Virtual ADAS Testing with real vehicles – pulling the test track into the lab and your vehicle never feels a difference

Setting up a VIL test lab for ADAS testing

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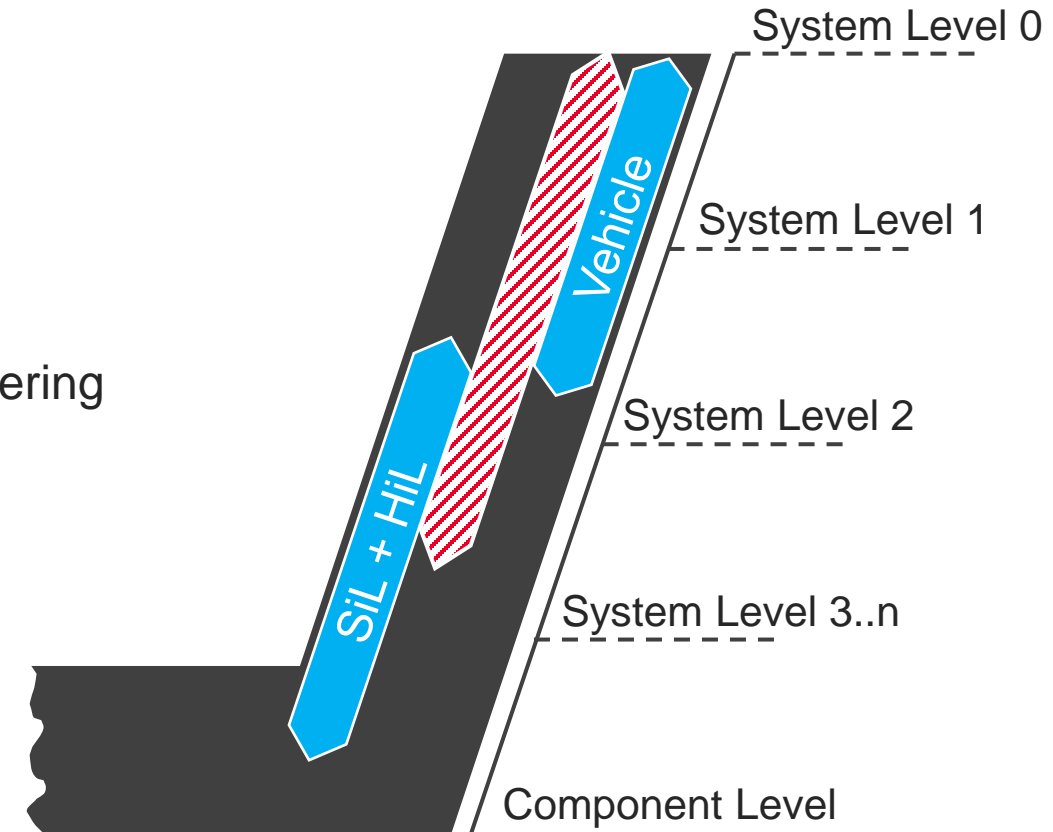
How is it done today

Close the gap between HIL and road

- Road-Testing
  - With limited reproducibility / only one-shot measurement
  - With unforeseeable influence

- SiL- and HiL-Testing
  - With limited influence from/on drivetrain, powertrain and steering
  - With all pros and cons of simulation
  - No 1:1 transferability from e.g. HiL to Vehicle

conclusion
>> Break in V&V-Workflow
>> intermediate step in V&V-Workflow necessary

System Level 0
System Level 1
Vehicle
System Level 2
SiL + HiL
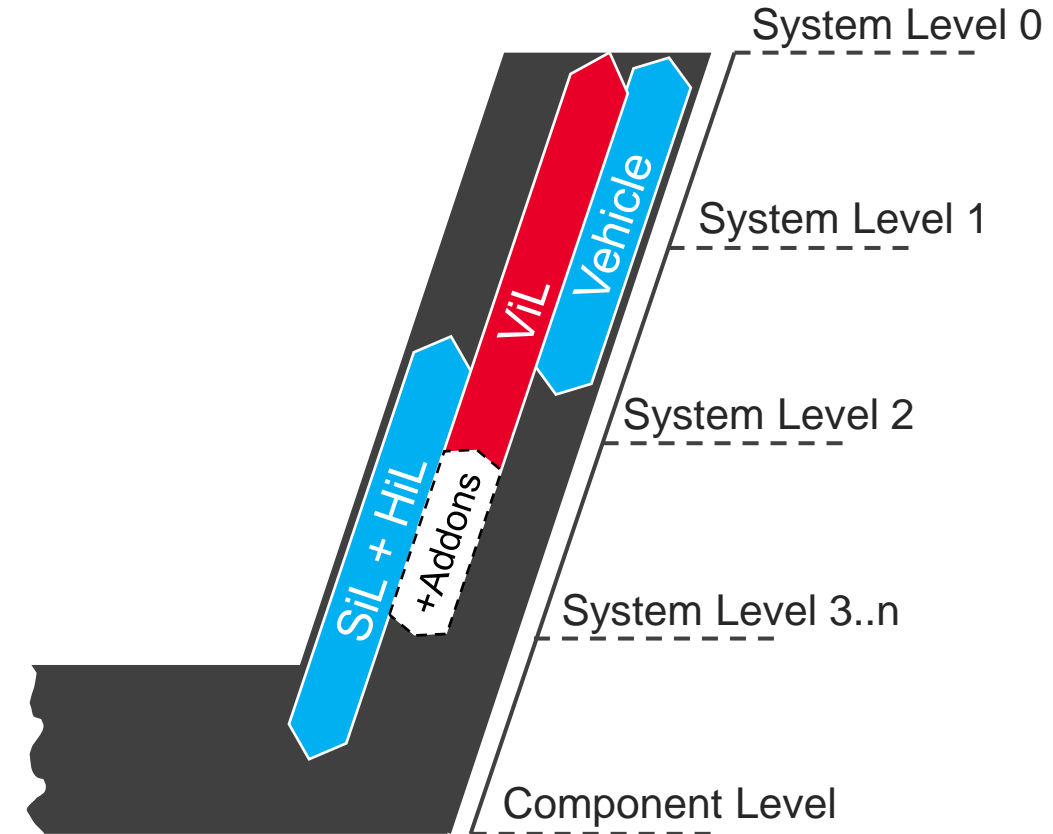System Level 3..n
Component Level

KEYSIGHT

Goal

The complete picture

- End-to-End Testing Capabilities
  - Continuous Usage of test catalogue
  - Reuse Testing Methodology and Results

- Automated and reproducible testing
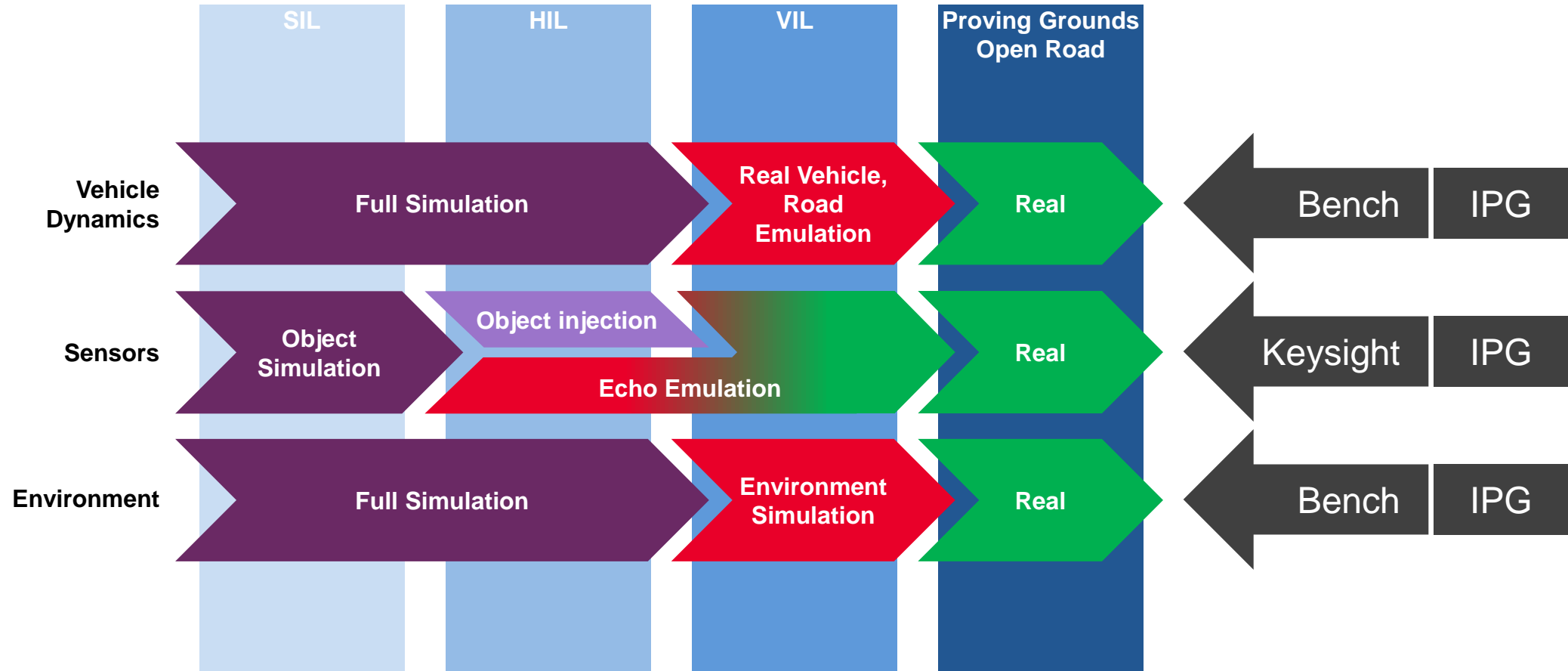 - Regardless of weather, traffic or road conditions
  - 24/7

Goal
>> Closed gap between HiL- and Road-Testing
>> Increased efficiency and reduced test vehicle usage

System Level 0

System Level 1

System Level 2

System Level 3..n

Component Level
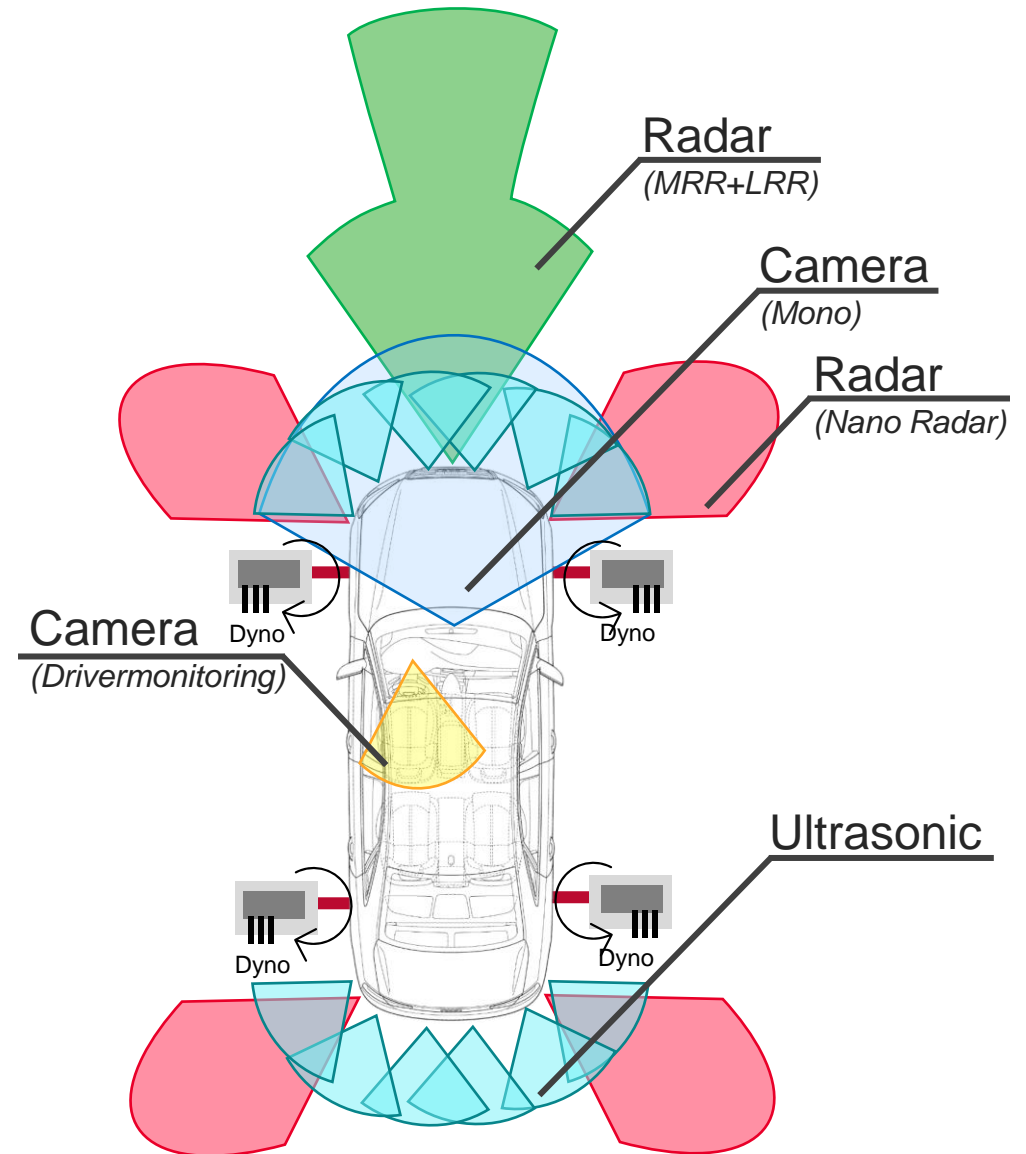
SiL + HiL

+Addons

ViL

Vehicle

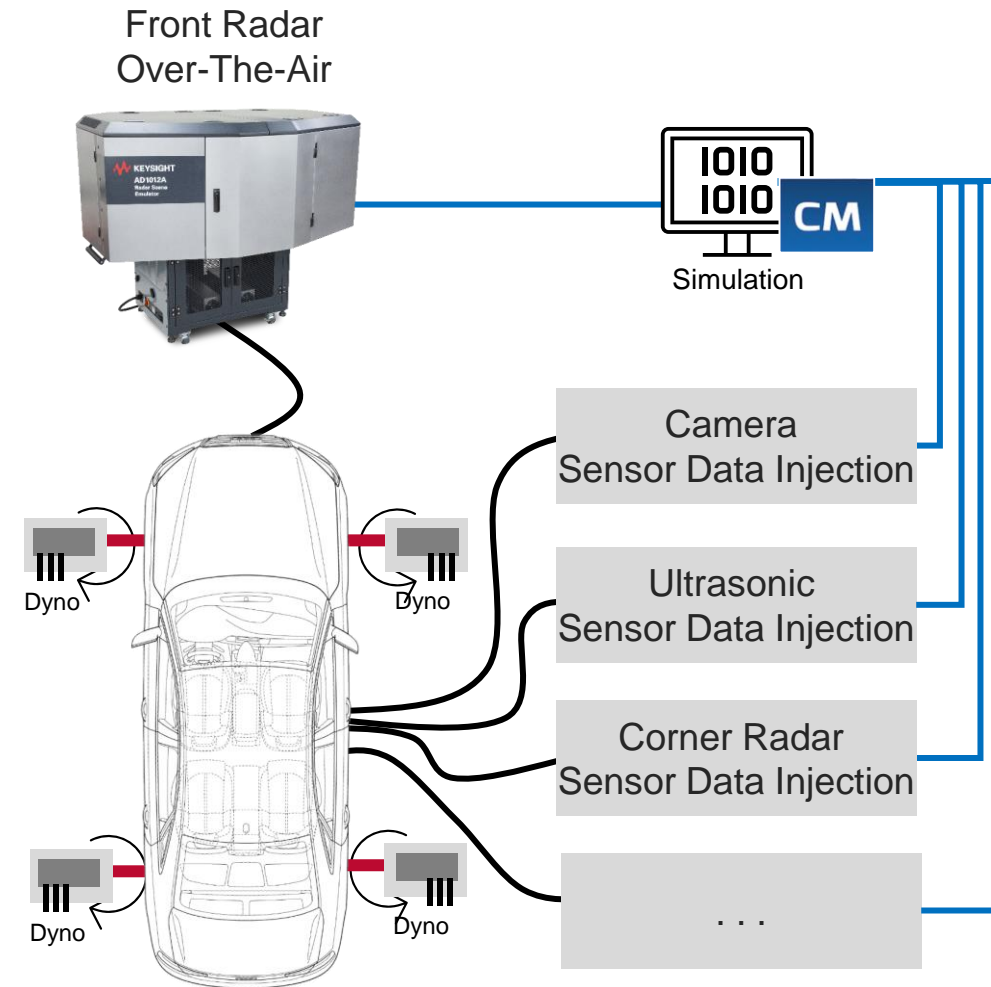# SiL → HiL → ViL

Managing the challenges

Testbench Setup

- Full driving capabilities

- Full steering capabilities

- Sensor Data Injection
  - Bus
  - specialized injection solutions
  - Over-the-Air

- Short set-up time

- Automatization

- Whole car in virtual environment

Radar
(MRR+LRR)

Camera
(Mono)

Radar
(Nano Radar)

Camera
(Drivermonitoring)

Dyno

Dyno

Dyno

Dyno

Ultrasonic

KEYSIGHT

Testbench Setup

- Full driving capabilities

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Front Radar
Over-The-Air

Simulation

Camera
Sensor Data Injection

Ultrasonic
Sensor Data Injection

Corner Radar
Sensor Data Injection

. . .

Dyno

Dyno

Dyno

Dyno

Example: EURO NCAP CCRs*

Car-to-Car Rear stationary collision prevention
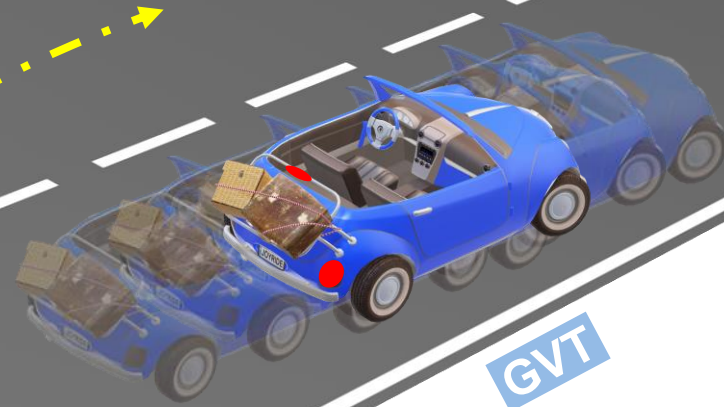
GVT

VUT
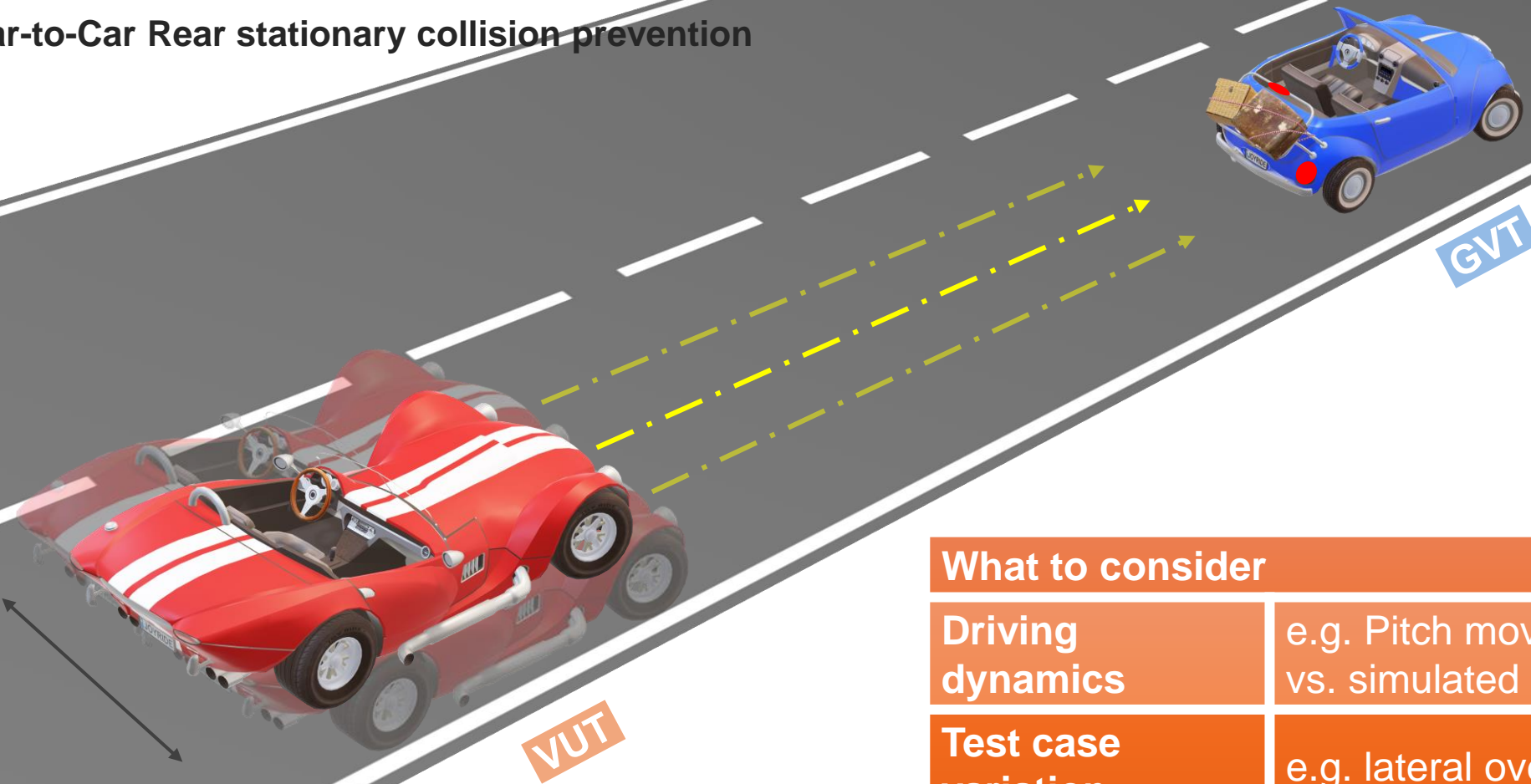
What to consider	
Driving dynamics	e.g. Pitch movement of real vehicle vs. simulated behavior
Test case variation	e.g. lateral overlap, VUT speed
Variant handling	Repeatability across different vehicle types

Example: Emergency Assist

Evasive Steering

GVT

VUT

What to consider in addition	
Driving dynamics	Steering, adding roll/yaw dynamics
Testcase variation	GVT speed, VUT speed, oncoming traffic
Test Automation	Steering Robot

A closer look at sensor emulation

Projecting the camera image
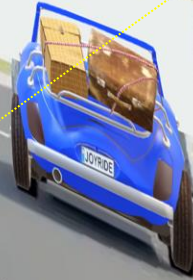
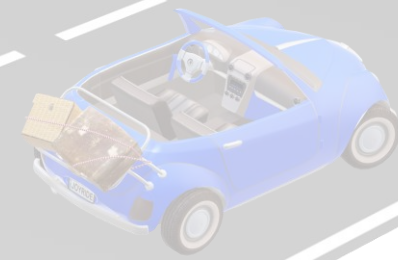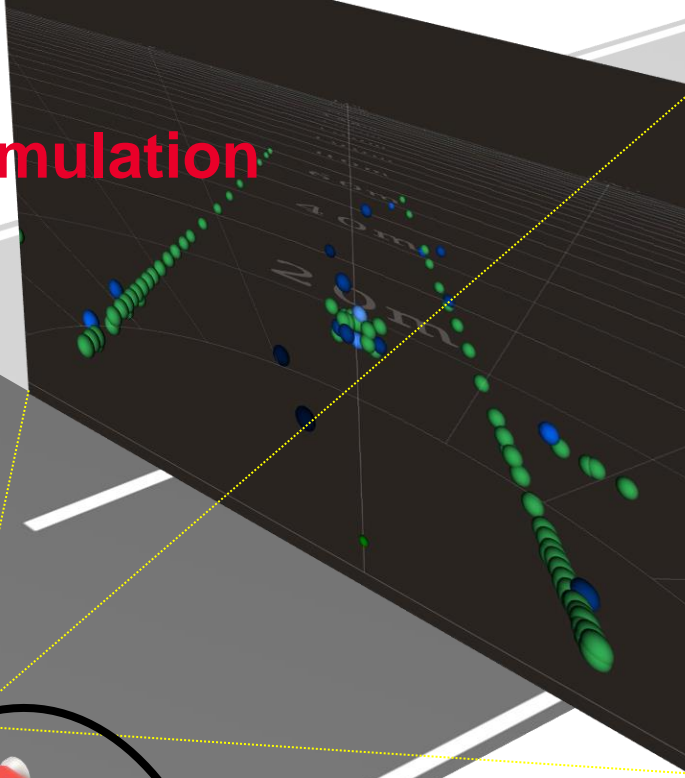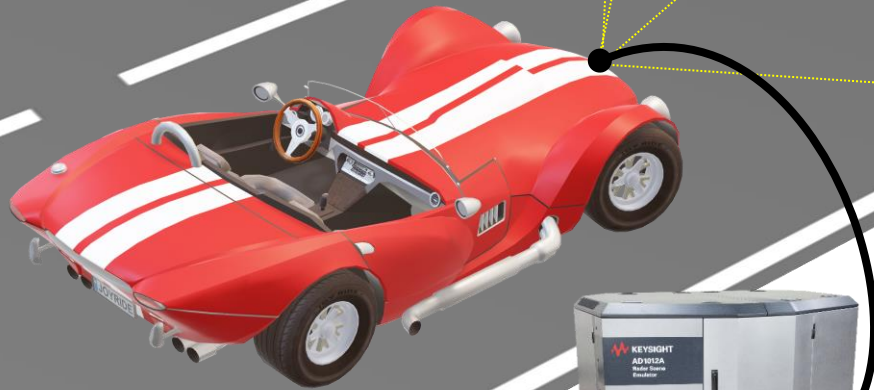| What to consider	
Driving dynamics	Relative "movement" of environment in reaction to yaw/pitch/roll
Object Detection	Perception, Classification, Tracking
Synchronization	Consistent dynamics, environment, and sensor data

A closer look at sensor emulation

Projecting the radar point cloud

What to consider in addition, for radar	
Driving dynamics	Movement of real vehicle on bench vs. simulated yaw/pitch/roll
Object Detection	Radar's processing stack: DSP, perception, classification
Sensor Position	Emulation cannot block front of vehicle (other sensors, cooling, …)

Next steps

- Integration of Sensor Data Injection with Simulation, Testbench, Vehicle etc.
  - For remaining Sensorset

- Final Validation of Testbench Setup

- Productive Testing and continued alignment between HiL and ViL
  - e.g. Usage of Keysight RSE in HiL-Environment