National Highway Traffic Safety Administration

Pedestrian Test Mannequins Objective Criteria for Evaluating Repeatability and Accuracy of PCAM Systems

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Abstract

Pedestrian test targets are very important for the repeatability and accuracy of PCAM system evaluations. Pedestrian size, radar cross section, robustness, static/dynamic animation, and dynamic articulation are a few of the key elements that can affect the results of PCAM performance. This presentation will discuss research about these factors and how they are being evaluated to determine objective criteria on pedestrian test mannequins.

Pedestrian Test Targets

Research is focused on evaluating a number of different pedestrian test targets that are being used to conduct PCAM testing. This includes static posable pedestrian test targets and articulated pedestrian test targets.

Pedestrian Test Target Sizes

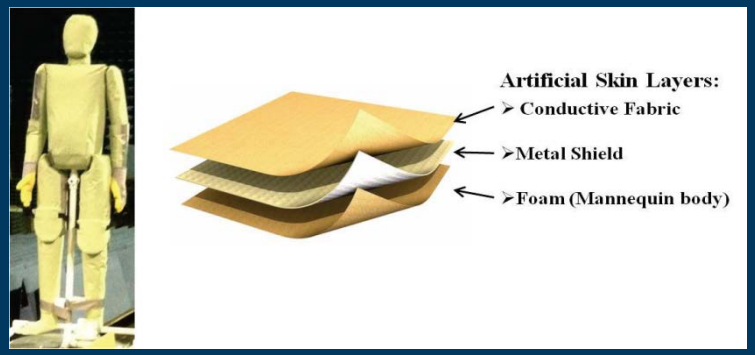
- Research is evaluating how PCAM system technology responds to different pedestrian sizes in different situations.
- Adult pedestrian test target size represents a 50% male.
- Child pedestrian test targets size represents a 6 year old child.

Pedestrian Test Target Radar Reflective Characteristics

- Research is being conducted on pedestrian test targets that have characteristics which are similar to real humans.
- Theses pedestrian test targets were developed to have radar cross section values that are realistic from different angles.

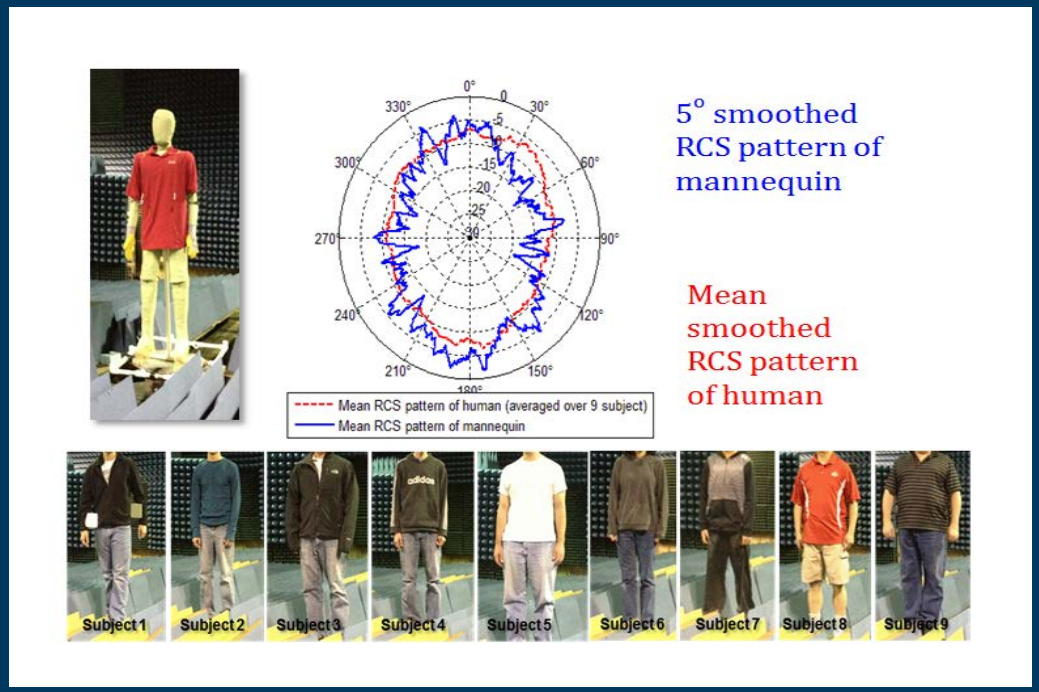
Radar Reflective Characteristics

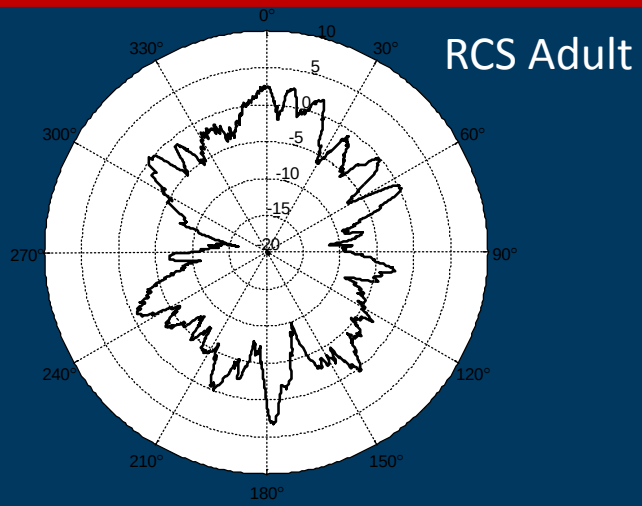
- The pedestrian test targets shown on the right were developed by the Transportation Active Safety Institute (TASI).
- Theses test targets have an artificial skin that covers the whole body.
- This artificial body skin has electrical characteristics similar to human skin when scanned by an automotive radar at 77 GHz.

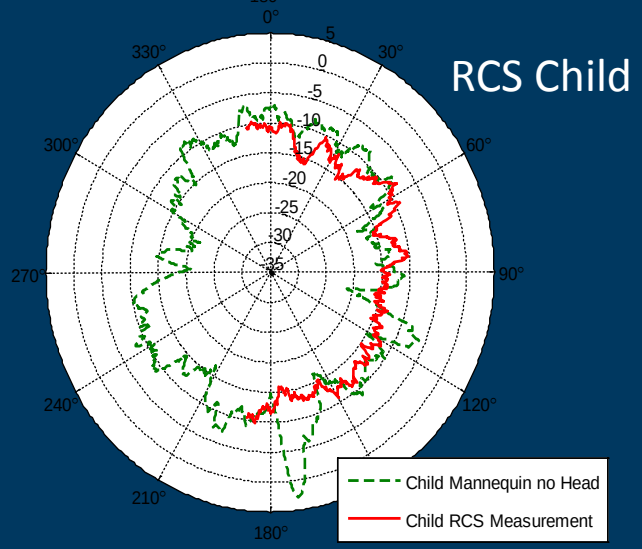


TASI Adult and Child RCS Measurements

- RCS differences between same size humans and adult mannequin is about 5 db.







Radar Reflective Characteristics

- The pedestrian test targets shown on the right were developed by 4a Engineering.
- These test targets were developed for testing vehicles equipped with advanced pedestrian avoidance technologies.
- The mannequins are tuned for RADAR, IR, and optical features.

Radar Reflective Characteristics

- The pedestrian test target shown on the right is a low cost articulated mannequin developed in house for our testing needs and as a research tool.
- Scans of this pedestrian test target have not been conducted. Electrical characteristics are currently unknown.
- Evaluations using this test target are focused on the durability of electrical and mechanical components.

Pedestrian Test Target Animation

- Static Posable Pedestrian
  - Pedestrian test targets that have adjustable leg and arm spacing.
  - Arms and legs do not move during forward motion.
- Articulated Pedestrian
  - Mimic dynamic arm and leg movements like real humans.
  - Test track evaluations are being conducted using pedestrian test targets that generate different levels of leg and arm motions.

Static Posable Pedestrian Test Targets

- Arms and legs are posed and hold position while the pedestrian test target is moved across the test surface.
- Mannequins are posed to have a defined leg spread.
- Arms are angled.

Leg Motion

Adult and child pedestrian test targets shown on the right are configured to generate leg motion only. Arms are posable and will hold position while target is moved across the test surface.

- Posable Shoulders
- Fixed elbows
- Motor driven hips
- Passive knees

Arm and Leg motion (Example 1)

Adult and child pedestrian test targets shown on the right are configured to generate arm and leg motion.

- Motor driven shoulders
- Passive Elbows
- Motor driven Hips
- Motor driven knees (Adult only)

Arm and Leg Motion (Example 2)

The adult pedestrian test target shown on the right is configured to generate arm and leg motion.

- Motor driven shoulders
- Fixed Elbows
- Motor driven hips
- Fixed knees

Feedback on Mannequin Performance

- Mannequin support poles are visible to the sensing technologies, but don't appear to cause problems with detection. Steps should be taken to minimize the visibility of the poles.
- Mannequin stability is important. Steps should be taken to reduce mannequin swing forward and backwards.
- Distance between mannequin feet and the ground should be minimized. Filling the gap is not recommended.
- Leg articulation should not be to large or over-exaggerated.
- V-shaped pose helps recognition.
- Doppler spread of the 4a Engineering and TASI mannequins are comparable to real human. In house developed mannequin had low Doppler spread.

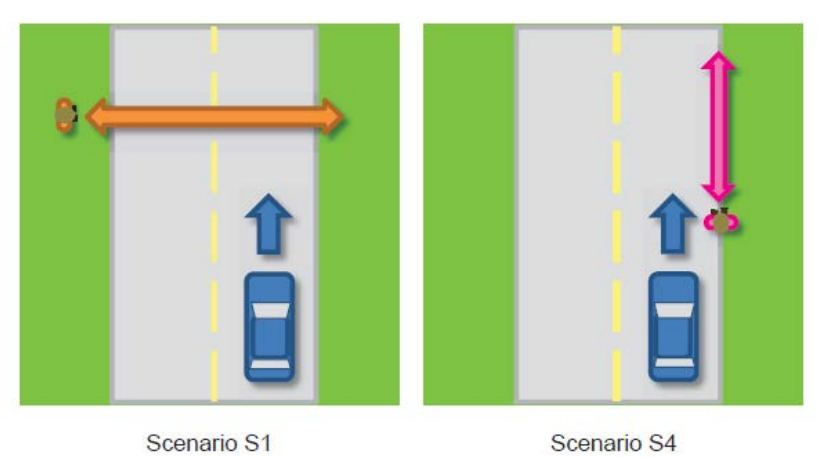
Robustness

Mannequin durability is an important factor for testing accuracy and repeatability.

- Evaluations of mechanical and electrical components are being conducted to determine the survivability of the different pedestrian test targets.
- Some vehicle damage has occurred from the pedestrian target support pole impacting the vehicle's windshield.

PCAM Test Scenarios

Test track evaluations using these mannequins are being conducted in which the pedestrian test targets crosses into the vehicle's path or is moving parallel to the vehicles path.



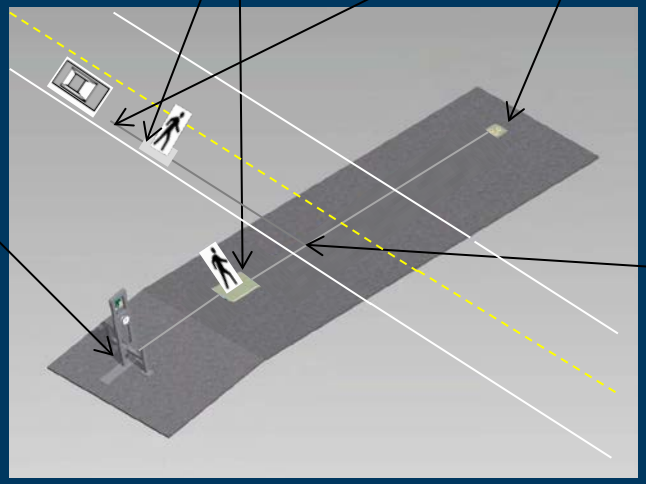
Test Equipment

Puller

Sled

Return Pulley
(S1/S4 Scenario)

Control Panel



90 Degree Pulley
(S4 Scenario only)

S1 Scenario

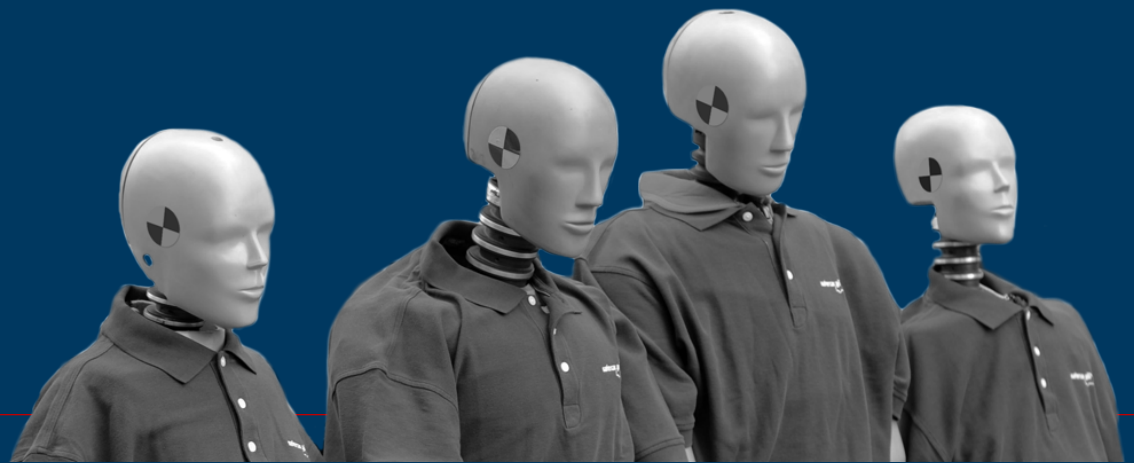
S4 Scenario

Conclusions

In Summary:

- Test methods and equipment should be adaptable to different pedestrian test mannequins.
- Radar cross section of pedestrian test targets should be comparable to real humans.
- Test target durability is important for accuracy and repeatability. Adjustments to the test target from vehicle impacts could potentially change the RCS and or motion of the arms and legs.
- Mannequin presentation should be as realistic as possible. Mannequin stability, feet elevation from ground, and articulation are all important factors.

QUESTIONS



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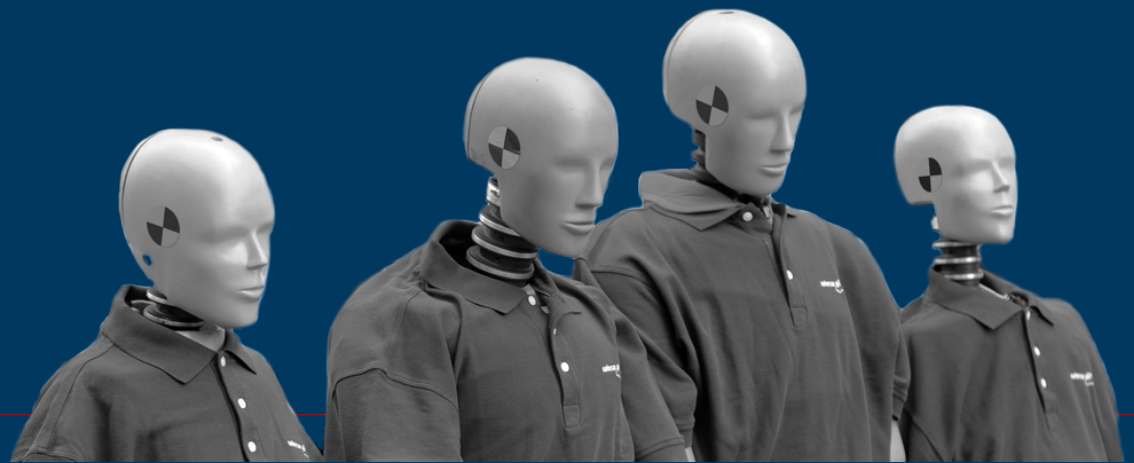
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