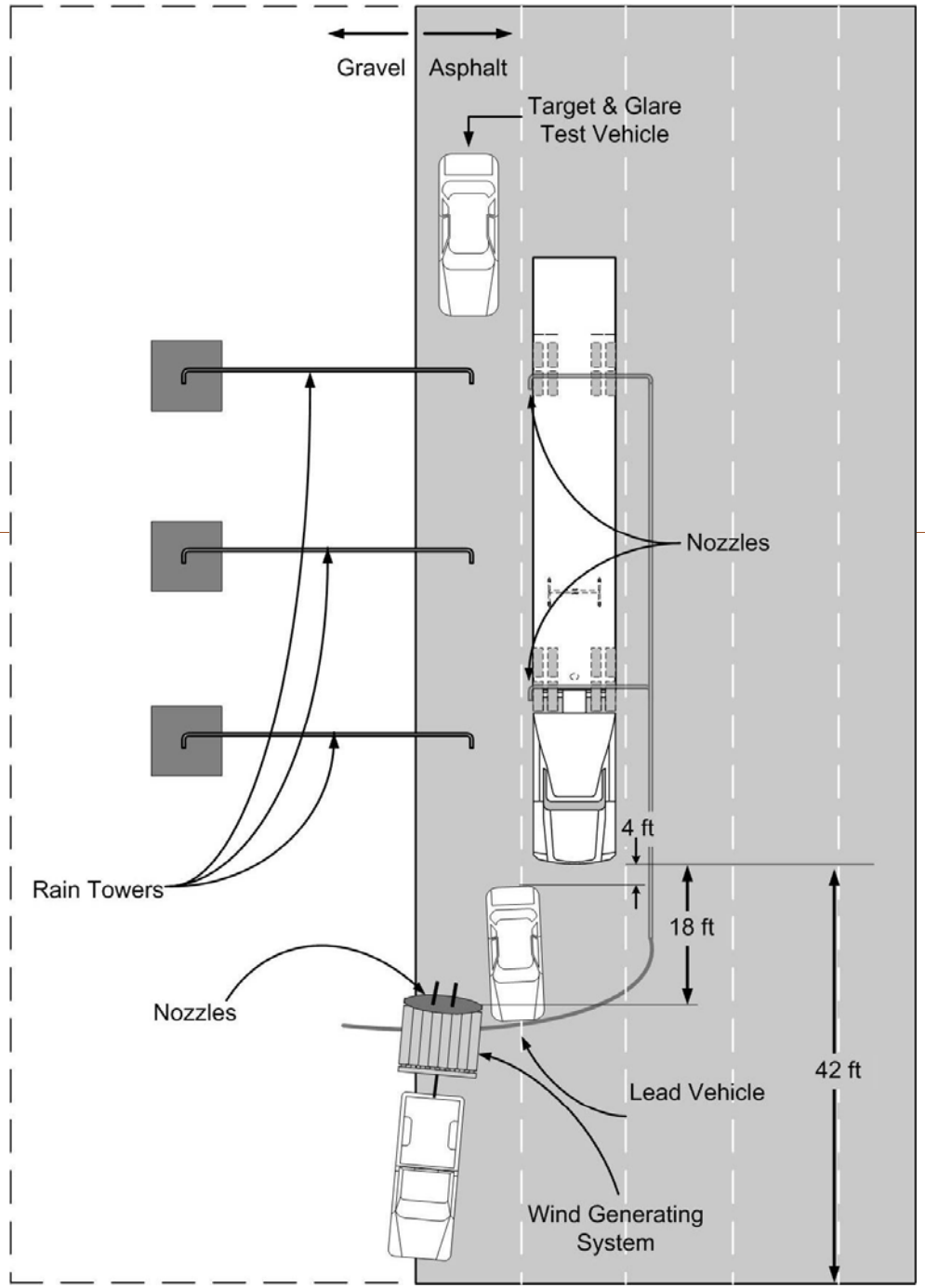
Static Testing



Outdoor Facility Video

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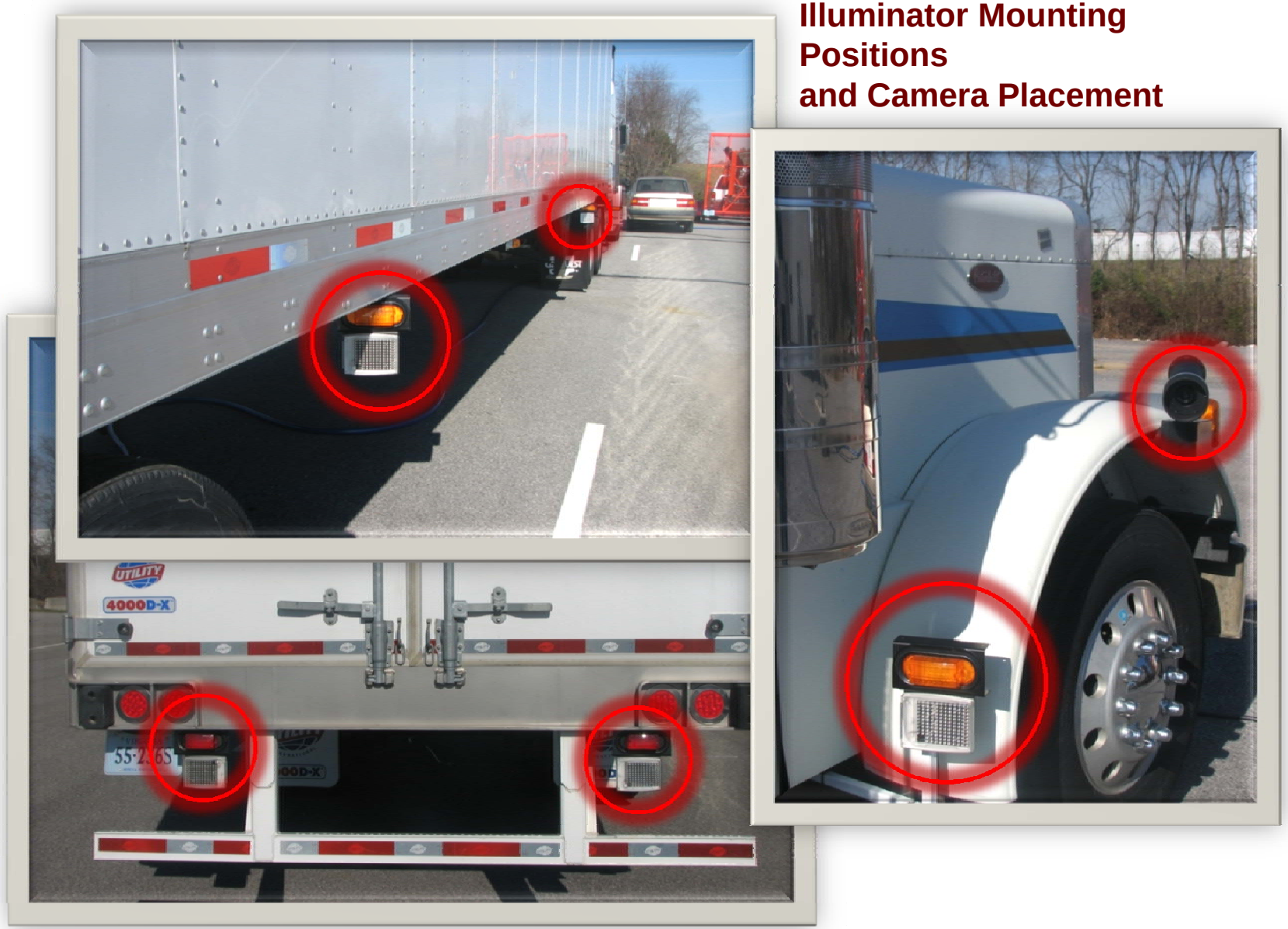
Static Tests

Illuminator Mounting Positions and Camera Placement



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Dynamic Testing

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Summary

- A three-channel E-C/VIS is feasible.
- Rear camera should be a wide-angle multipurpose look-down camera.
- System operates from total darkness (B/W) to bright daylight (color).
- IR illuminators work well at night for dark objects, 940nm.
- Cameras must be capable of switching from B/W to color, must be sensitive to near IR.
- Image processing producing outlines of objects is helpful.
- All performance, eye glance, and ratings data appear promising

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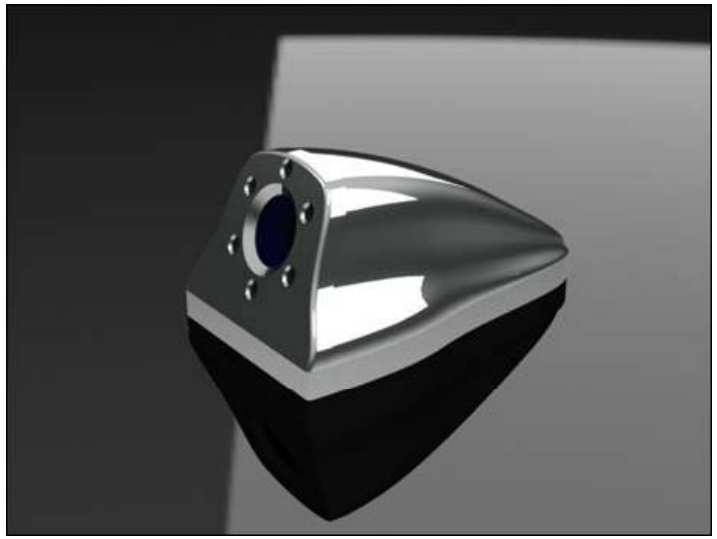
Field Demonstration of an Advanced Camera/Video Imaging System

Assess safety and driver performance benefits of enhancing the west coast style mirrors with an Advanced Camera/Video Imaging System (A-C/VIS) in a real-world, revenue producing, driving environment



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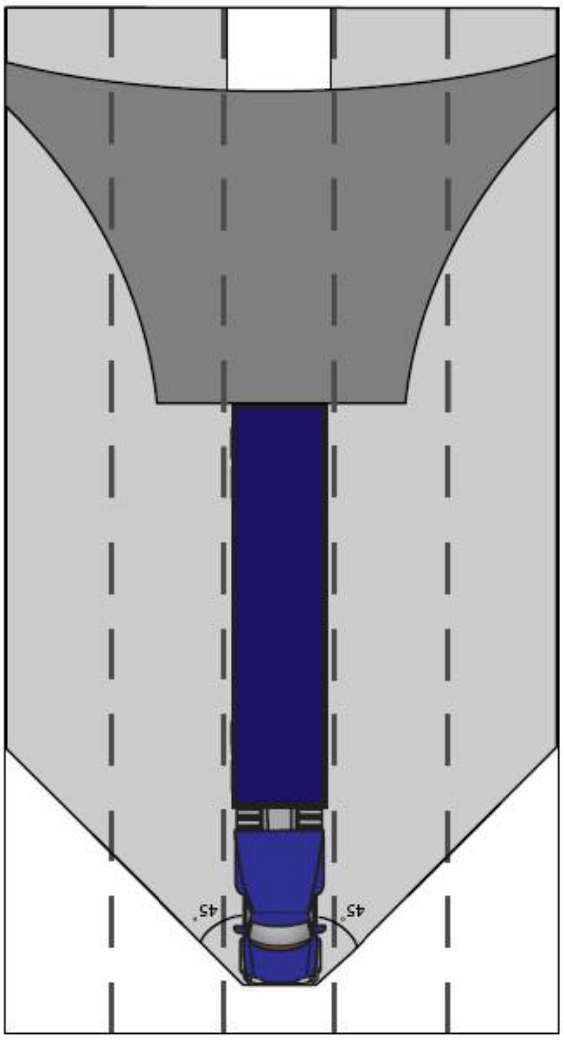

Project Goals

- Identify and evaluate a commercially available system and compare with baseline
- Develop and evaluate an A-C/VIS and compare to baseline
  - Approximate the performance specs developed in previous phases
  - Smaller, weatherproof camera assemblies with anti-bloom technology
  - In-line machine vision processing modules
  - IR illumination from tractor and trailer
  - DVI for control of display brightness and processing level
- Showcase the technology in a field demo

Method Highlights

- Independent Variables
  - System Type: Commercial System, A-C/VIS
  - Condition: Displays Off - Baseline (4 wks), Displays On (12 wks)
- Study Implementation
  - 6 vehicle (3 per system type): Married tractor and trailer
  - 12 CDL-A drivers (6 per system type)
  - Daily out-and-back drivers

Reduce and Analyze Data

- Identify the number of safety critical events (SCE)
  - Sample eye glance
- Characterize LCs performed w/wo systems
  - Identify 1000 lane changes (500 w, 500 wo)
  - Single Vehicle Lane Change Behavior
    - Duration, direction, type, turn signal use
  - Other Vehicle Behavior
    - Distance, approach rate, location, type
  - Environmental Variables
  - Sample eye glance
- Driver Ratings

Timeline

- 30 months
- Started in August, 2008

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Thank You!!
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