MathWorks
**AUTOMOTIVE CONFERENCE 2024**
North America

# Scene Sync - Bridging Real-world Scenarios with Virtual Environments for ADAS/AD Development


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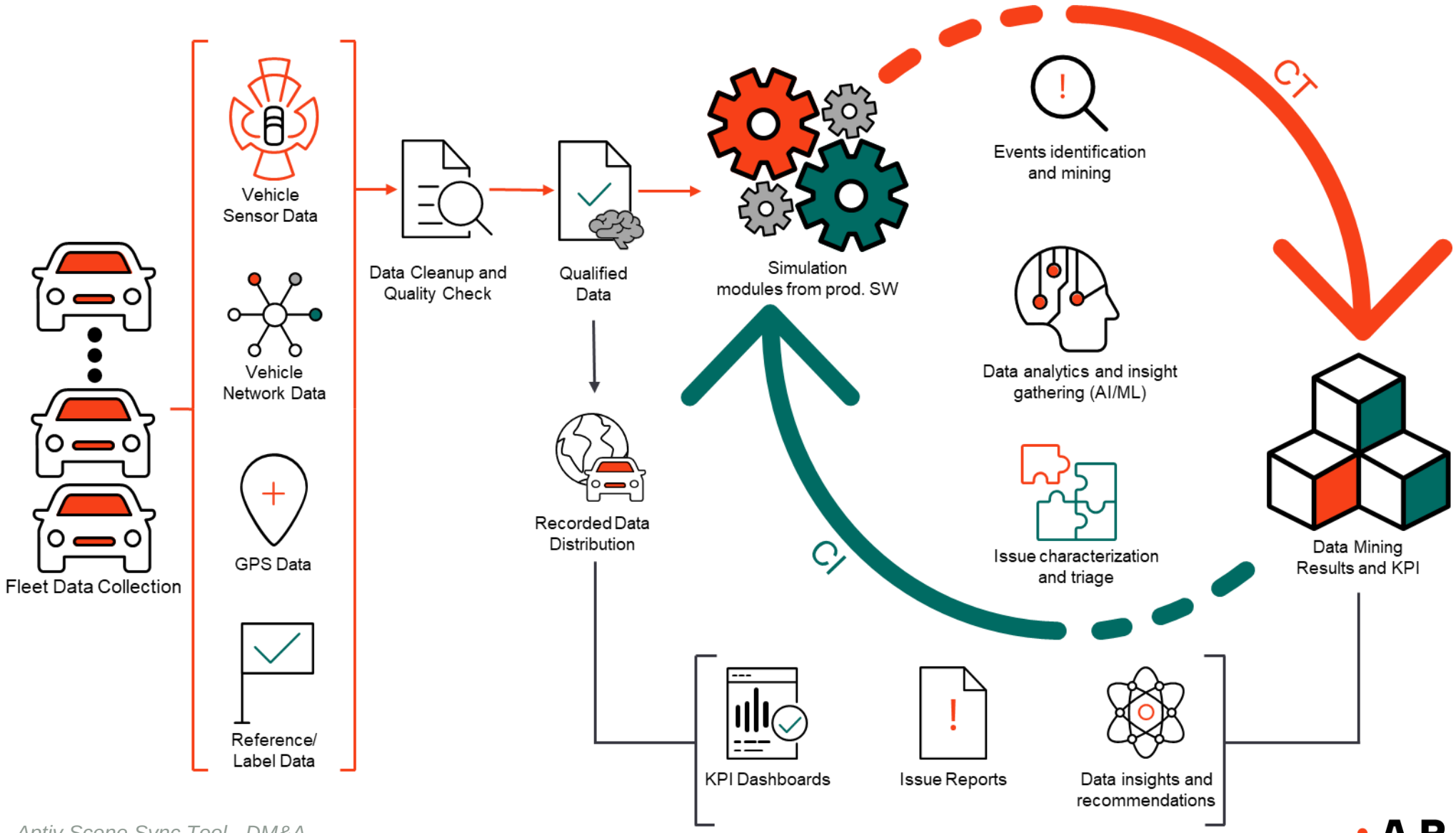
# Data Flow – ADAS/AD Development & Validation



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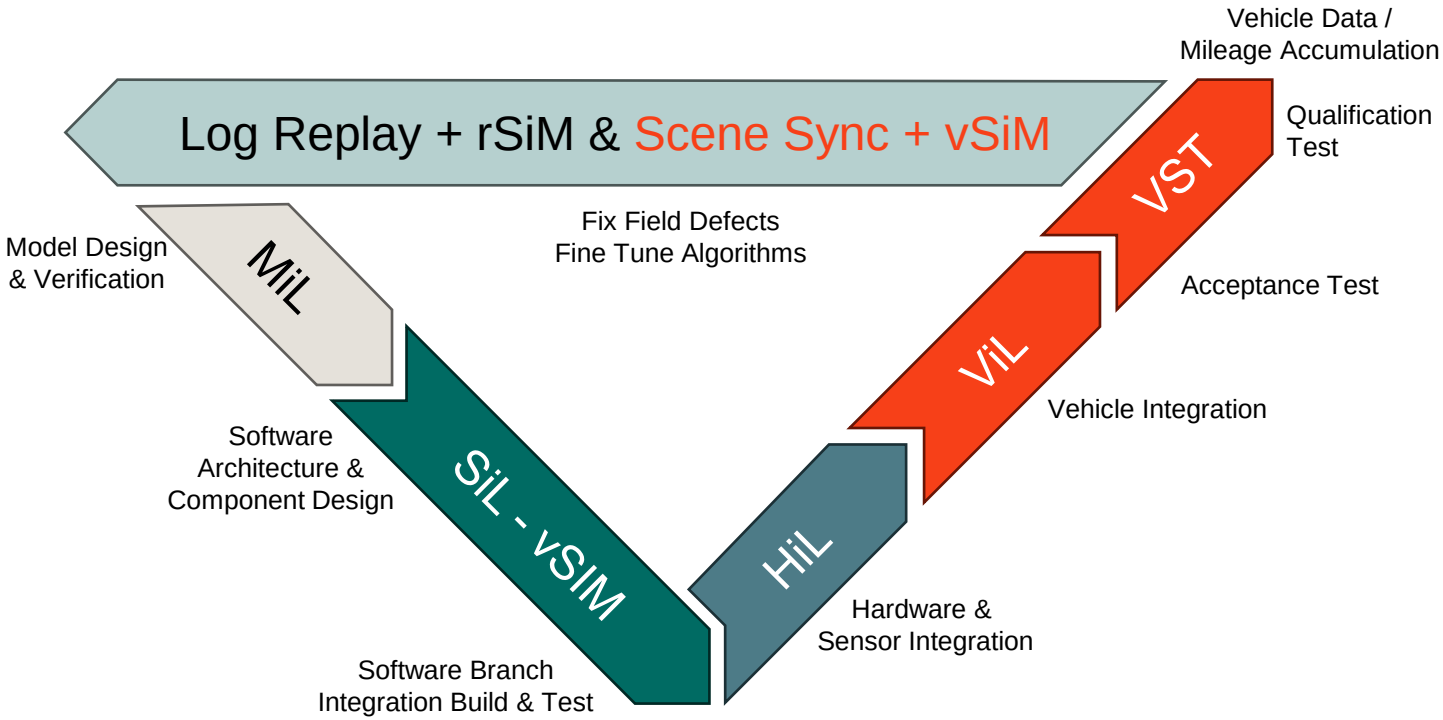
# Scene Sync - Motivation

- Data collected during mileage accumulation is traditionally used only for open-loop simulation – rSiM
  - Closed loop features require closed loop feedback for evaluation
- Virtual simulations - vSiM are traditionally only used for functional requirements – based testing
  - Each aspect of the scenario needs to be finely tuned in the simulation – and these parameters are defined in the requirements specification

**What if we could combine the strengths of both?**



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# Scene Sync

## Objective

Create Simulations based on Real world recorded data

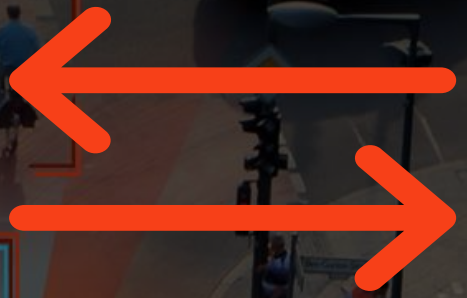
## Bridges

r-SIL/r-Sim based validation

(Open Loop playback/Recorded Data)

v-SIL/v-SIM based validation

(Closed Loop playback/Synthetic Data)



## Uses

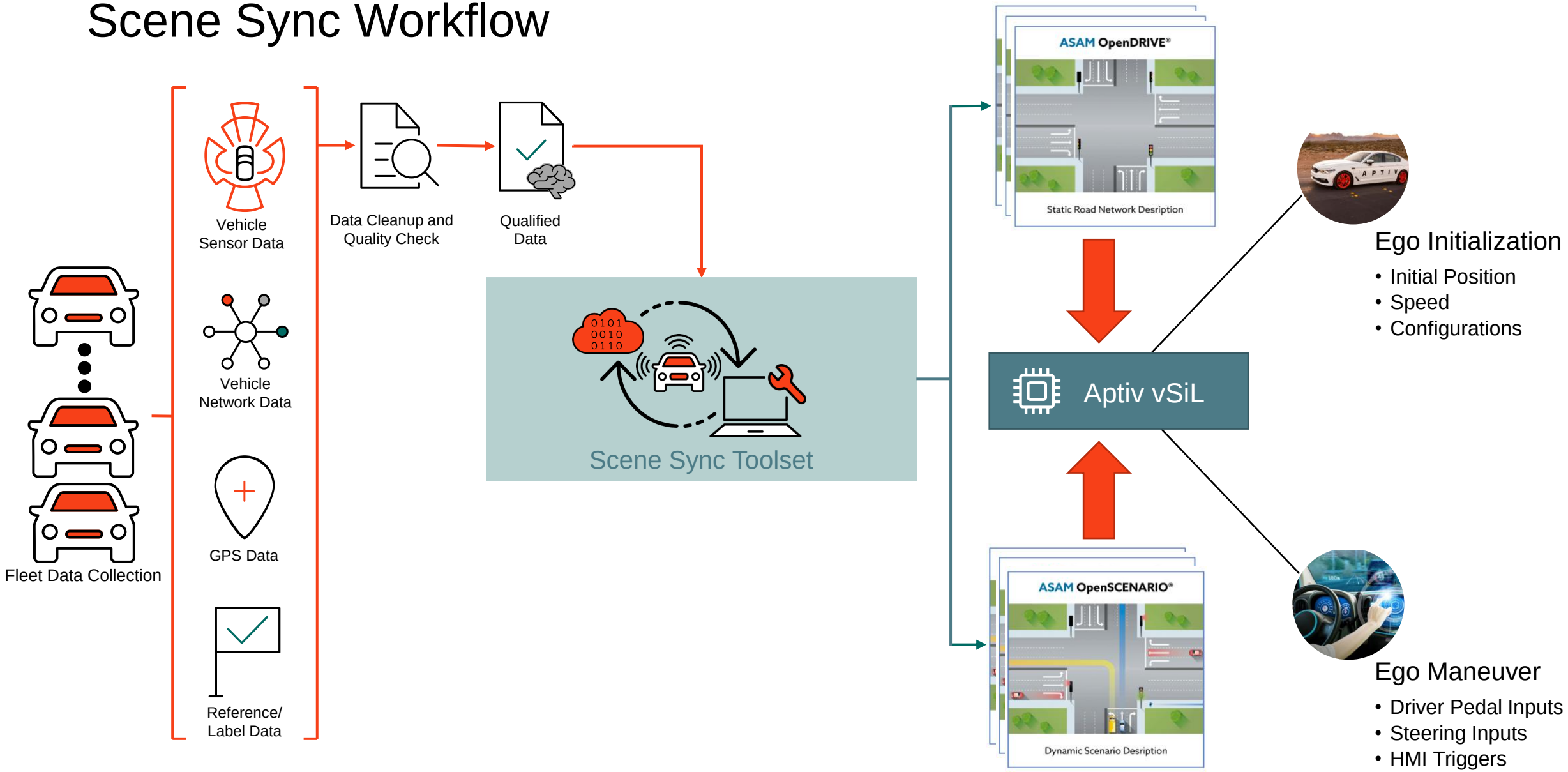
Host vehicle trajectory

Objects (Radar/Vision/GT/Fused)

Environment inputs (Roads, Lane Markers, Signs)

HMI Inputs from the driver during data collection

# Scene Sync Workflow



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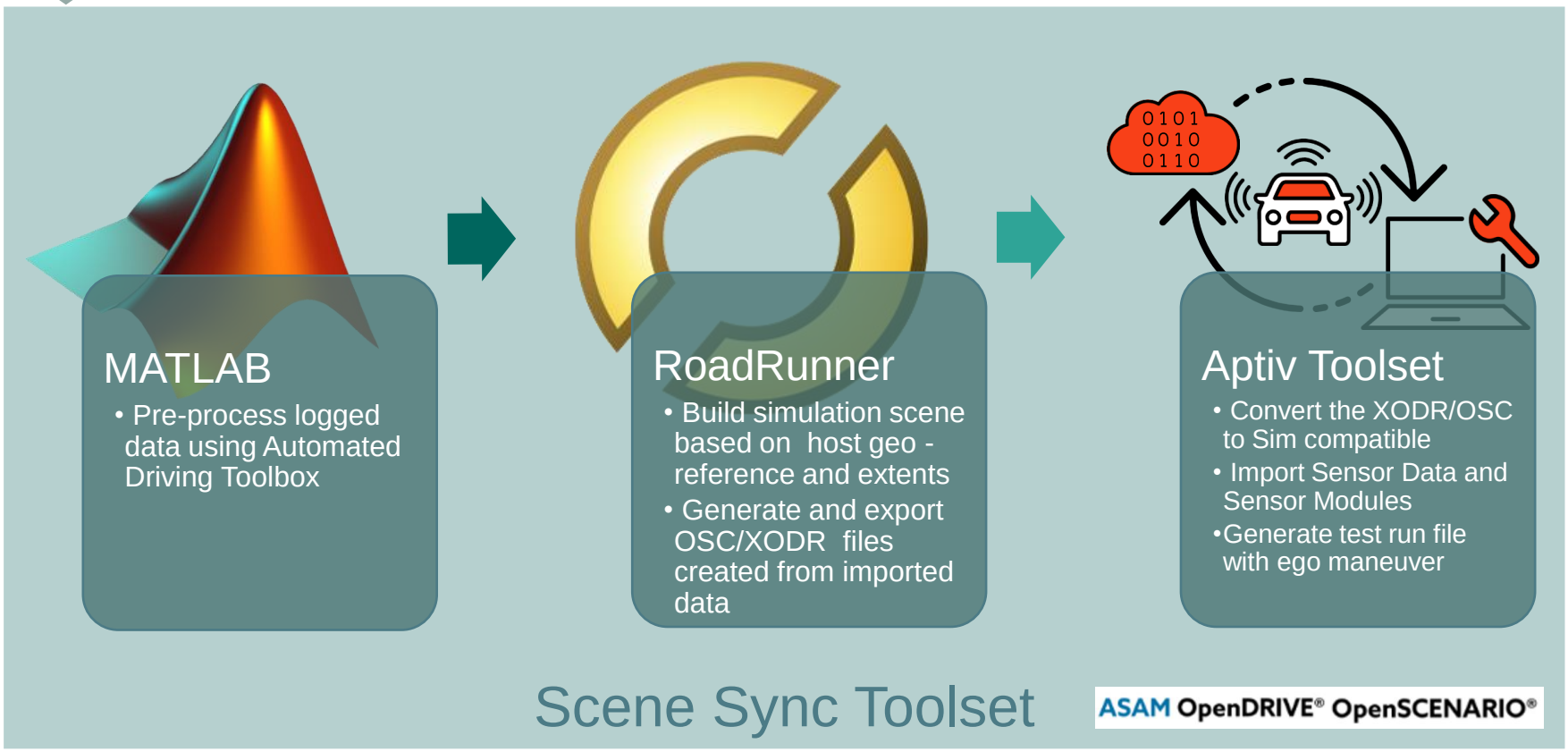
# Scene Sync Workflow

Qualified Data




Aptiv vSiL

**IPG Carmaker**

- Import the test run file
- Run the simulation
- Co-simulate w/ SIL built from embedded code.



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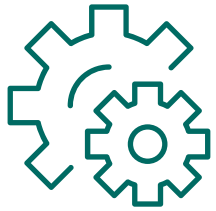
# Scene Sync Workflow

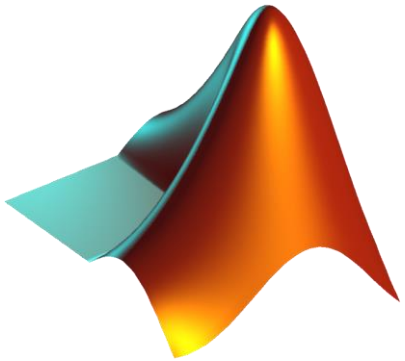
## Extract

- Extract ego trajectory
- Extract traffic actor list as recorded in log (Sensed/Ground Truth)



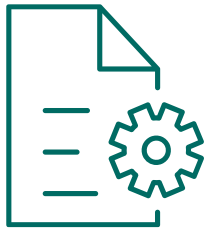
## Process

- Process the ego trajectory data
  - Use Automated Driving Toolbox to fuse GPS, IMU and Vision data
- Process the traffic actor list
- Create trajectories in global coordinates for simulation use



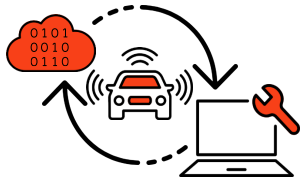
**MATLAB**

Preprocess Host Data



## Save

- Save host and target trajectories data



# Scene Sync Workflow

**RoadRunner**

Create Simulation Scene

Set scene using World Coordinates

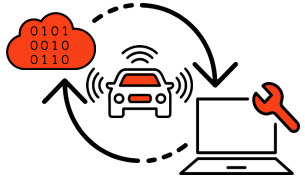
- Ego trajectory origin
- Ego trajectory bounds

Import HD map data to build scene

Import traffic actor trajectories into RoadRunner to create scenarios

Visualize the scenario in RoadRunner to compare with logged data

Export OpenDRIVE and OpenSCENARIO files using RoadRunner for import into simulation environment



# Scene Sync Workflow

Make OpenSCENARIO file compatible with Simulation Tool (CarMaker)

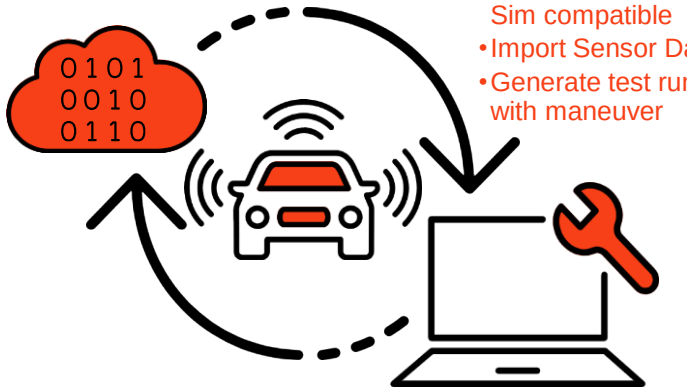
ASAM OpenSCENARIO®

Make OpenDRIVE file compatible with Simulation Tool (CarMaker)

ASAM OpenDRIVE®

**Aptiv Toolset**

- Convert the OSC to Sim compatible
- Import Sensor Data
- Generate test run file with maneuver




Extracting ego vehicle HMI and config data to initialize the ego maneuver

Generate Test Run file with road, ego and traffic maneuvers



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# Scene Sync Workflow

Aptiv vSiL

IPG Carmaker

SIL Execution Environment

## Run Simulation

- Run the simulation using TestRun file and virtual road with Aptiv vSiL
- Aptiv vSiL contains:
  - Sensor Modules
  - ADAS/AD and Perception Algorithms
- Save SiL output signals for analysis using data mining methods

Ego Initialization

Traffic Data

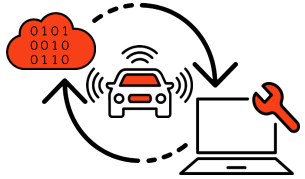
- Generated from OpenSCENARIO

Road

- Generated from OpenDRIVE

Ego Maneuver

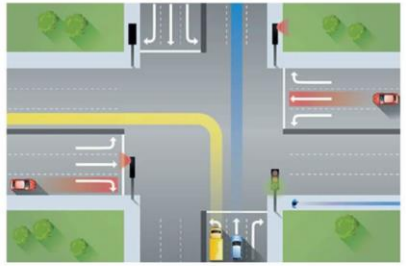




# Scene Sync Scenario Export - Comparison

From RoadRunner…

ASAM OpenDRIVE®



ASAM OpenSCENARIO®

…To Carmaker

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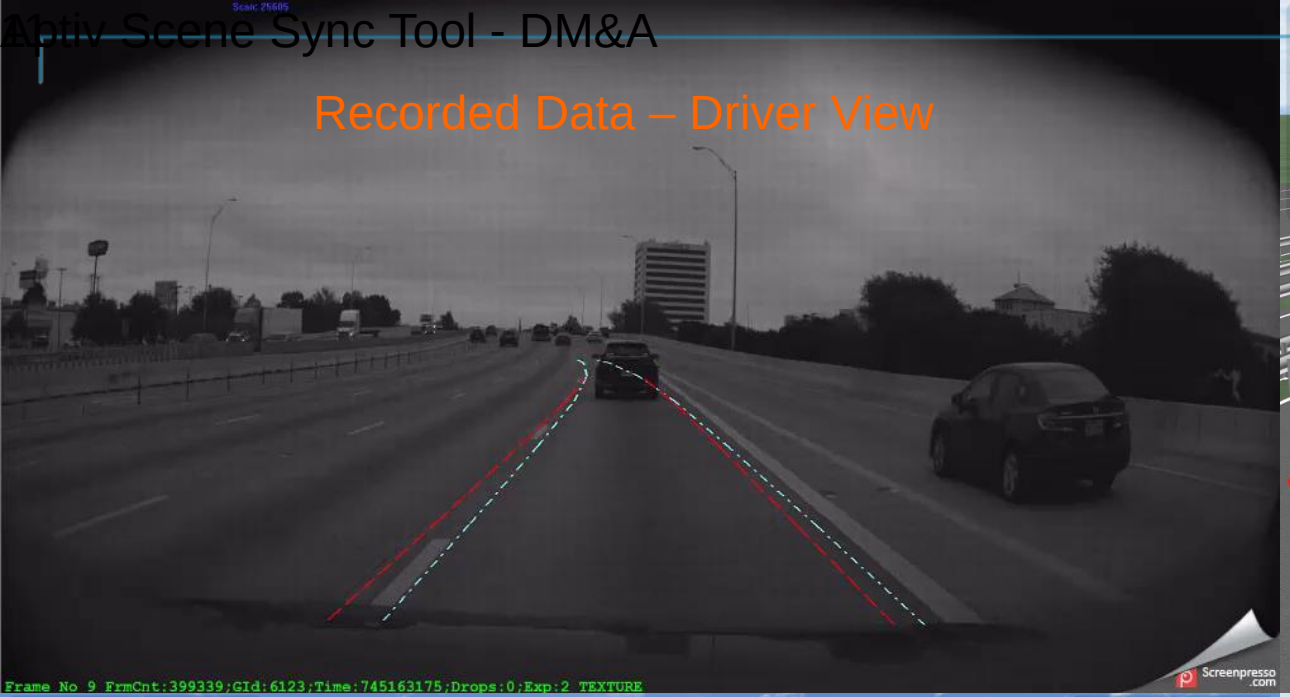
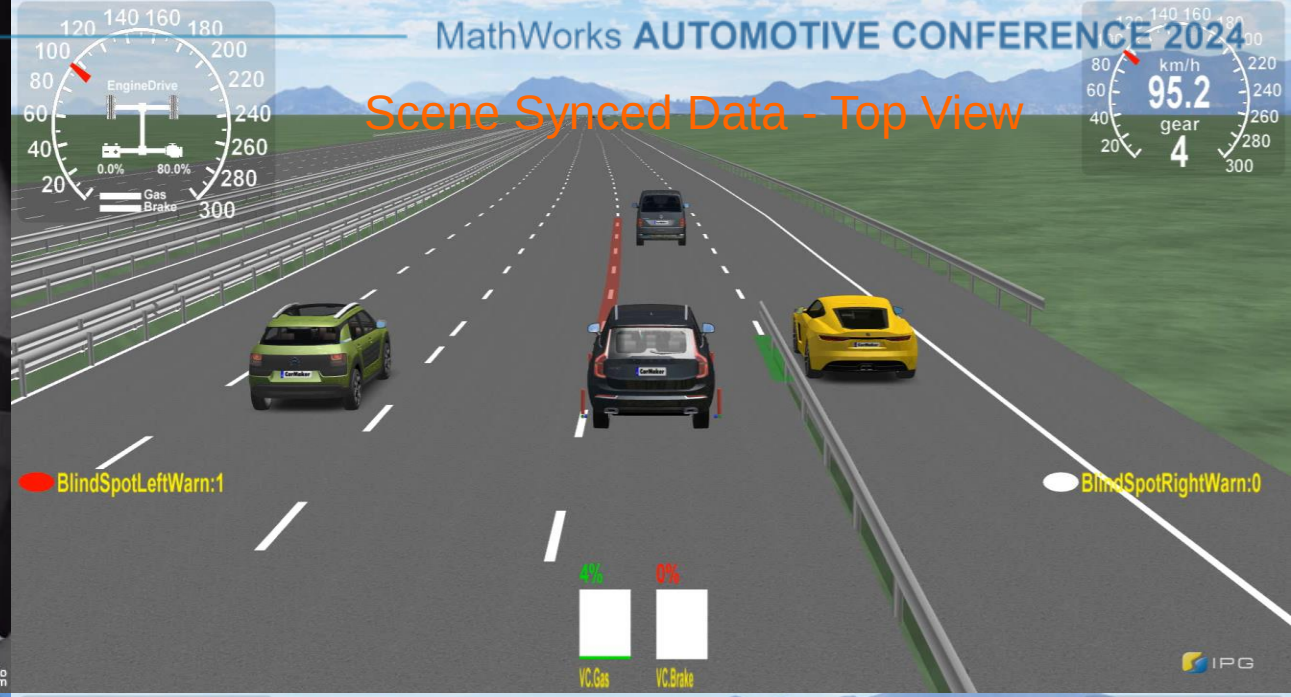
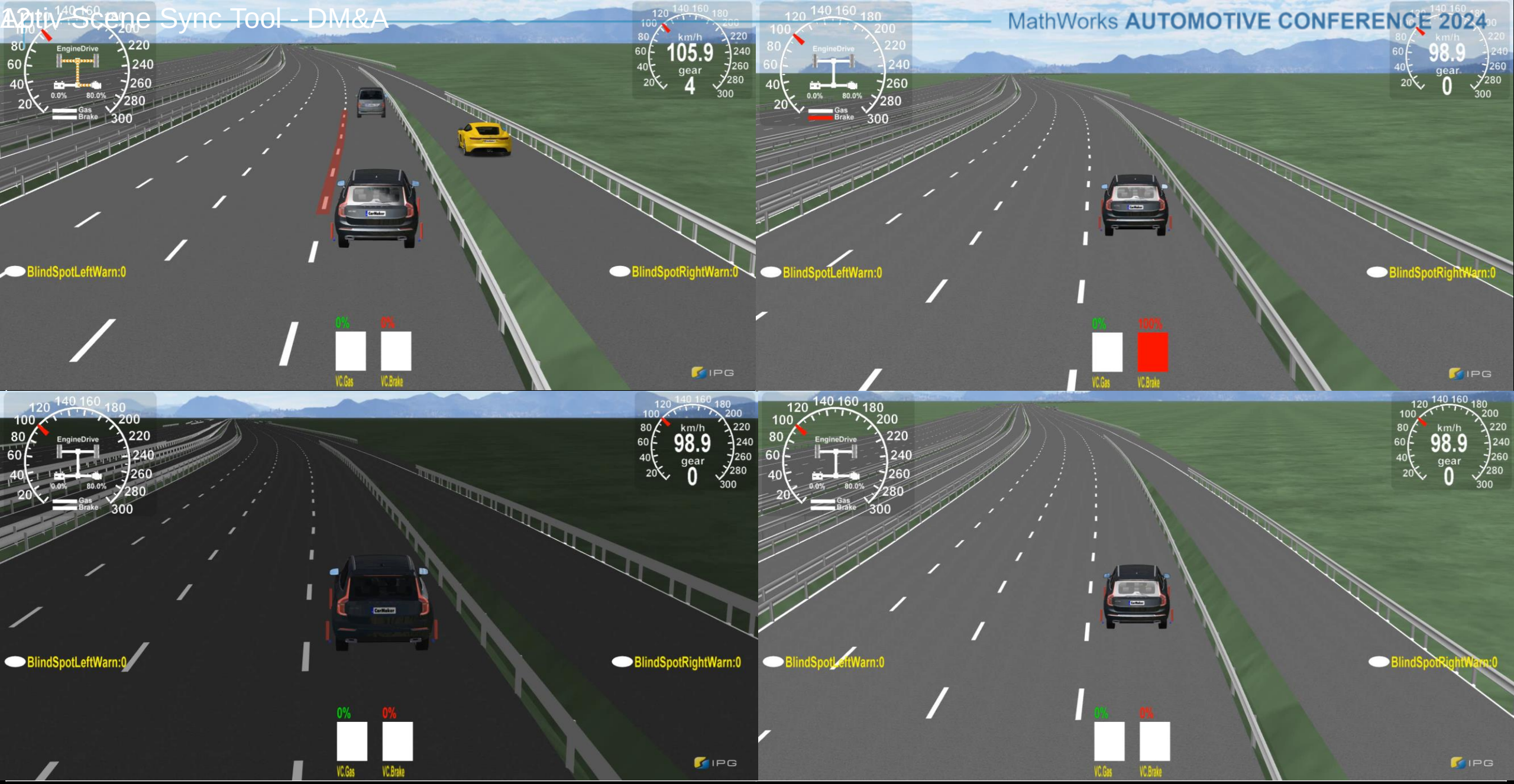


In **the Simulated AEB scenario**, the host vehicle speed was reduced to make the traffic vehicle cut-in Infront of host vehicle




**In Scene Sync Simulation – Target Class can be updated in Simulation to introduce variability in testing**

# Summary

- Scene Sync enables us to import wide variety of traffic behavior and road characteristics from recorded data into the simulation environment.
- Scene Sync allows optimized usage of simulation methods to perform relevant exploratory testing and answer questions about feature performance
- Scene sync also allows us to test the fidelity of the simulation – by enabling 1:1 comparison between recorded and simulated data.

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## Thank you

Please contact with questions
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