Powering Innovation That Drives Human Advancement

Robust ADAS through NCAP Virtual Testing

Guoyin ZHAO

Lead Application Engineer

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New challenging safety regulations for ADAS

Euro NCAP 2026 & further

Crash avoidance / AEB

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NCAP 2026+

- Increases the **weight of ratings** for ADAS technologies.
- Emphasizes on systems that **detect VRUs** especially in urban environments.

- <u>Target</u>: Avoid sub-optimization due to strict testing conditions
  - Incorporate **virtual testing methods** into the assessment process.
  - Introduce **robustness** tests to challenge all system layers: algorithm and **perception**

Crash Avoidance

Frontal Collisions		Lane Departure		Low Speed Collisions	
Car & PTW	**40**	**Single Vehicle**	**10**	**Car & PTW**	**10**
Longitudinal	15	Road Edge	5	Turning	4
- Standard Scenarios	*12*	*- Standard Scenarios*	*3*	*- Standard Scenarios*	*3*
- Robustness layers	*3*	*- Robustness layers*	*2*	*- Robustness layer*	*1*
Turning	10	Acceptance	5	Crossing	6
- Standard Scenarios	*8*				
- Robustness layers	*2*				
Crossing	15	**Car & PTW**	**10**	**Pedestrian & Cyclist**	**10**
- Standard Scenarios	*12*	Oncoming	5	Crossing	3
- Robustness layers	*3*	*- Standard Scenarios*	*4*	Manoeuvring	5
		- Robustness layers	*1*	Dooring	2
Pedestrian & Cyclist	**20**	Overtaking	5		
Longitudinal	5	*- Standard Scenarios*	*4*		
- Standard Scenarios	*4*	*- Robustness layers*	*1*		
- Robustness layers	*1*				
Turning	5				
- Standard Scenarios	*4*				
- Robustness layers	*1*				
Crossing	10				
- Standard Scenarios	*8*				
- Robustness layers	*2*				

***Ardiano Palao**, Technical Manager ADAS & AD Euro NCAP*

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NCAP 2026 – Virtual testing is part of assessment process

- NCAP now accepts virtual testing results as valid input for Safe Driving and Crash Avoidance performance:
  1. Qualification of simulation model by OEM
  2. Virtual testing generates color predictions
  3. Physical verification testing by Euro NCAP (random selection)
  4. Validation of virtual test data

- Database of scenario provided by Euro NCAP in OpenSCENARIO XML format.

Scenario cluster	Acceptance criteria Standard Matrix	Acceptance criteria Extended Matrix
Frontal – Longitudinal	[0.7]	[0.5]
Frontal – Turning	[0.7]	[0.5]
Frontal – Crossing	[0.7]	[0.5]

ISO score (ISO TS 188571) – longitudinal vehicle acceleration

Scenario cluster	KPI_error	Accepted KPI_error
Frontal – Longitudinal	TTC_AEB [s]	[+-0.2]
	TTC_FCW [s]	[+-0.2]
	Remaining distance [m]	[+-1.0]
	Impact speed [m/s]	[+-1.0]
Frontal – Turning	TTC_AEB [s]	[+-0.2]
	TTC_FCW [s]	[+-0.2]
	Remaining distance [m]	[+-1.0]
	Impact speed [m/s]	[+-1.0]
Frontal – Crossing	TTC_AEB [s]	[+-0.25]
	TTC_FCW [s]	[+-0.5]
	Impact speed [m/s]	[+-1.0]
Lane – ELK	DTLE_ELK [m]	[+-0.2]
	DTLE_LDW [m]	[+-0.2]

KPIs per Scenario Cluster

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NCAP 2026 – Performance prediction using simulation

Pedestrian & Cyclist assessment	Maximum points			
	Standard Range	Extended Range	Robustness Layers	TOTAL
	16	2	2	20

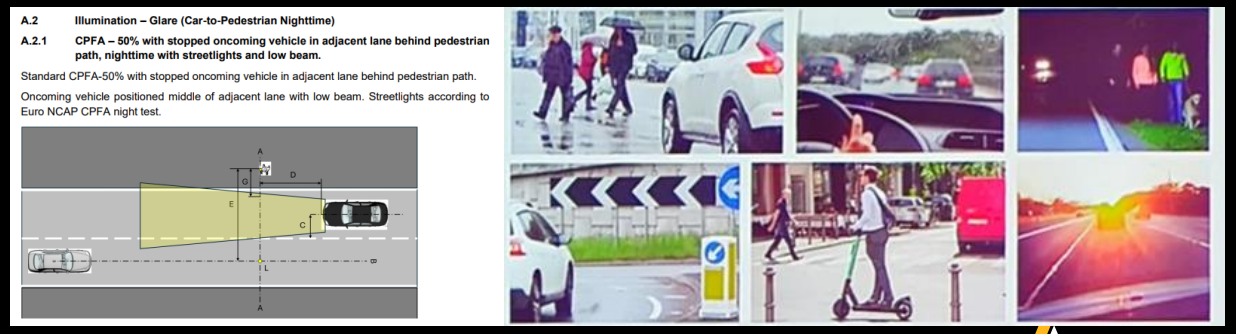
- Main Layer – Scenario
  - Focus on planning & control algorithm performances
  - Scenario GRID testing – color ratings
    - 2D matrix with Standard Range + Extended Range
    - Virtual Testing can be used as valid input, assuming “perfect” perception.
- Additional Layers – Perception
  - Introduction of test complexity and variation, designed to challenge vehicle systems and encourage reliable “real-world” performance
  - Based on real-world data logging (FOT)
  - Can be anticipated with perception in the loop simulation

CPNA	EPT Speed	✱/C	Impact Location 10%	25%	50%	75%	90%
10 km/h	5 km/h	✱					
20 km/h	5 km/h	✱					
30 km/h	5 km/h	✱					
40 km/h	5 km/h	✱					
50 km/h	5 km/h	✱					
60 km/h	5 km/h	✱					
10 km/h	5 km/h	C					
20 km/h	5 km/h	C					
30 km/h	5 km/h	C					
40 km/h	5 km/h	C					
50 km/h	5 km/h	C					
60 km/h	5 km/h	C					

Standard Range
Extended Range

Predicted Colour	Grid cell scaling (mitigation & avoidance scenarios) Standard Range	Extended Range Impact Location ≤2 colours down*	Impact Location >2 colours down*	VUT Speed ≤1 colour down*	VUT Speed >1 colour down*
Green	1	PASS	FAIL	PASS	FAIL
Yellow	0,75				
Orange	0,50				
Brown	0,25				
Red	0	FAIL		FAIL	

** When compared against the adjacent grid cell of that parameter (Excluding Red), where impact location has higher priority than vehicle speed.*



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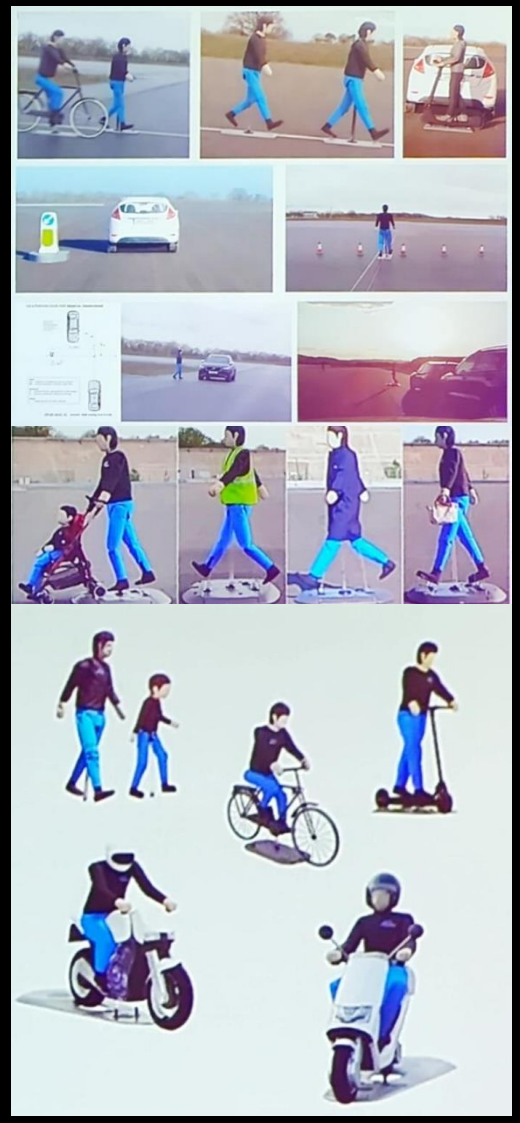
NCAP 2026 – Robustness test with perception

- Robustness testing needs perception in the loop:
  - VRU target type, Appearance
  - Adverse Weather, Illumination (nighttime, glare)
  - Infrastructure & objects obscuration

- OEMs must demonstrate that the system perception is not significantly degraded
  - Proven by real driving logs: typically challenging to collect
  - Should be anticipated based on perception in the loop simulations



Protocols 2026 – V1.0

Robustness layers		Description	Verification Test	Input source
Type	Layer			
VUT	Driver input pre-crash	Normal driving without steering robot and/or speed control function	Yes	OEM information on system overriding conditions
Target	Speed	Small variance in the nominal target speed	Yes	VTA or OEM self-claim
	Acceleration	Small variance in the nominal target acceleration	Yes	
	Initial position offset	Small variance in the nominal target initial position	Yes	
	Trajectory/ Heading	Small variance in the nominal target heading	Yes	
Environment	Type	Different collision partner type with similar kinematics	No	FOT data**
	Appearance	Same collision partner type but with different appearance (e.g., colour, accessories, shape)	No	
	Adverse weather conditions	Functionality available under the presence of Rain, Fog, Dirt/ice/moisture	No	
	Illumination (Night time)	Performance in darkness (1 lux) for all daytime scenarios	No*	
	Illumination - Glare	Functionality available under the presence of glare caused by Low sun (all scenarios)	No	
		Functionality available under the presence of glare caused by headlights of a stationary vehicle on adjacent lane (all standard nighttime scenarios)	No*	
	Infrastructure / clutter	Performance in environments cluttered with objects such as urban furniture or secondary road users (without fully obscuring the main target)	No*	
	Obscuration / Obstruction	Variance in the layout of nominal obstructions	No*	

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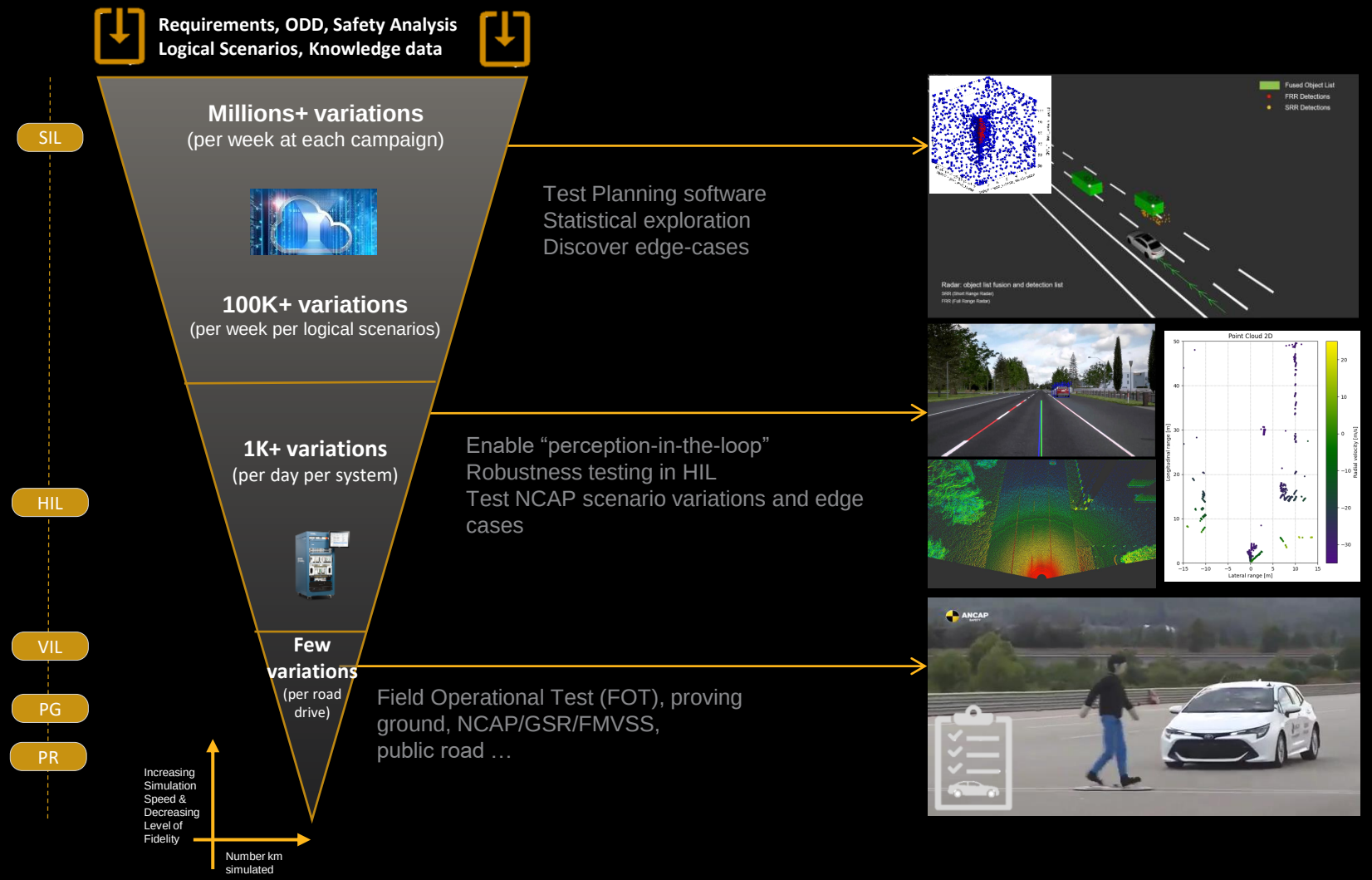
Ansys solutions for NCAP testing



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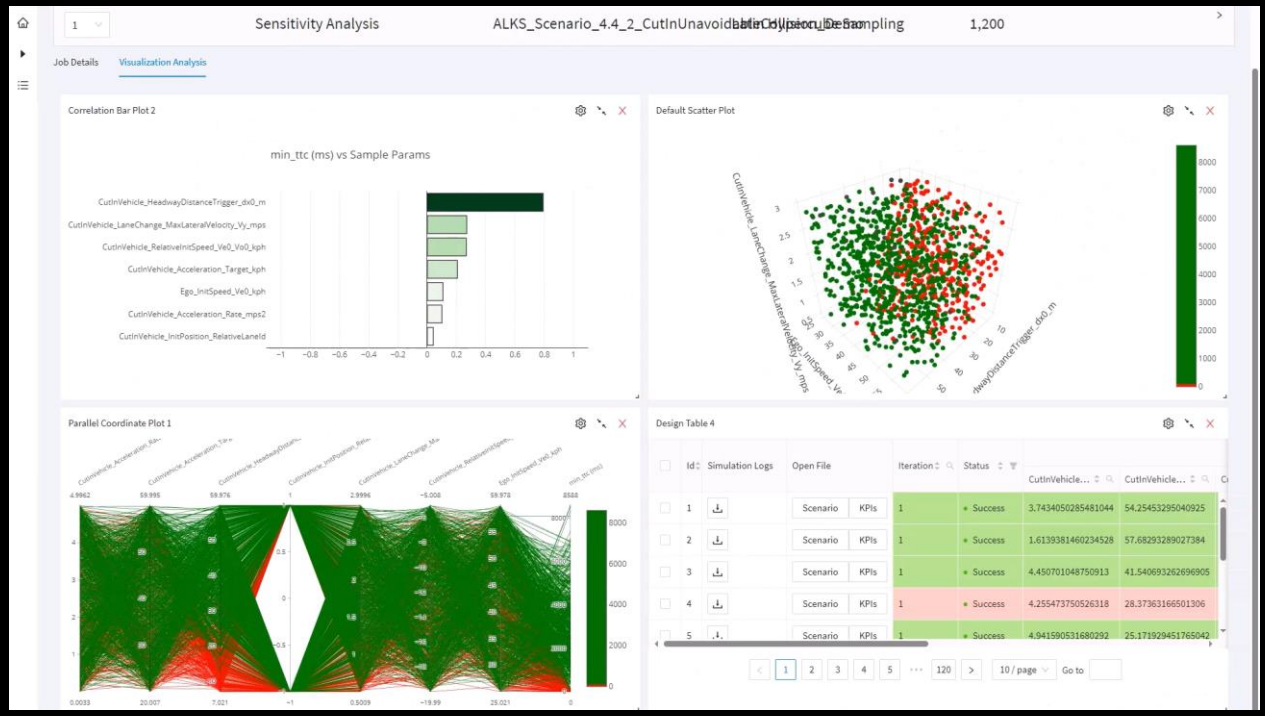
Scenario-based testing for NCAP

- Explore, Optimize, Automate
  - Bring logical scenario variation in CI/CD process (>500k variation)
  - Optimize scenario exploration
  - Orchestrate simulation on cloud AWS/Azure
  - Open simulation framework based on ASAM standards



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High fidelity sensor for NCAP perception

- Video removed due to confidentiality

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NCAP Virtual Testing examples

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NCAP CCRb (performance prediction using simulation)

Car-to-Car Rear braking

The CCRb tests will be performed at a fixed speed of 50km/h for both VUT and GVT with all combinations of -2 and -6m/s² acceleration and 12 and 40m headway. Different overlap situations may be tested for monitoring purpose at the end of the test program.

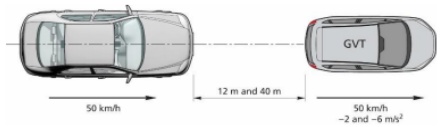
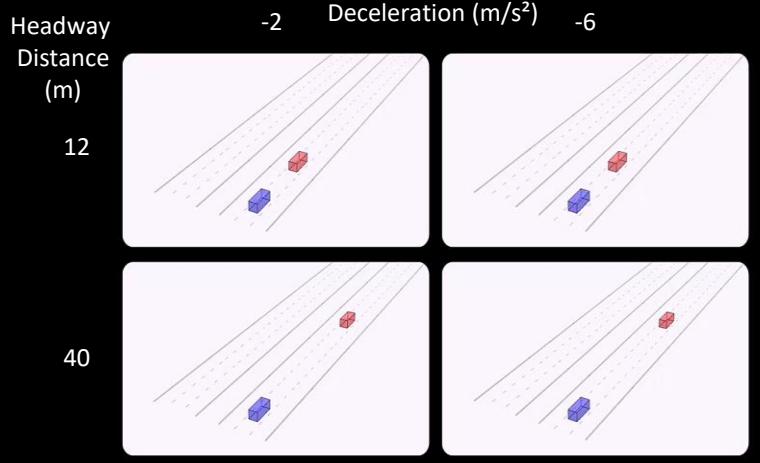


Figure 8-3: CCRb scenario

		AEB+FCW combined & AEB only	
		-2 m/s²	-6 m/s²
AEB CCRb	12m	50 km/h	50 km/h
	40m	50 km/h	50 km/h

For CCRb $T_0 = T_{GVT_deceleration_start} - 1s$.

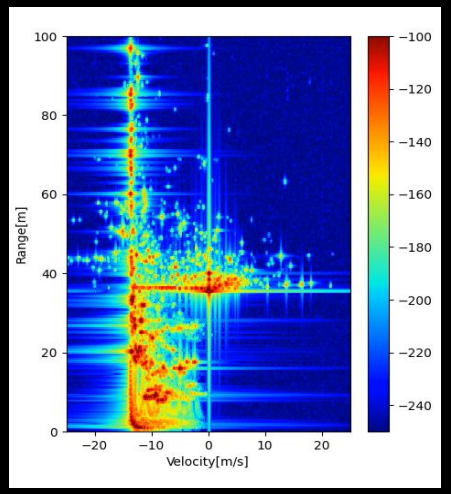
T_0 begins 1 second before GVT starts deceleration, for tolerance monitoring purposes. The desired deceleration of the GVT shall be reached within 1.0 second (T_0 + 2.0s) which after the GVT shall remain within ± 0.5 km/h of the reference speed profile, derived from the desired deceleration, until the vehicle speed equals 2km/h.

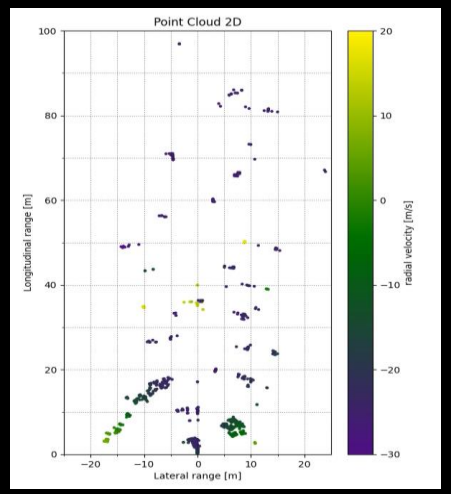


Scenario view (3rd person view)

Front camera

Radar range doppler map





Radar point cloud

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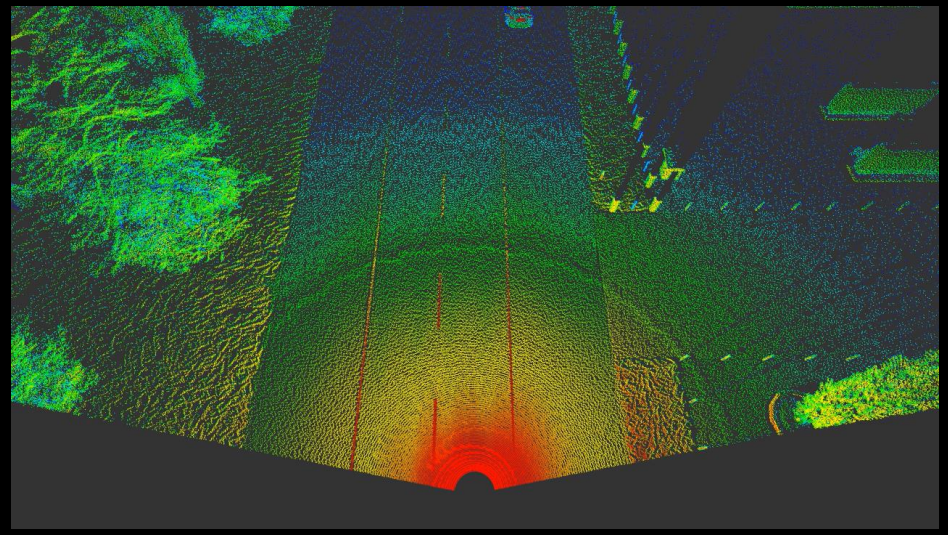
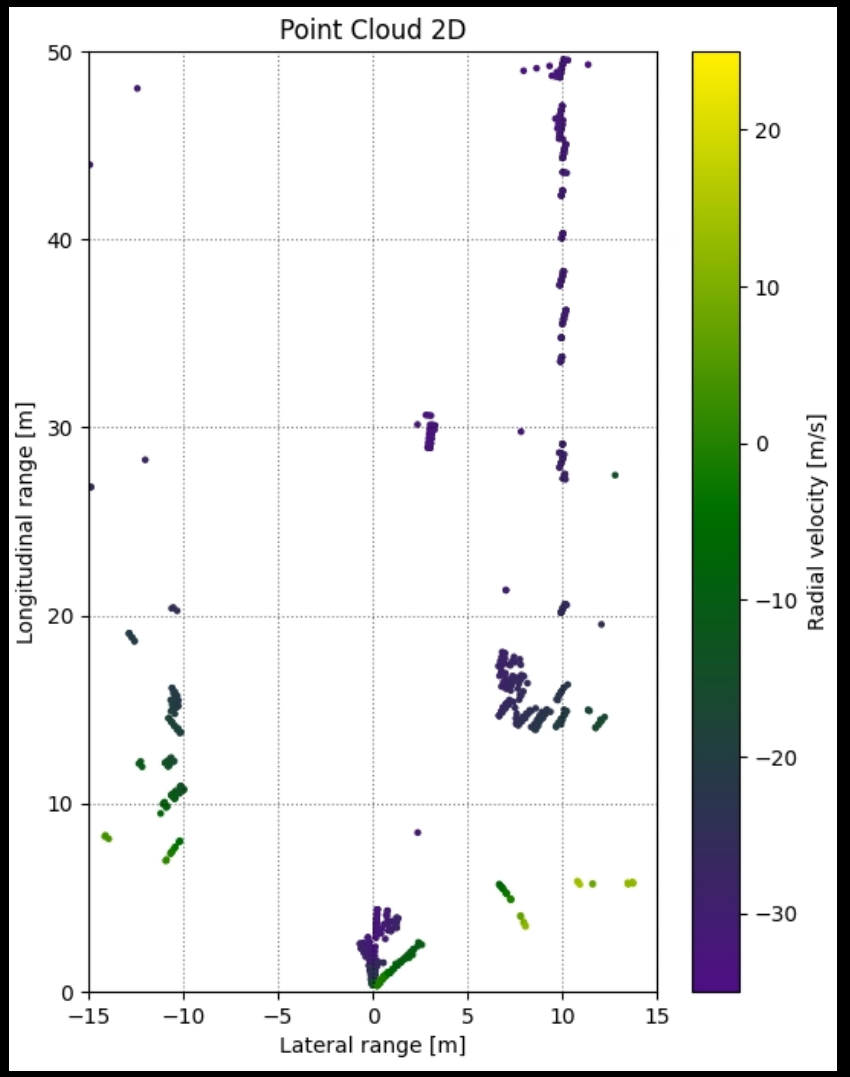
NCAP CPNCO (robustness daytime)

Front camera

Front lidar





Radar
point cloud

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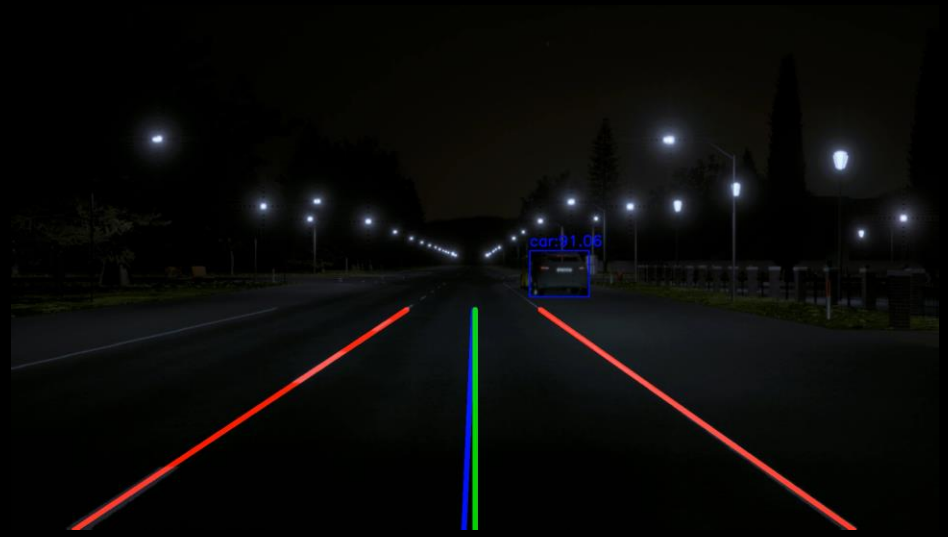
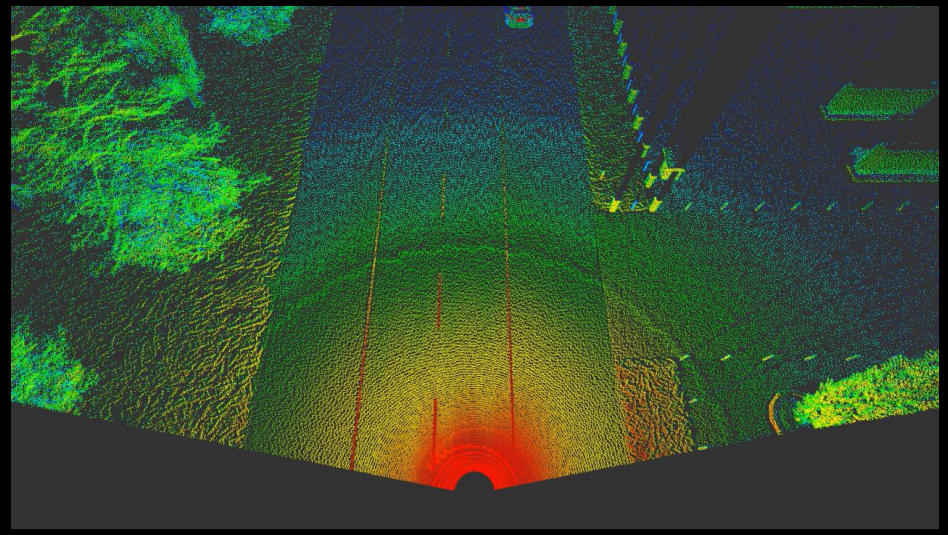
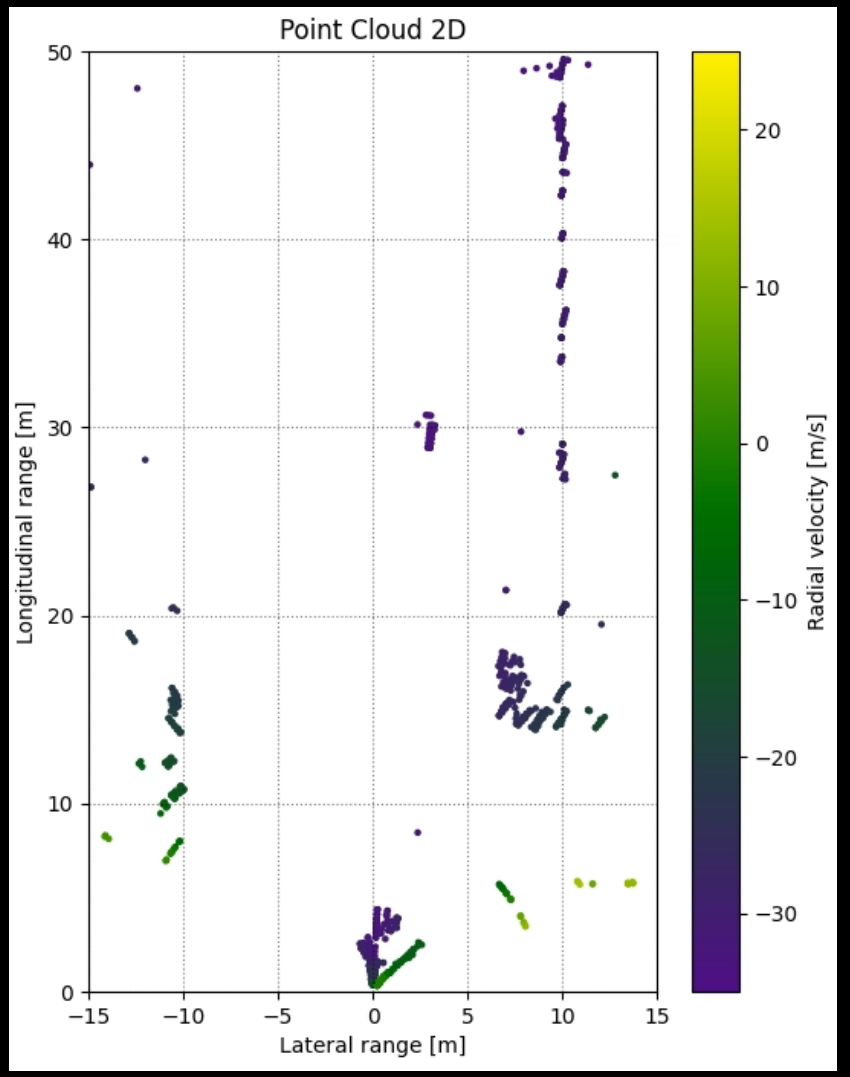
NCAP CPNCO (robustness nighttime)

Front camera



Front lidar





Radar
point cloud

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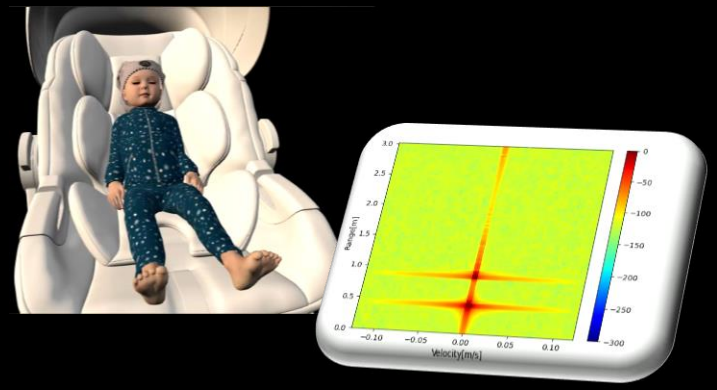
Simulation for NCAP beyond crash avoidance

- DMS/Occupant monitoring



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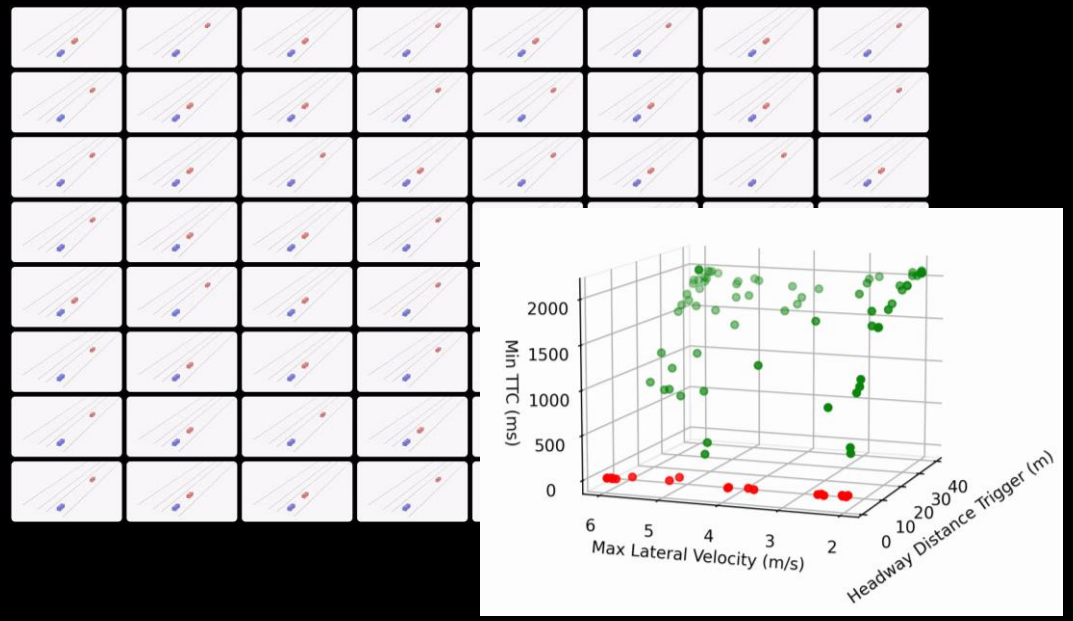
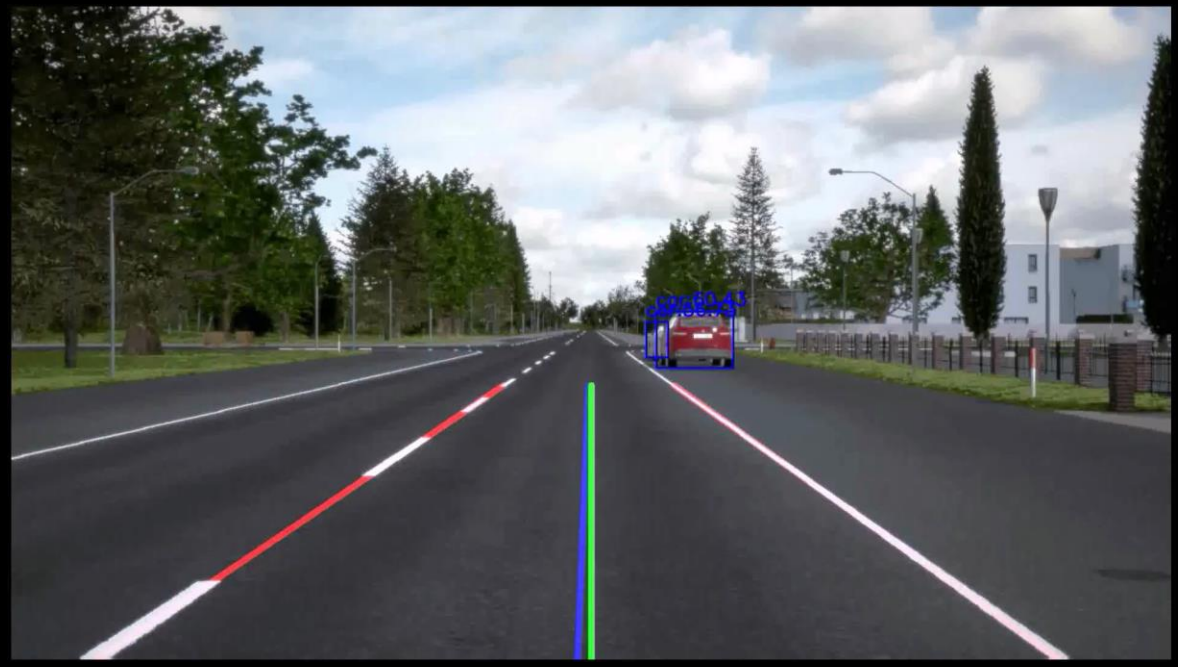
Scenario variations

- Quickly simulate NCAP scenario variations with customer ADAS Algo testing
- Help engineers to optimize ADAS algorithms using reliability methods
- Generate NCAP virtual testing reports



Perception

- Perception-in-the-loop testing using physics-based sensor (camera, radar, etc).
- Variations: target appearance, type, weather, day/night…
- Quantify performance and secure on-road testing



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