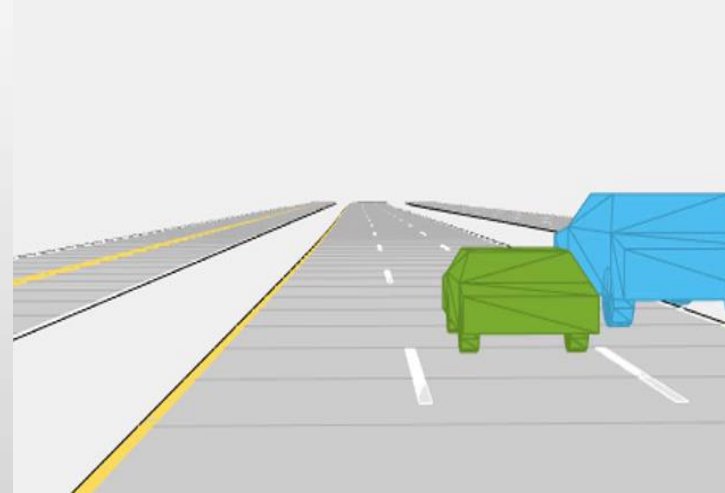
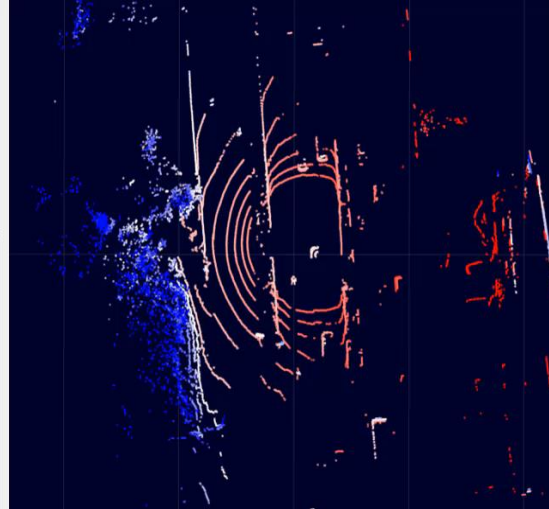


BRINGING REAL WORLD TO SIMULATION FOR VIRTUAL TESTING OF ADAS



Presented By - Ninad Pachhapurkar, ARAI

Jyoti Kale, Manish Karle,
Ujjwala Karle



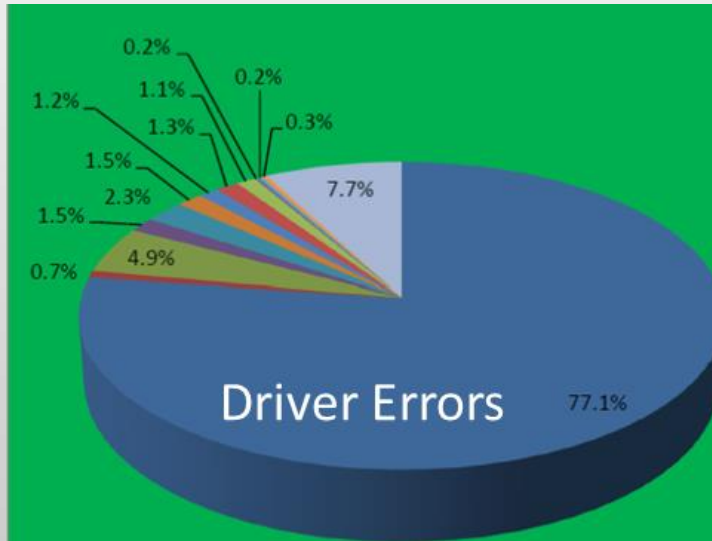
Dr. Rishu Gupta
Saket Saurav



Safety Goals Through Advanced Driver Assist (ADAS)

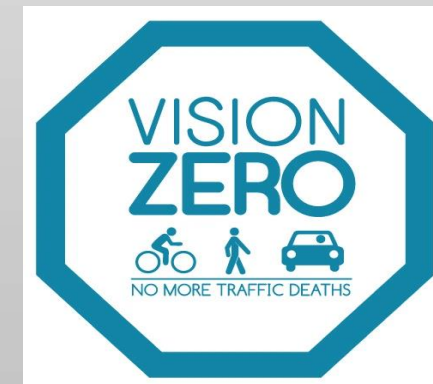
Focus to reduce road accidents/fatalities by 50%

- India ranks 3rd in terms of deaths due to road accidents
- There is one death every four minutes due to a road accident in India.



- Around 80% of accidents are due to Driver errors
- Can driver be assisted .. To minimize errors...

Long term goal of



Source : Road Accidents in India 2018 : MoRTH India



Focus Features for India

360 deg view

Forward Collision Warning

Electronic Stability Control

Parking Assist

Automated Emergency Braking

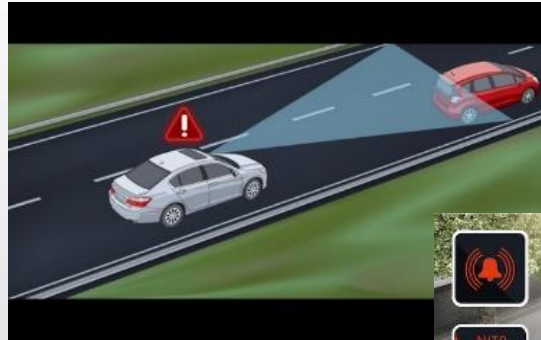
Drowsiness/
fatigue Alert

Forward Collision Assist

Blind spot detection

Driver Monitoring

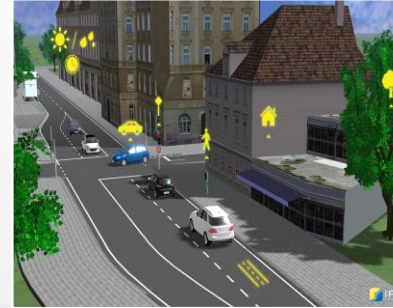
Adaptive Cruise Control



Different Indian Use Case



Complexity of Automated Driving Functions



Variation of scenarios and parameters



Climate/Weather uncertainties



Challenges due to vast road population:
Vehicle-to-everything (V2X) communication
Amount of data to be handled



Poor road infrastructure



Traffic behavior



Indian Traffic Conditions

Height Constraint Barrier Speed breakers with missing Sections



Speed breakers without markings



Drainage meshes on road



Broken Road Signs



Malfunctioning signal Lights



Broken Drainage meshes on road



Manhole Below Road Level

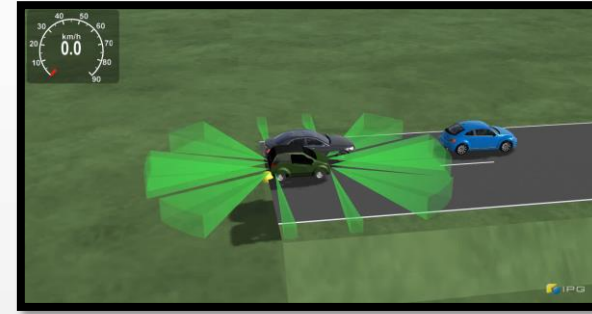


Narrow Iron Bridge

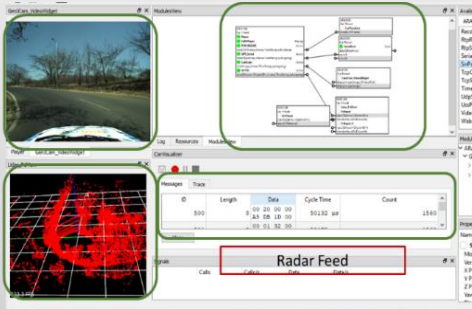


Paved Road Patch





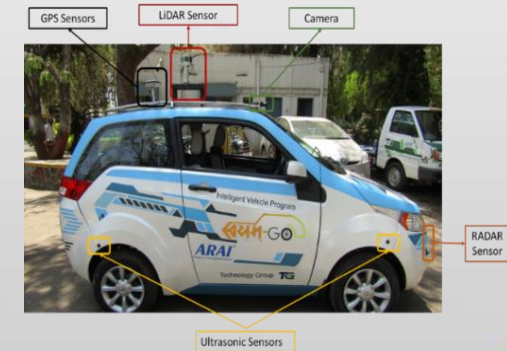
AI/ Machine Learning



Indian traffic signs and vehicles annotation



Solutions for Indian Use Cases



Real World tests

on Road Assessment .. infinite use cases

Physical Certification Tests

Selected few standard tests

AUDIT & ASSESMENT

Simulation Based Testing & Validation
..Driver in Loop (DIL) +HIL

Virtual and Experiential V&V Methods



Integrated testing & validation Approach



Indian Database & Use case

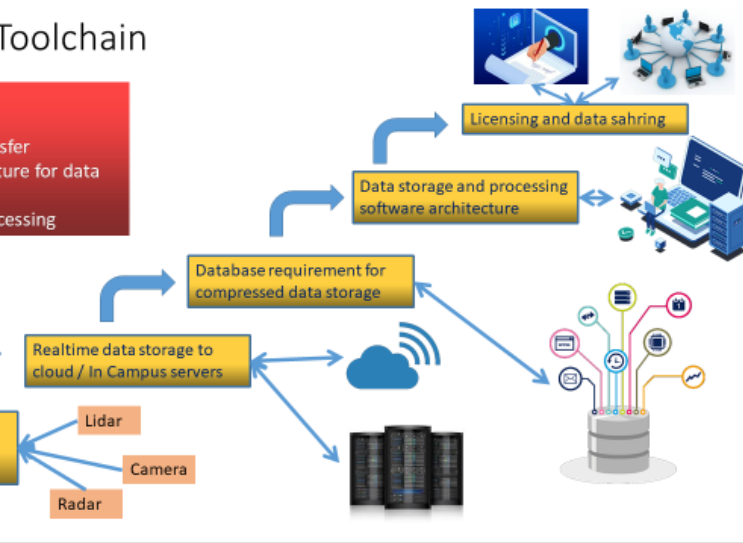
Conversion to digital domain

Vehicle Testing

Lab level V&V with DIL

Data Center Toolchain

- Current limitation -
1. Huge data size
 2. Only offline data transfer
 3. No software architecture for data storage
 4. No realtime data processing

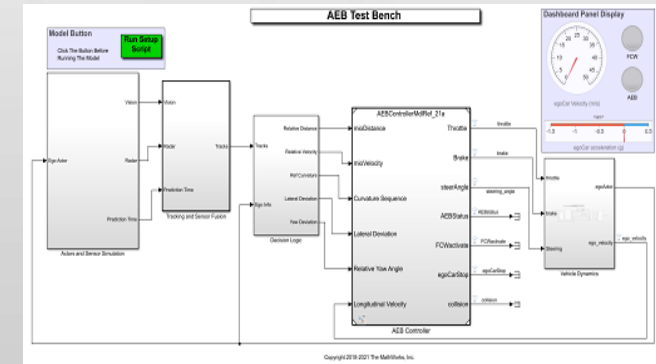
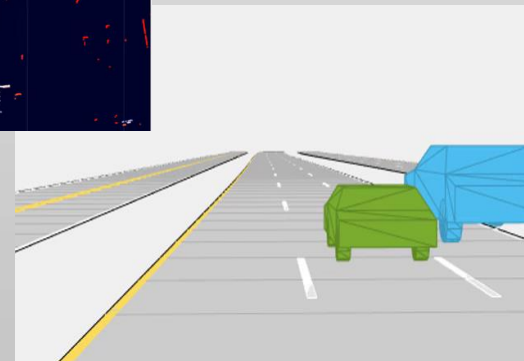
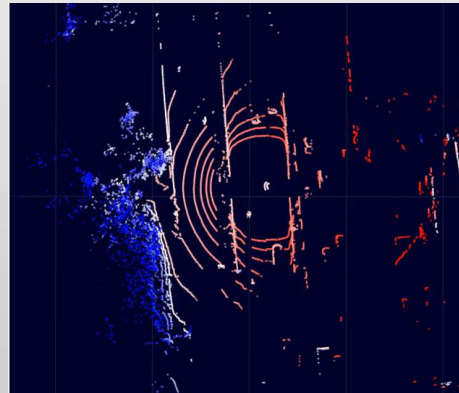
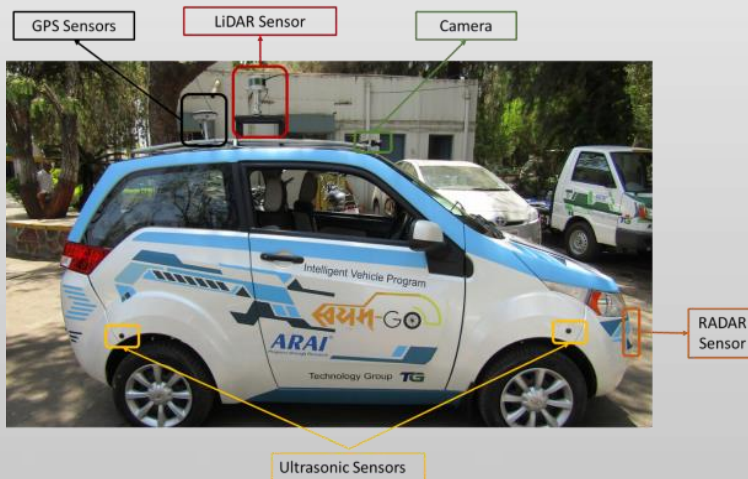


Simulating real world environment for virtual testing in ADAS

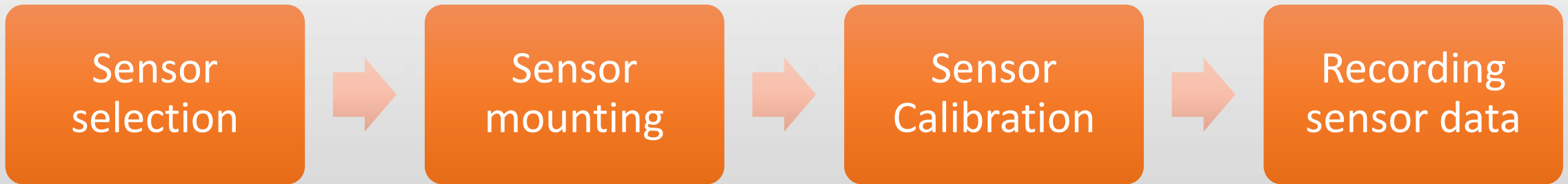
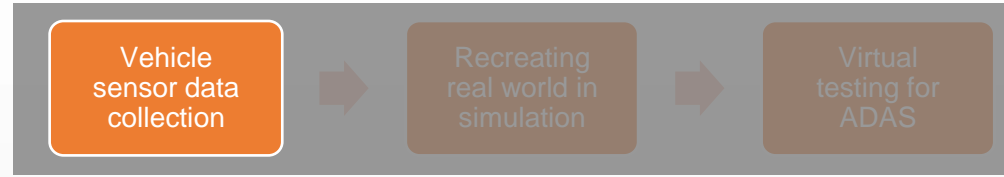
Vehicle sensor data collection

Recreating real world in simulation

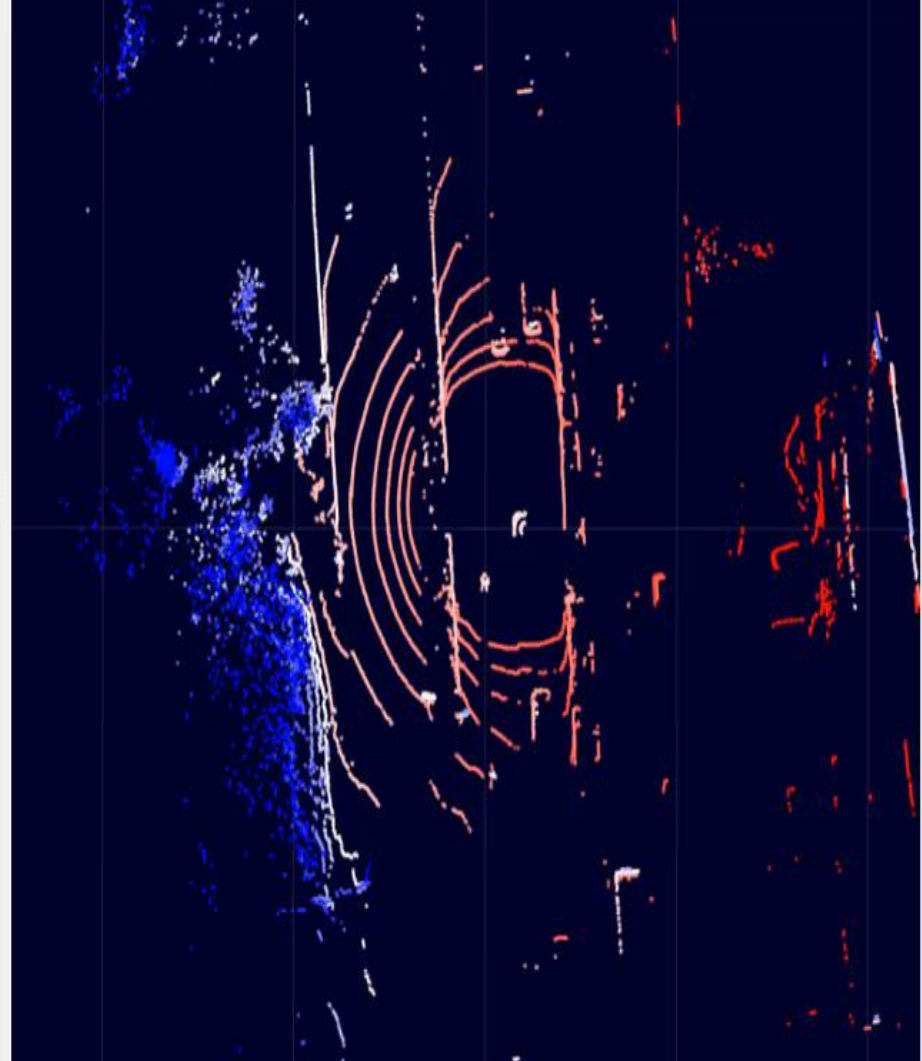
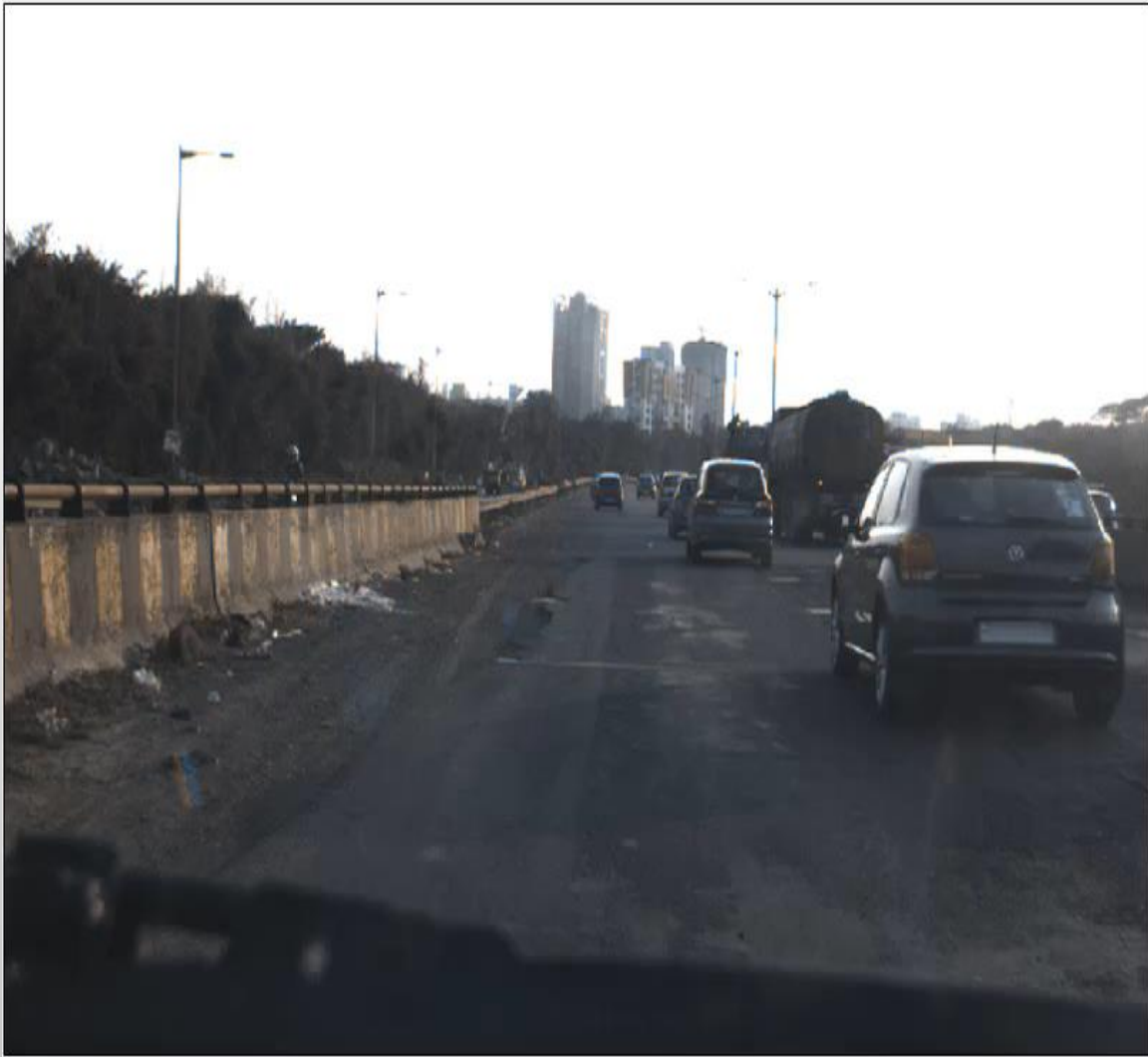
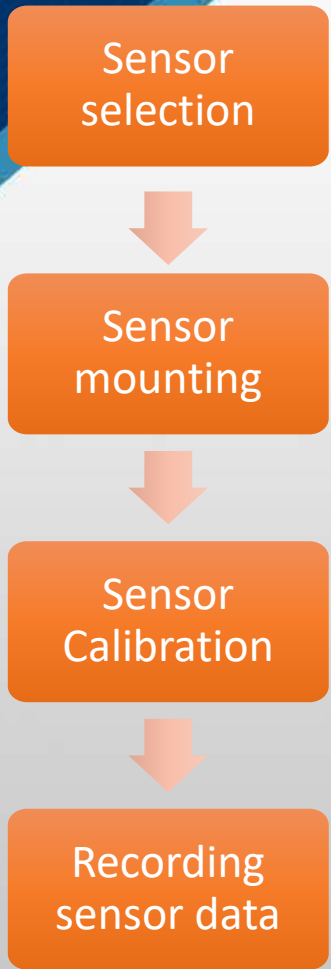
Virtual testing for ADAS



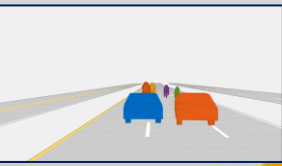
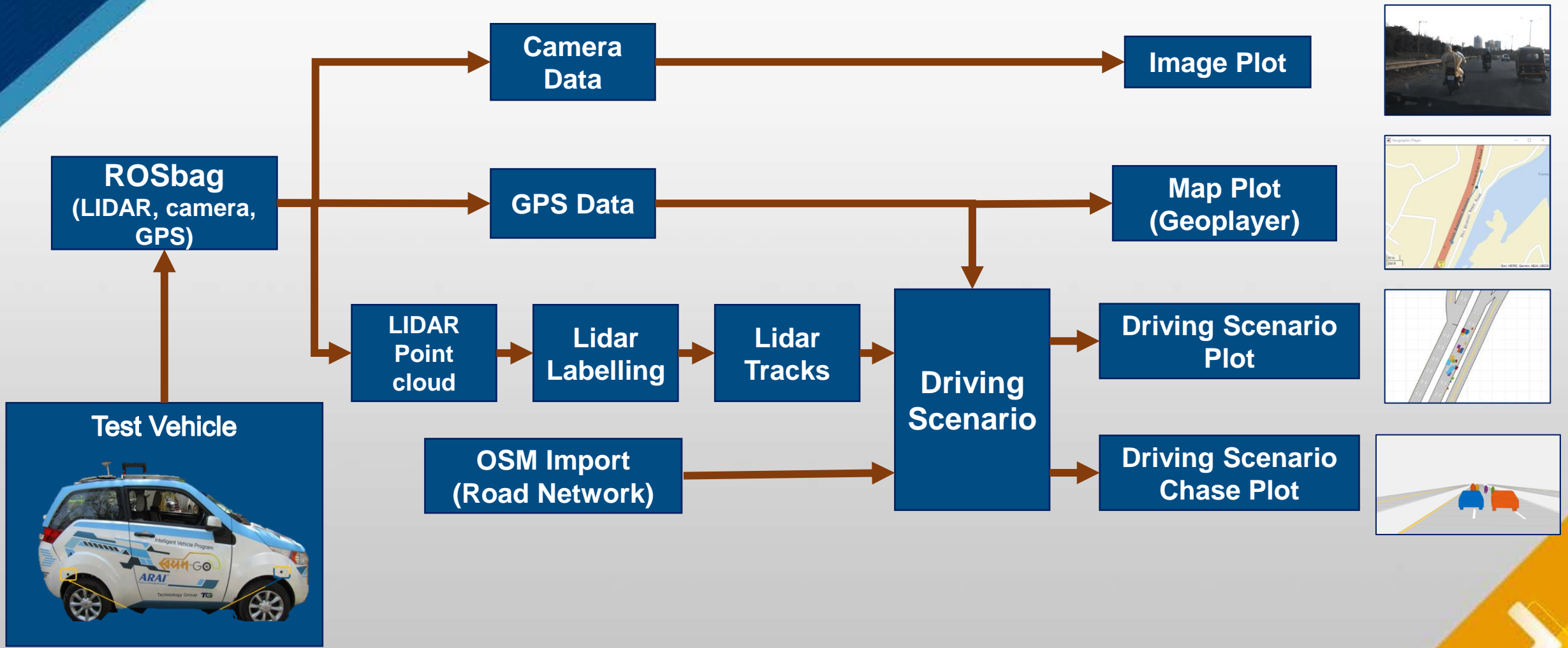
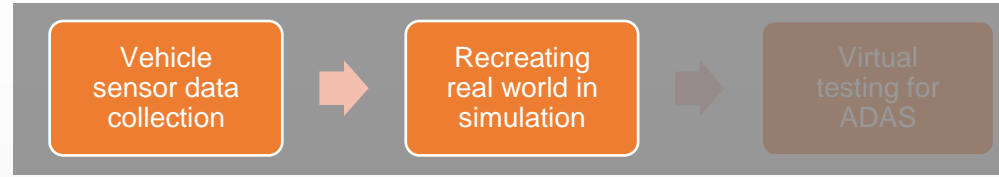
Real world sensor data collection



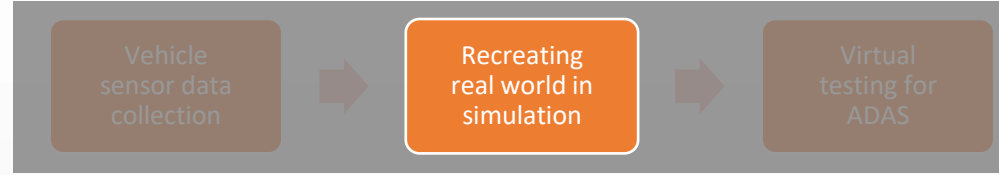
Real world sensor data collection



Creating scenario from real world sensor data



Creating scenario from real world sensor data



The MATLAB R2021a interface displays a multi-panel workflow for creating driving scenarios. On the left, a vertical plot shows recorded sensor data with colored rectangular markers representing non-ego actors. The top-right panel, titled "Driving Scenario", shows a 3D perspective view of a road with a yellow ego vehicle and several non-ego vehicles (green, blue, purple) in a simulated environment. The bottom-right panel, titled "Open Scenario", shows a real-world camera view of a road with a similar 3D overlay. Below the plots, a horizontal timeline with a grid shows the process steps: "Pose estimation at LIDAR time stamps", "Placing non-ego actors", "Synchronize visualization", and "Save Scenarios". A legend in the bottom right corner identifies "EgoSim" with a blue circle and "Lidar" with a red plus sign.

Scenario variation- Crash scenario

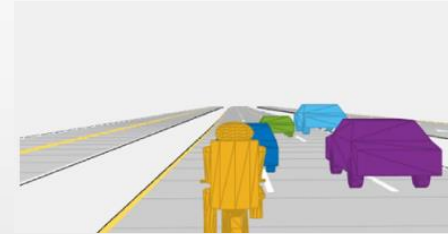


Recorded time stamped data

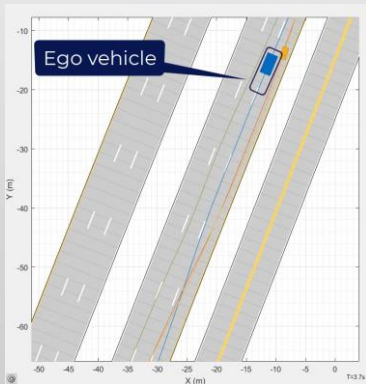


**Sensor to
Scenario**

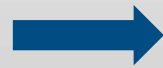
Scenario
Creation



Open Scenario

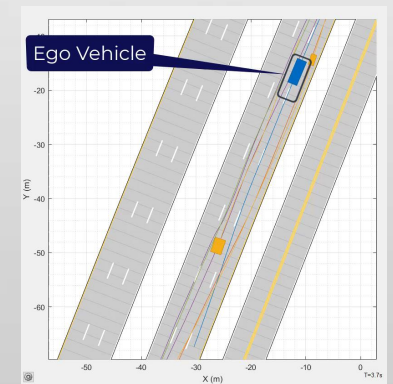
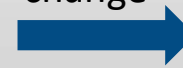


SEED SCENARIO



**Scenario
Variation**

Target velocity
change



CRASH SCENARIO



Scenario variation- Crash scenario

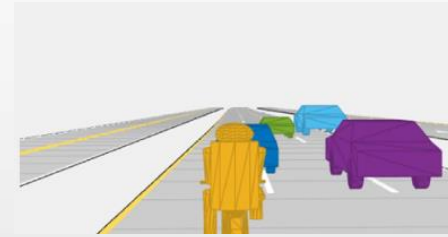


Recorded time stamped data



**Sensor to
Scenario**

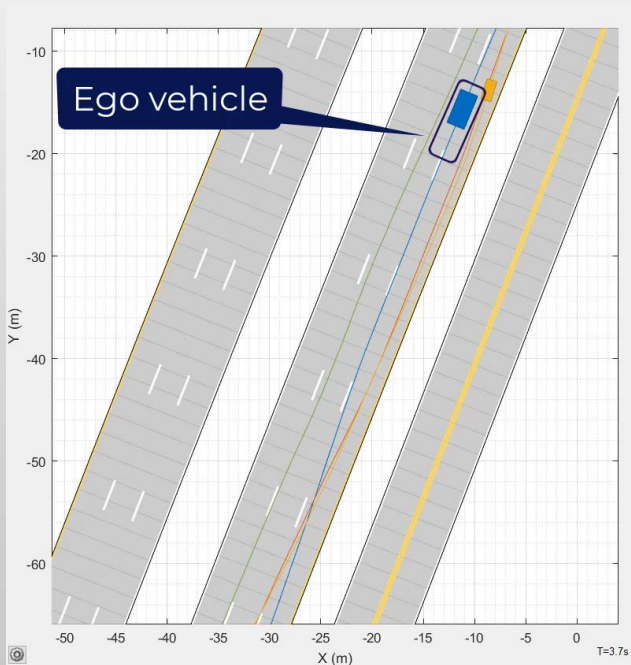
Scenario
Creation



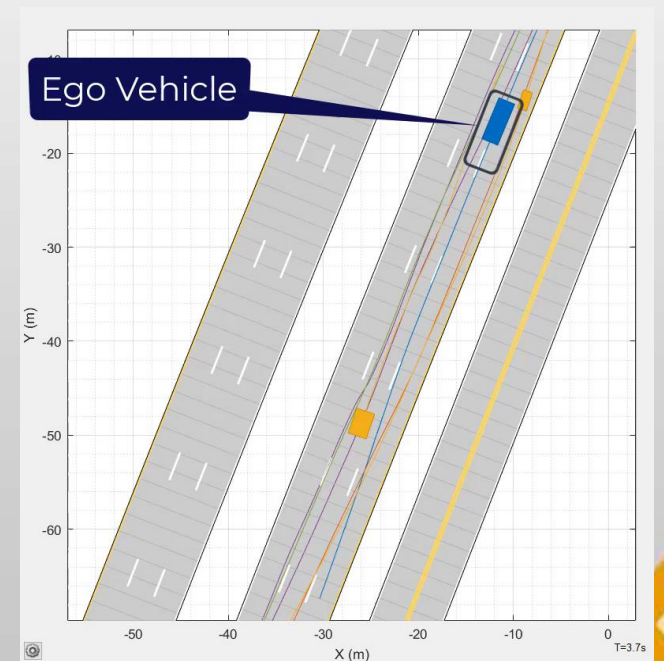
Open Scenario

**Scenario
Variation**

Target velocity
change

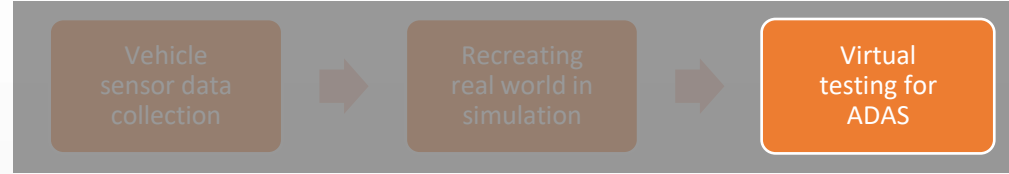


SEED SCENARIO

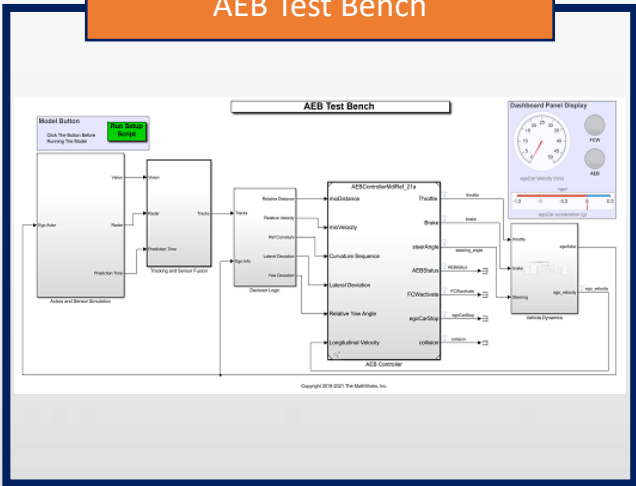


CRASH SCENARIO

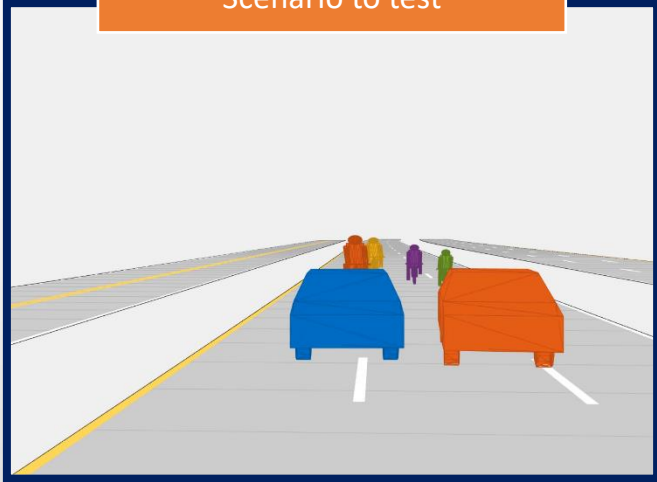
AEB testing with recorded scenario



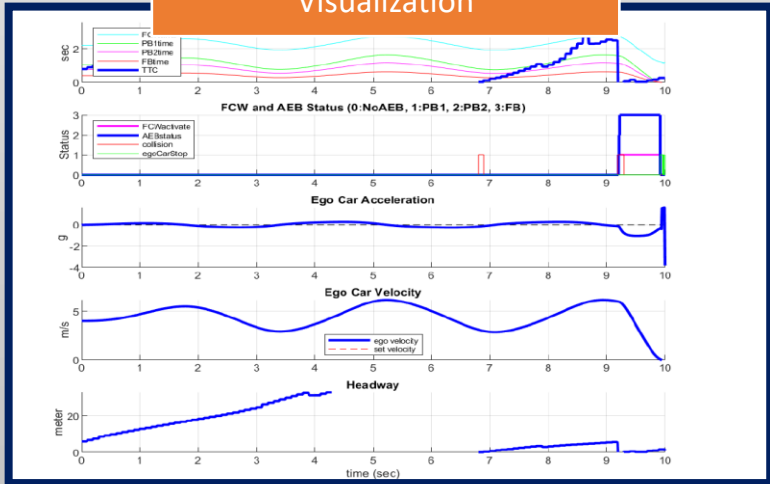
AEB Test Bench



Scenario to test



Visualization



Test automation for AEB with multiple scenarios

Vehicle sensor data collection

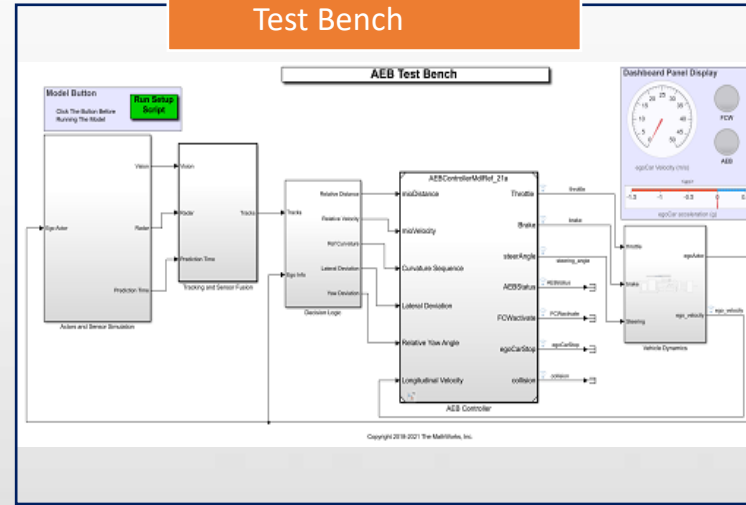
Recreating real world in simulation

Virtual testing for ADAS

Requirements Gathering

The screenshot shows the Requirements Editor interface. On the left, a list of requirements is displayed with columns for ID, Name, and Summary. The selected requirement is 'AFB_PedestrianTurning_Farside_10kph'. The main area shows the 'Test Description', 'Target Actor' (Adult pedestrian), and 'Requirement Vehicle Unc' (The VUT will follow straight-line in the lane which will from the centre).

Test Bench



Scenarios to Test

The screenshot shows a 'Filter tests' interface for 'AutomateTestingForAEB'. A tree view shows the 'AEB Test Bench' folder expanded, listing several scenarios: Recorded Vehicle Data, AEB_PedestrianTurning_Farside_10kph, AEB_Pedestrian_Longitudinal_50width, AEB_Pedestrian_Nearside_75width, AEB_CCRm_100overlap, AEB_CCRb_6_initialGap_40m, AEB_Bicyclist_Longitudinal_25width, and AEB_PedestrianChild_Nearside_50width.

Test Manager

The screenshot shows the Test Manager interface. It features a 'TESTS' list on the left with columns for Name, Type, Model, Simulation Mode, Location, Enabled, and Hierarch. The selected test is 'Recorded Vehicle Data'. The main area shows the configuration for this test, including 'Model: AEBTestBenchExample_21a', 'TEST HARNESS', 'SIMULATION SETTINGS AND RELEASE OVERRIDES', 'PARAMETER OVERRIDES', and 'CALLBACKS'.

Report Generation

Summary

Name

Results: 2021-Aug-20 00:26:09

- [-] AEB Test Bench
- [+] Recorded Vehicle Data
- [+] AEB PedestrianTurning Farside 10kph
- [+] AEB Pedestrian Longitudinal 50width
- [+] AEB Pedestrian Nearside 75width
- [+] AEB CCRm 100overlap
- [+] AEB CCRb 6 initialGap 40m
- [+] AEB Bicyclist Longitudinal 25width
- [+] AEB PedestrianChild Nearside 50width

Outcome	Duration (Seconds)
8 ✓	356.306
8 ✓	356.307
✓	58.272
✓	55.112
✓	39.002
✓	41.969
✓	41.798
✓	38.59
✓	40.599
✓	40.739

Summary

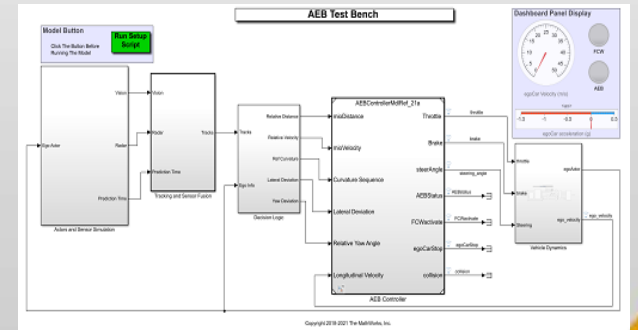
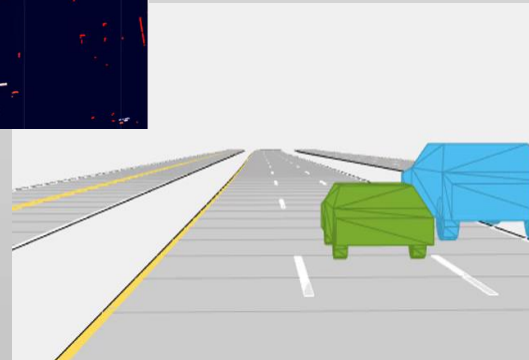
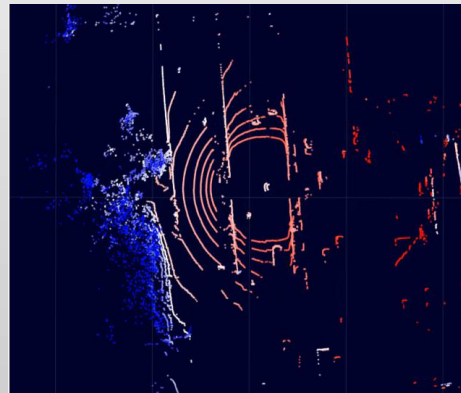
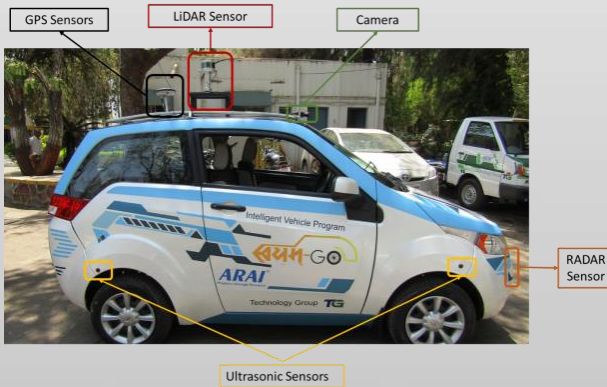
Vehicle
sensor data
collection



Recreating
real world in
simulation



Virtual
testing for
ADAS



Conclusion

To make ADAS vehicles safer, real word testing plays a very crucial role

Simulation will be the key for making ADAS vehicles safer and improve the development speed

Current work gives a promising platform and process for lab level validation

While we have shown AEB, this workflow could also be adopted for other ADAS features

Incorporating Indian specific traffic conditions



THANK YOU!

Deployment
platform

Complete V&V
setup



Scenario
generation from
recorded sensor
data

India specific data
set generation

Please get in touch with us for further queries/discussions

karle.tg@araiindia.com

