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Development of Safety Testing for Automated Driving Systems (ADS) Equipped Vehicles

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SIP-agus Workshop 2019

Safety Assurance

Autonomy*: a cinematic exploration of the history and state of automated driving technology*

Documentary Release November 15, 2019

Dr. Sadayuki Tsugawa

In 1977, under Japan's Ministry of International Trade and Industry (MITI), Tsugawa-san and his team of researchers turned a black Toyota sedan into what is now credited as the "world's first autonomous car."

ADS Technology “Deployments”

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Technically, most companies/organizations are just testing, but this testing involves more than engineers monitoring ADS performance and tracking disengagements:

Examples of on-road automated Testing Locations:

- Canada
- United States
- United Kingdom
- Netherlands
- France
- Finland
- Switzerland
- Germany
- Israel
- Russia
- China
- Japan
- Singapore
- Australia
- New Zealand

Development of Safety Testing for ADSs

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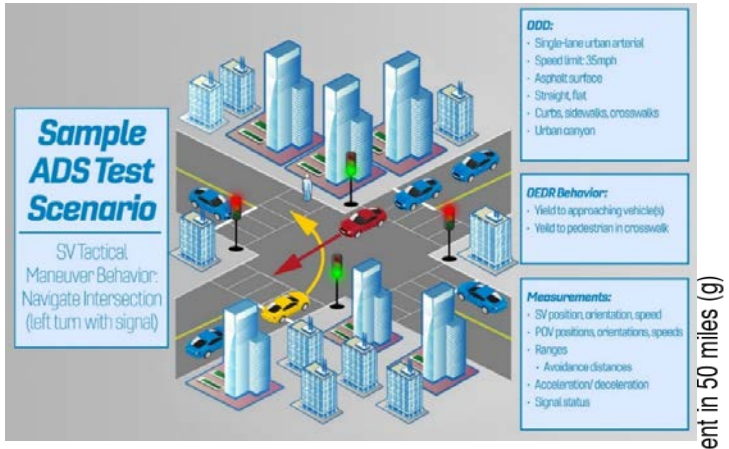
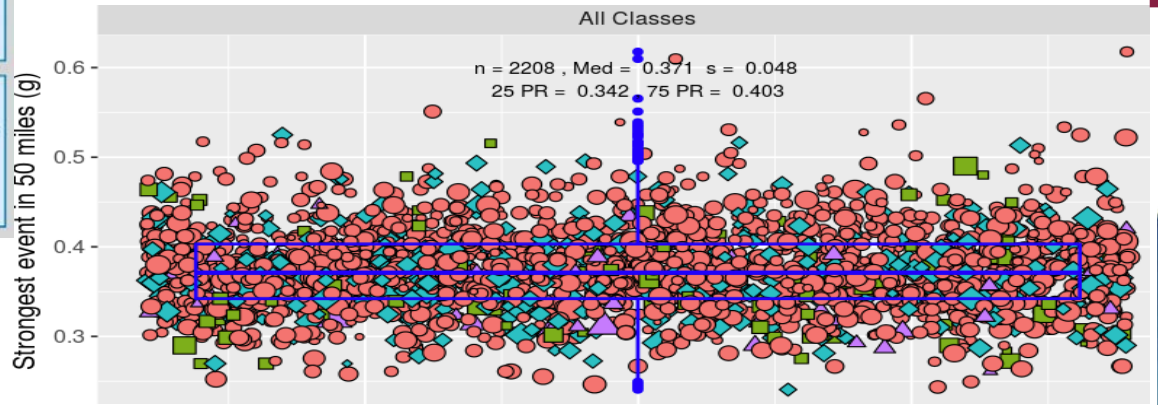
The development of safety testing for ADSs is needed and will not happen overnight

…establishing a thoughtful methodology that allows testing to evolve with the technology will be critical to addressing the complexity of ADSs safety testing.

Testing Framework



Data and Analysis for Framework Implementation



Real-world Deployment Considerations

Development of Safety Testing for ADSs: Testing Framework

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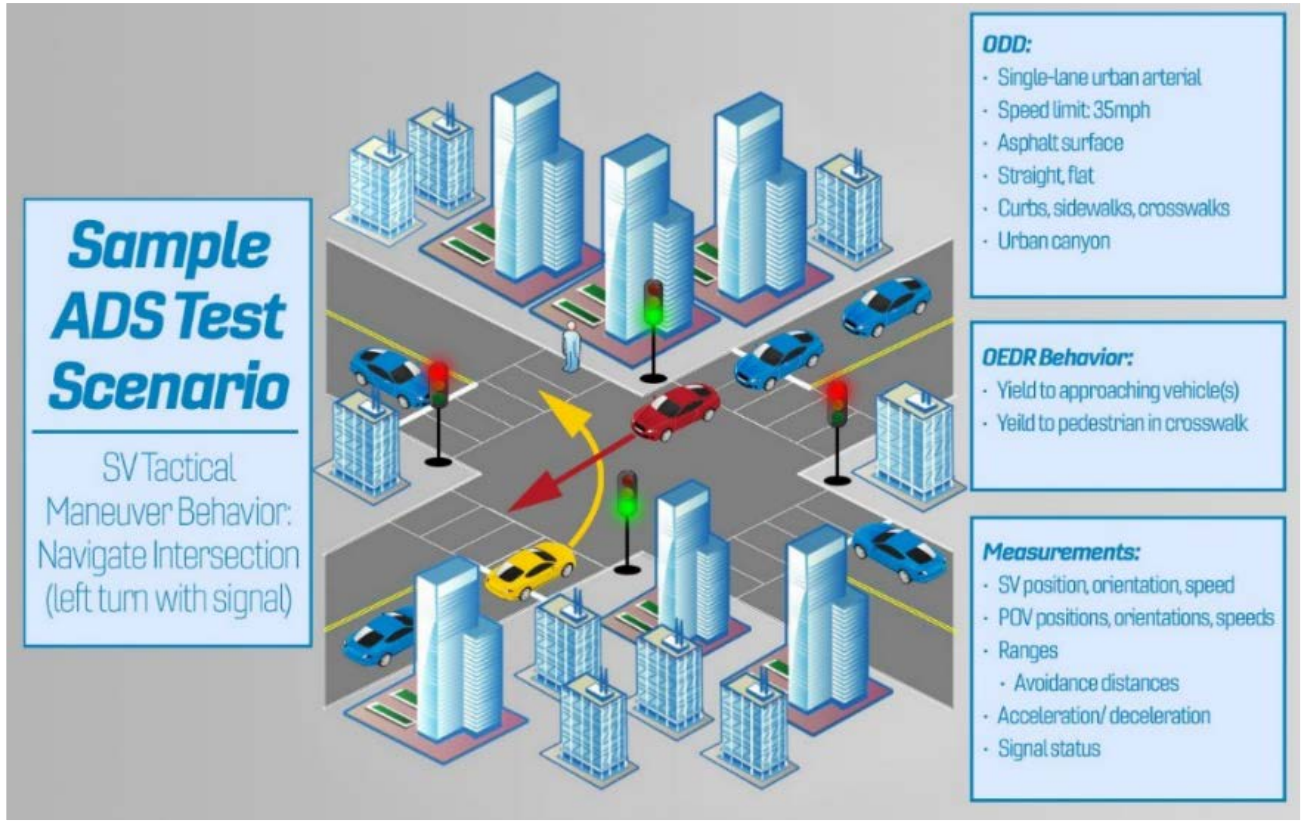
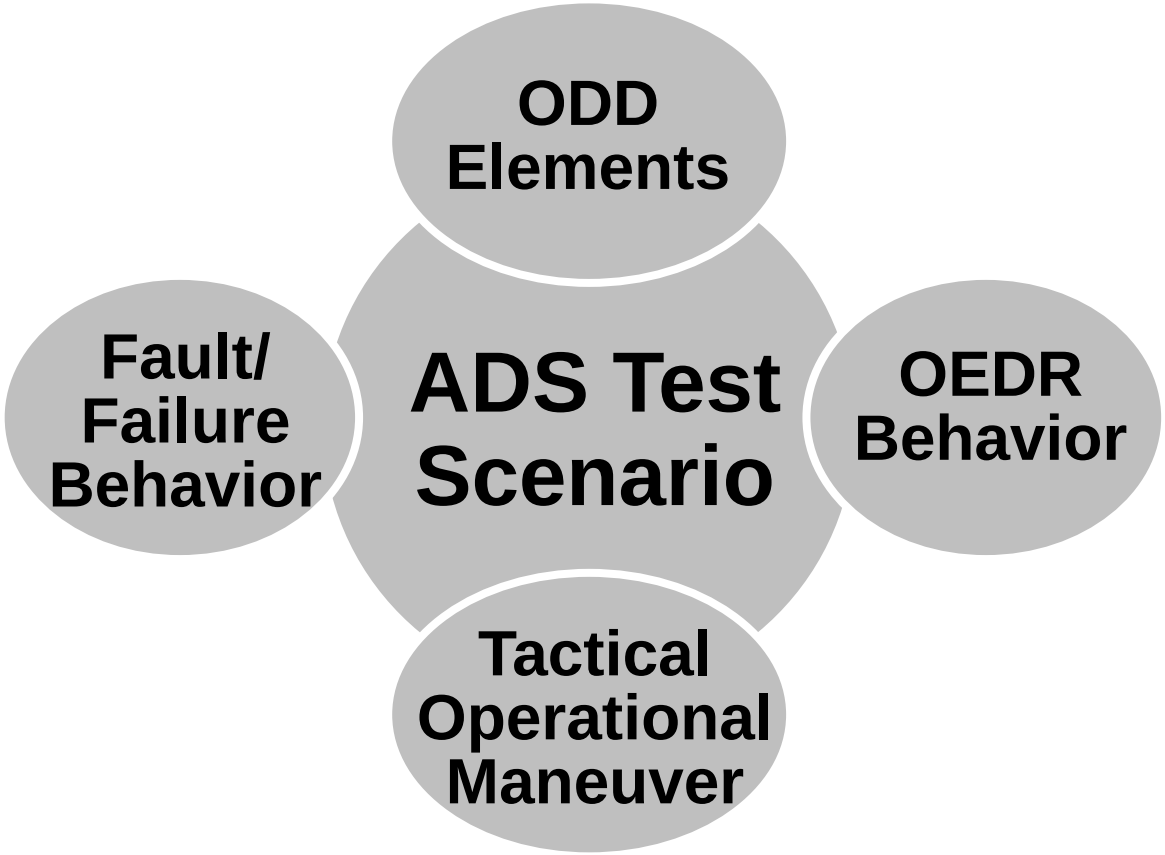
NHTSA's Testable Cases and Scenarios for Automated Driving Systems created a framework for describing an ADS test scenario; however, more research is needed to identify testable cases and associated test architecture.





Reference:
Thorn, E., Kimmel, S., and Chaka, M. (2018, September). A framework for automated driving system testable cases and scenarios (Report No. DOT HS 812 623). Washington, DC: National Highway Traffic Safety Administration. URL: https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13882-automateddrivingsystems_092618_v1a_tag.pdf

Development of Safety Testing for ADSs: Data and Analysis for Framework Implementation

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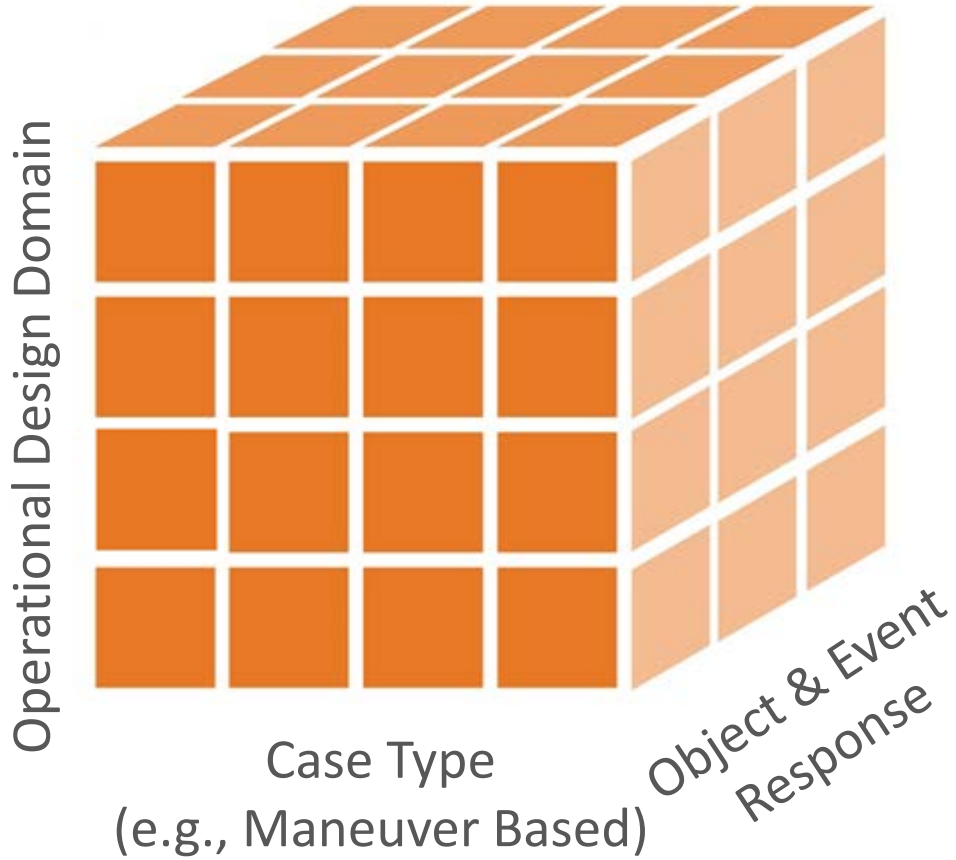
Safety testing (specifically identifying test cases) starts with the data and knowledge we have today.



AMP

Automated Mobility Partnership

An industry partnership promoting the development of tools, techniques, and data resources to support the rapid advancement of automated-vehicle deployment for its members.

Development of Safety Testing for ADSs: Real-world Cases, Analytics and Tools

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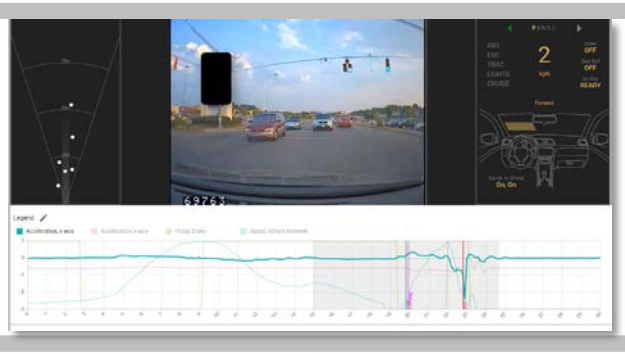
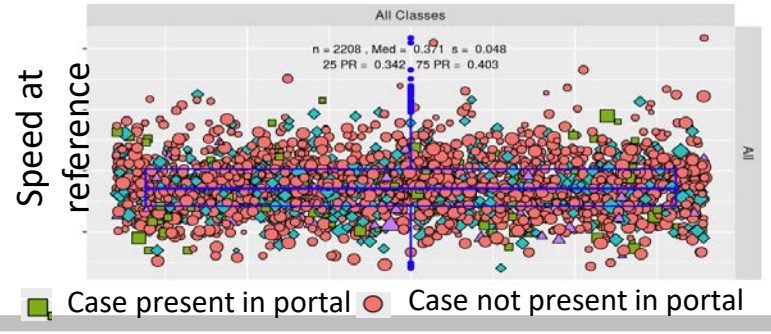
VTTI's AMP Program is working to support the rapid advancement of ADS deployment.



Library of Cases



Interactive Analysis

Tool for the Development and Evaluation of ADSs

Case Reconstruction

AMP Library: Case Browser

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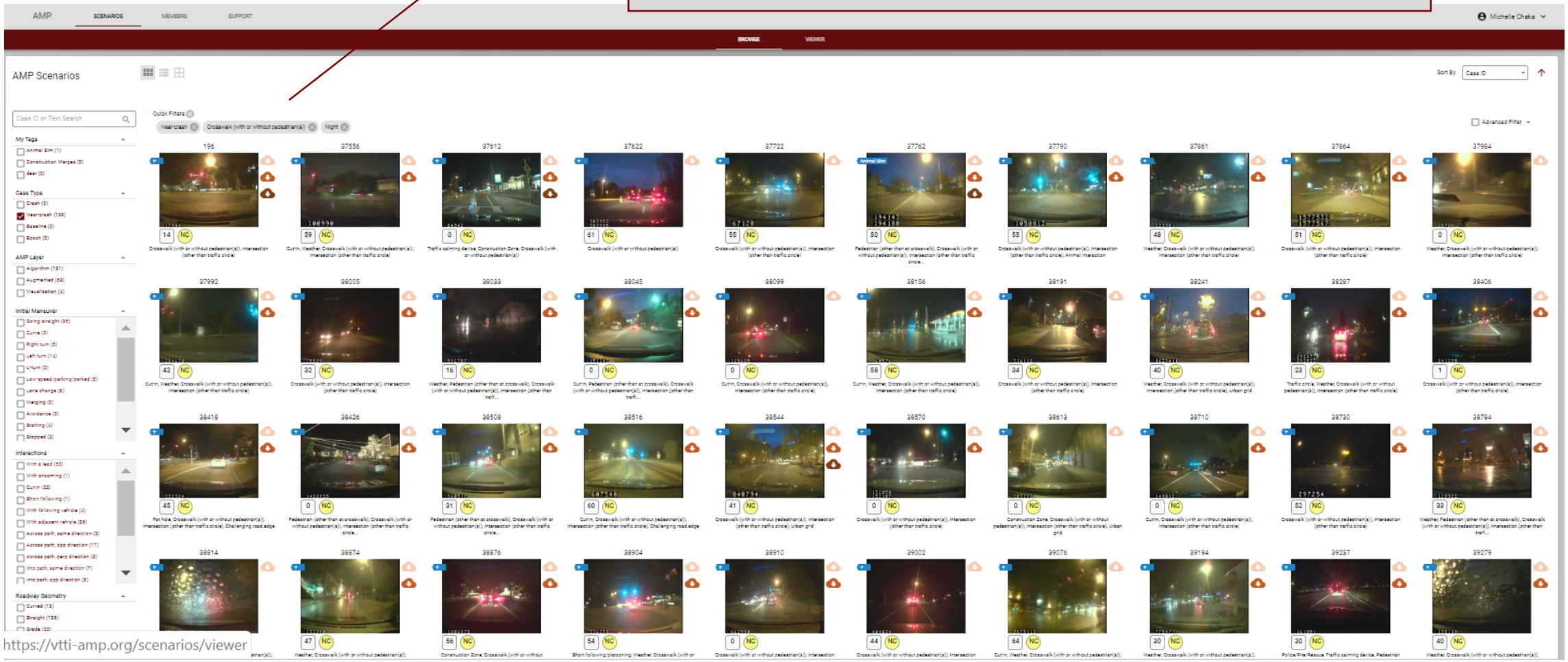
Near-crashes, Night, Crosswalk



AMP Library: Case Viewer

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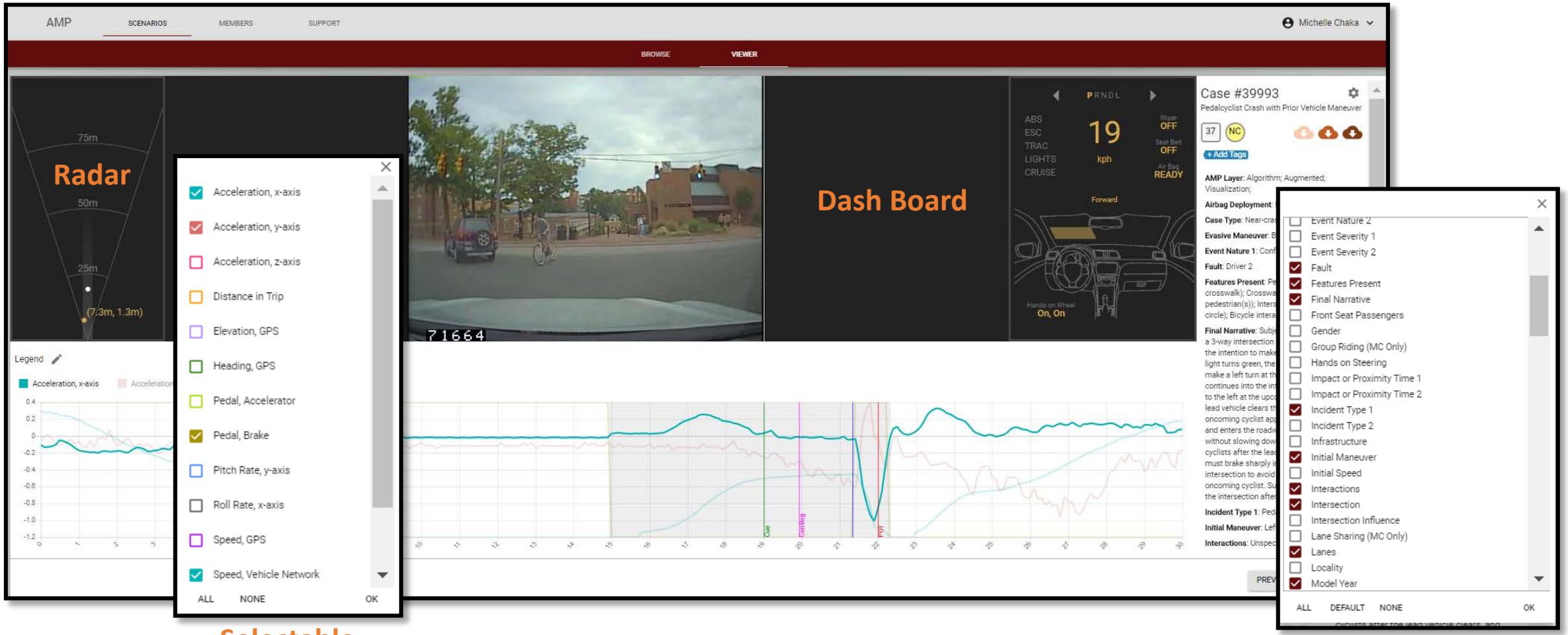

Selectable Variables

Selectable Annotation Elements

Interactive Analytics

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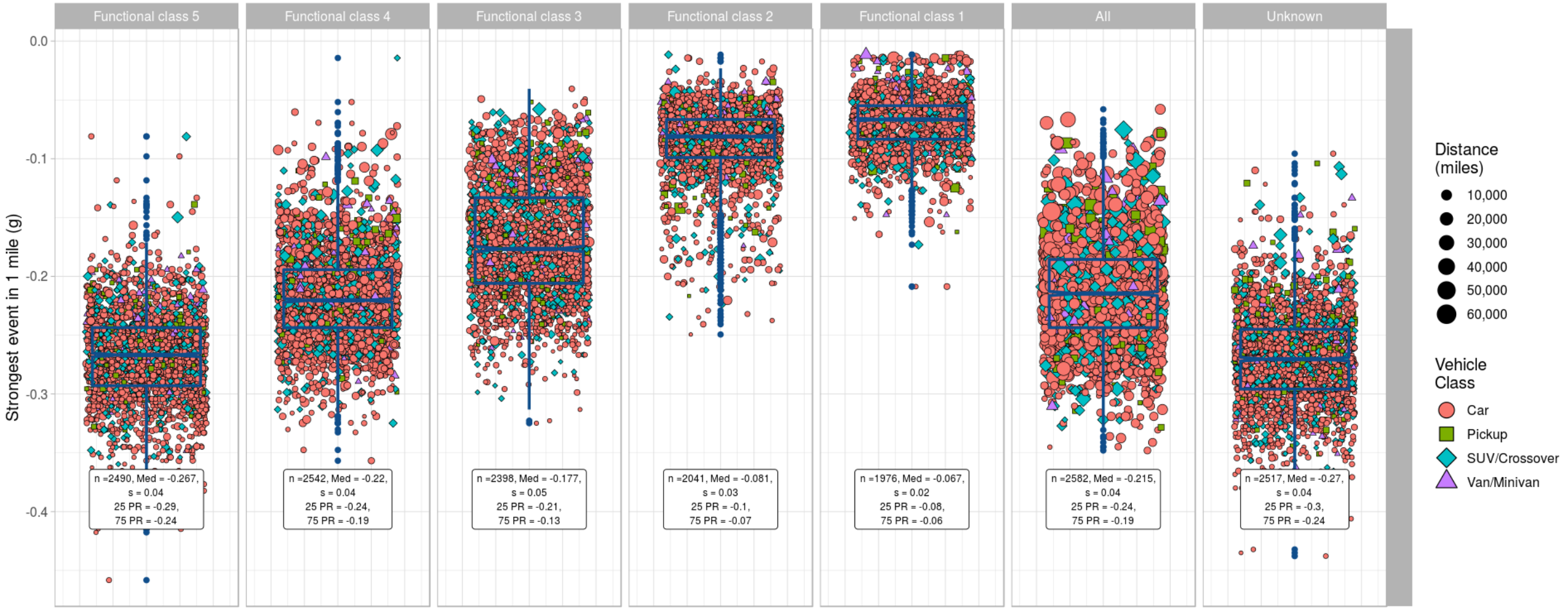
Strongest Event in 1 Mile (g)



AMP

AMP Near Crash Left Turn Across Path From Opposite Directions Example Case

AMP Near Crash Left Turn Across Path From Opposite Directions Example Case

Development of Safety Testing for ADSs: Data and Analysis for Framework Implementation

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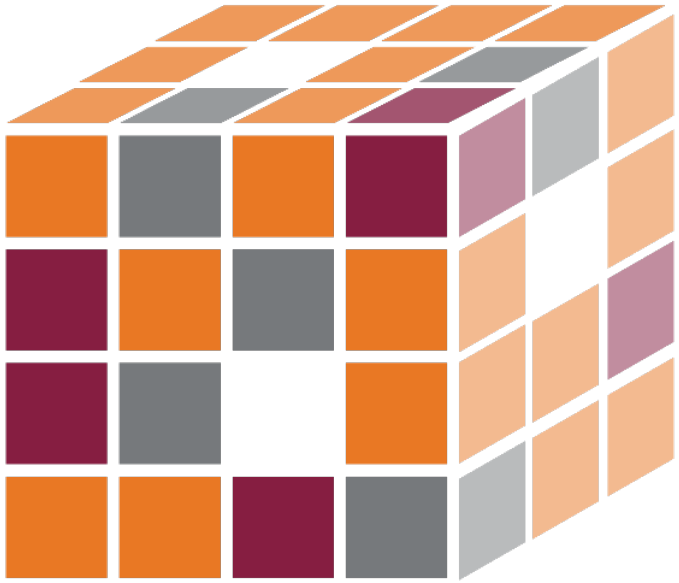
The complexity of the ADS and potential test cases may require a multifaceted testing architecture.



Coping with Variability and Uncertainty

Operational design domains can be limited, but most ADSs will still need to operate in highly dynamic domains (e.g., environmental, situational).

No two work zones are the same.

Vulnerable road user interactions add to unpredictability and error severity.

Human drivers, even safe ones, are highly variable.

VTTI Awarded US DOT Grants for Automated Vehicle Research

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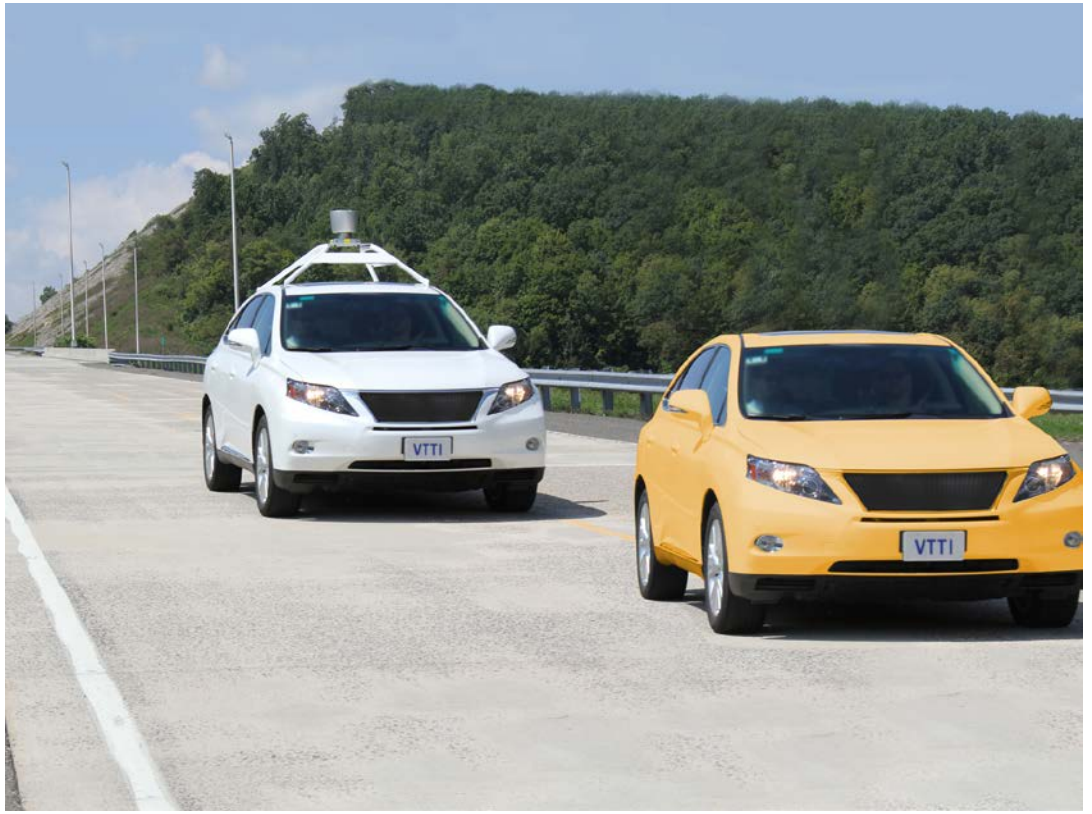
Two grants totaling $15 million were awarded to VTTI for advance research on the safe integration of automation into U.S. roadways:

- Safely Operating ADS in Challenging Dynamic Scenarios, An Optimized Automated Driving Corridor Demonstration

- Automated Trucks and Mixed Fleets



Safely Operating ADS in Challenging Dynamic Scenarios An Optimized Automated Driving Corridor Demonstration

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Demonstrate how highly automated vehicles safely interact in dynamic scenarios including interaction with public safety and cooperative freeway operations

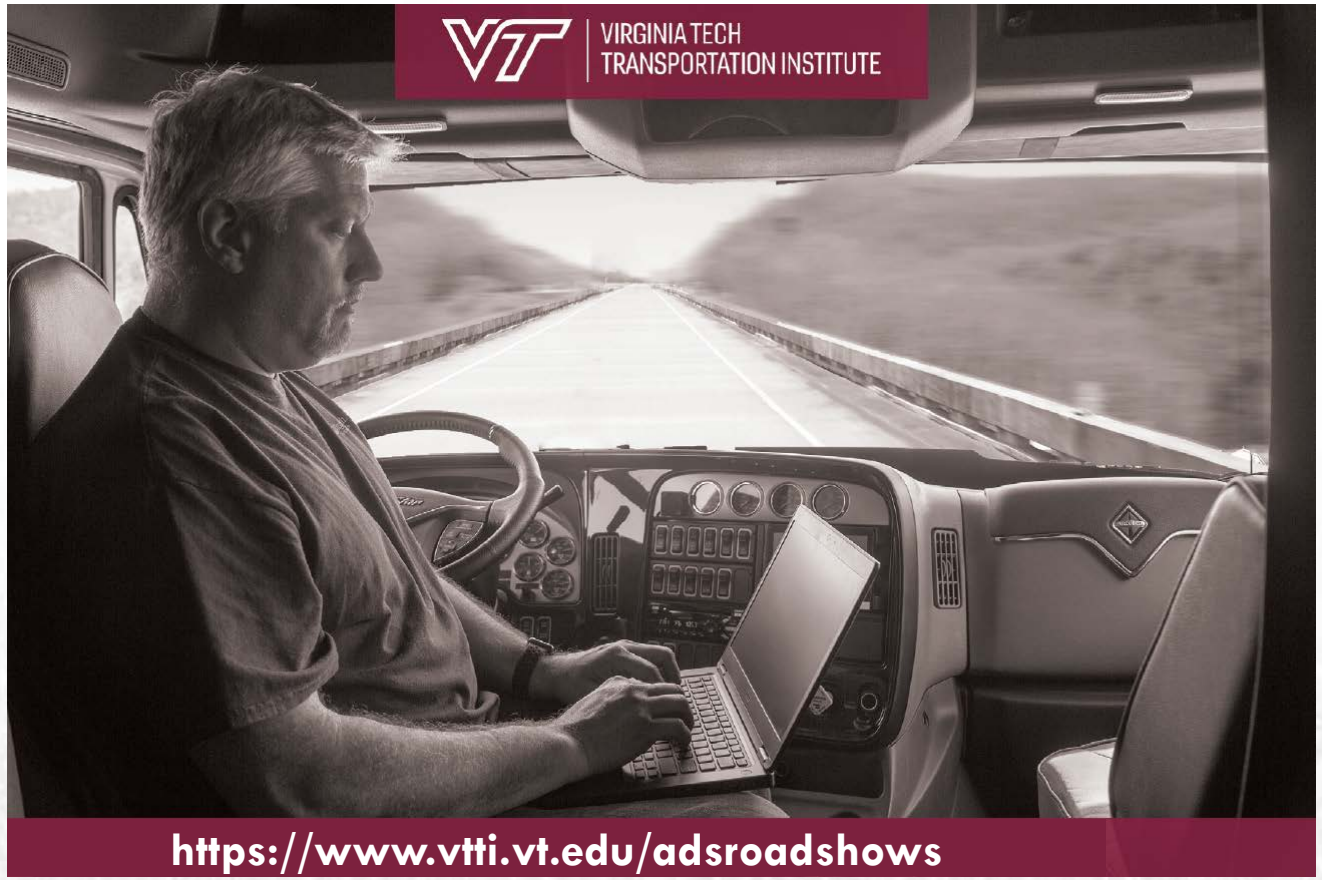
VDOT
Virginia Department of Transportation

GCAPS

CAMP
CRASH AVOIDANCE METRICS PARTNERS LLC

Transurban

Automated Trucks and Mixed Fleets



- Provide the trucking industry with clear guidelines on how to safely implement and benefit from trucks equipped with automated driving systems.
- In concert with the development of a fleet concept of operations, demonstrations will occur on public U.S. roadways.

Real World Deployment Considerations

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An innovative approach is needed for the deployment of ADSs.
Safety testing alone may not fully ensure safe, robust, and reliable ADS technologies.
Some examples for manufacturers to consider include:

Safety Testing Methodologies for ADSs

test track

open road

simulation

ghost deployments

active safety systems separate

over-the-air updates

post deployment monitoring

Deployment Best Practices

Development of Safety Testing for ADSs

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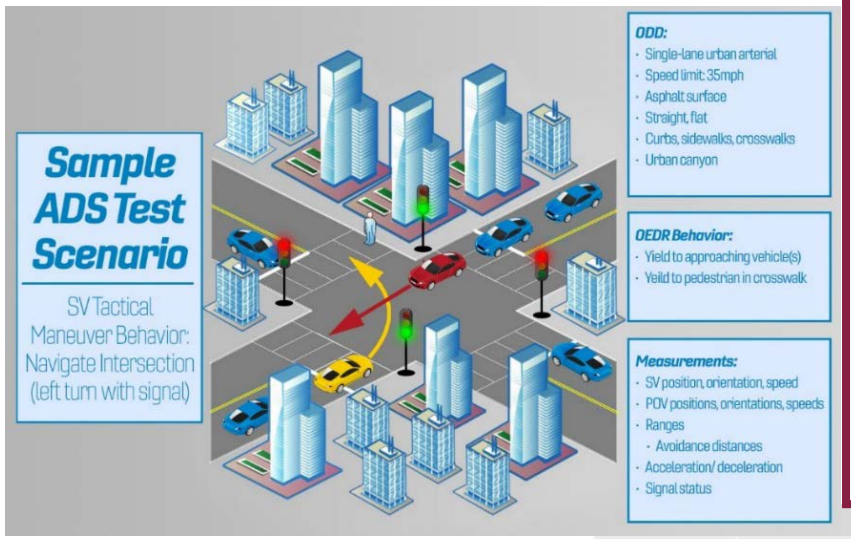
All elements needed for the development of ADS safety testing are in place, but they must evolve rapidly and be universally agreed upon.

Testing Framework



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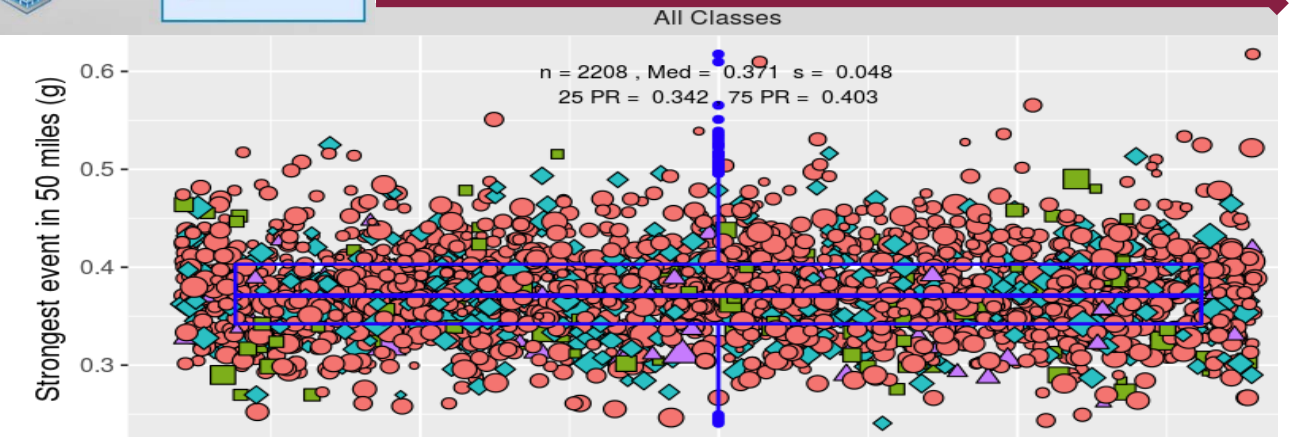

Real-world Deployment Considerations

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Thank You!

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