

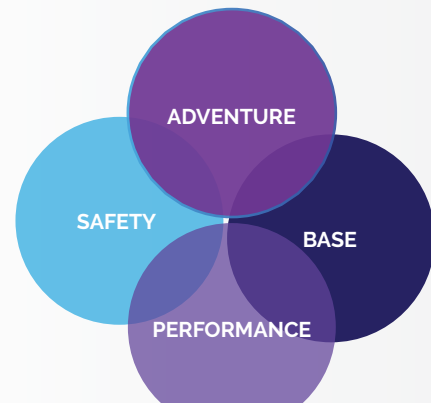
# Cartex 4H

Cartex 4H is based on a Renesas V3H architecture with at least a 100° FOV  
It is composed of four kernels: Base, Safety, Performance and Adventure



The four kernels utilize most of the Renesas V3H resources

The base kernel requirements are set to allow full score in NCAP VRU, C2C, and SA test cases which is needed for the overall 5 stars rating. In addition to other base functionality such as: ACC/TJP, LCA, HLB, ADB, TFL and free space



## BASE

### OBJECT DETECTION

	Detection	Maximal distance (day)	Maximal distance (night)	Classification
<b>Vehicle</b>	3D (width, length, height)	150m – car, truck 80m - motorcycle	150m – car, truck 80m - motorcycle	Car, truck/bus, motorcycle
<b>Pedestrian</b>	2D (width, height)	75m	50m	Pedestrian, cyclist

Object detection, tracking, and measurements are used for AEB, and ACC applications only. At host vehicle speed of 0-120km/h

Up to 20 relevant objects will be detected in the host lane direction, and oncoming lanes. Parked vehicles are excluded

### LANES DETECTION

- The algorithm detects, tracks, and measure continuous host, next right, next left lane marks, and road edges when the camera field of view allows for it, up to 150m
- Lane detection will be used for LDW, LKA, and LCA applications only. At host vehicle speed of 0-120km/h
- Lane marks, and road edges will be detected when their radius of curvature is larger than 50m
- Detected lane marks will be classified into the following categories: solid, dashed, Bott's dots, solid-dashed, dashed-solid, and triple lane marks
- Detected lane marks colours will be classified into the following categories: White, Yellow, Blue, and Orange
- Detected road edge will be classified as road edge

### TRAFFIC SIGNS AND TRAFFIC LIGHT DETECTION

- Detection, tracking, measurement and classification of traffic signs is based on the road signs listed in the Vienna convention
- Detection of traffic signs is limited to signs relevant to the host lane
- Detection range for traffic signs is based on common TSR industry standards
- Traffic signs classification is limited to round, rectangle and triangle
- Detection of traffic lights is based on the traffic lights listed in the Vienna convention
- Detection of traffic lights is limited to traffic lights relevant to the host lane
- There is no classification for traffic lights

## CARTEX 4H SAFETY

The Safety kernel is oriented towards providing the best value for money regarding ego vehicle and VRUs safety  
Includes SSW, Animals FCW/AEB, Pedal confusion, and Lane assignment

### OPTIONAL NARROW FUNCTIONS

Open door AEB, FCW child, School zone assist, Bypass assist, Zebra crossing alert, Vehicle cut in alert, Pullover maneuver, Scooter alert, Wrong way alert, Open door steer assist, Turn assist, Lateral "FCW", and Dog/cat FCW

### CARTEX 4H PERFORMANCE

- The Safety kernel is oriented towards providing a top-notch driving experience to the driver
- Includes Hazards/debris, and road profile

### OPTIONAL NARROW FUNCTIONS

Bypass assist, Open door AEB, Highway exit reminder, Parking assist, Vehicle cut in alert, Pullover maneuver, Road profile, Open door steer assist, Turn assist, Construction area pilot, and Speed bump ahead

### CARTEX 4H ADVENTURE

The adventure kernel provides some fun, and more adventurous features such as: Off-road road profile, and vehicle summon. Both require ultra-sonic sensors

### OPTIONAL NARROW FUNCTIONS

Overtake assist, Open door AEB, Highway exit reminder, Parking assist, Vehicle cut in alert, Pullover maneuver, Road profile, Open door steer assist, Turn assist, Construction area pilot, and Speed bump ahead

## NARROW FUNCTIONS

### OPEN DOOR AEB/STEER ASSIST

AutoBrains solution can both classify a new obstacle as the open door of a parked vehicle and also detect partially open doors and estimate their final position and dimensions, allowing the ego vehicle ECU to adjust the vehicle path

### SCOOTER ALERT

AutoBrains solution can refine the classification as pedestrian or cyclist into a specific electric scooter sub-category. The time-to-collision alert is increased accordingly, so the AEB will have enhanced sensitivity to electric scooters within its field of view

### SCHOOL ZONE ASSIST

AutoBrains solution deploys OCR only after detecting a School Zone sign and the relevant frame areas for the OCR, which may be part of the traffic sign or as a supplementary sign. GPS data is then used to infer if Speed Alert is required when ego speed exceeds the speed indicated in the School Zone sign

### ZEBRA CROSSING ALERT

AutoBrains provides a solution which takes into account VRUs position, zebra crossing location, and other zebra crossing indications (Traffic signs)

It is based on several indications:

- Zebra crossing detection, and location
- Zebra crossing traffic signs
- VRUs proximity to any of the above

When either a Zebra crossing, or a zebra crossing sign is detected with pedestrians in near proximity an alert will be issued.

### TURN ASSIST

Our solution will predict, and calculate the trajectory of all objects in the field of view of the camera. When the objects predicated trajectory intersects with the ego vehicle trajectory. Torque adjustments will be given to avoid collision, and the need for AEB

### SPEED BUMPS AHEAD

The system will detect speed bumps only (a reduced road profile) and provide longitudinal distance and alerts to the driver

### OFF-ROAD ROAD PROFILE

The solution can be either passive or active. When passive it will alert the driver to various hazards such as debris, rocks, pot-holes and sharp inclinations.

When active in will be much like ACC (Adaptive Cruise Control), tracking the vehicle ahead and adjusting its path based on detected hazards.

### PARKING ASSIST

The average driver uses many "tell signs" to understand what a parking spot is and what is not: Parking signs, curb colour, spaces between parked vehicles, etc. Cartica solution will use a similar approach based on the following detection functions: traffic signs recognition, road edge detection, and vehicles detection

### FCW CHILD

Autobrain solution is to not only use unsupervised machine learning to classify a target as a pedestrian, or cyclists. But add a sub category of adult or child. After we determine if the target is a child. We will increase the various alerts time to collision accordingly. So the AEB function will be more sensitive to detected children in its field of view

### OVERTAKE ASSIST

Autobrain solution is based on two processes:

- Detecting driver intention to overtake a preceding vehicle - This can be done based on ego vehicle acceleration, yaw, and yaw rate. Compared to the preceding vehicle velocity, acceleration, yaw, and yaw rate. Also, comparing the ego lane curve radius, and the ego vehicle yaw
- Detecting vehicles in the soon-to-be ego-lane, and calculating the TTC to such objects. Then, compare those TTCs to the estimated time needed to successfully complete the bypass

### VEHICLE CUT IN ALERT

The system detects vehicles in adjacent lanes as well as in the closest two, or even three lanes to each side within the Field of View and measures approximate yaw, and yaw rate of those vehicles. The system alerts when a specific threshold is reached

### HIGHWAY EXIT REMINDER

The system detects lane mark splits indicating an upcoming exit at long ranges, and provides an indication of the upcoming exit by fusing it with the navigation system route.

### WRONG WAY ALERT

The system will detect when the ego vehicle is moving in the wrong direction based on target vehicles positions, traffic signs positions, etc.

### CONSTRUCTION AREA PILOT

The system will detect roadworks based on lane marks and construction area objects. It will adjust ACC, and TJP behaviour accordingly

### VEHICLE SUMMON

Summon vehicle inside parking lot only

## COMPARISON TO THE COMPETITION

ADAS application	Cartex4H - Safety	Mobileye EyeQ4 High/EyeQ5M
FCW	✓	✓
AEB	✓	✓
SA	✓	✓
LDW	✓	✓
LKA	✓	✓
ACC/TJP	✓	✓
No entry	✓	✓
HLB	✓	✓
ADB	✓	✓
TFL	✓	✓
LCA	✓	✓
Free space	✓	✓
SSW	✓	✓
Hazards/ debris	✓	✓
Animals FCW/AEB	✓	✓
Pedal confusion	✓	✓
Road profile	✓	✓
Lane assignment	✓	✓
Highway pilot	✓	
Urban pilot	✓	
Open door AEB	✓	
Open door steer-assist	✓	
Parking assist	✓	
Scooter alert	✓	
FCW child	✓	
Lateral "FCW"	✓	
Dog/cat FCW	✓	
Speed bump ahead	✓	
School zone assist	✓	
Overtake assist	✓	
Zebra crossing alert	✓	
Vehicle cut-in alert	✓	
Pullover maneuver	✓	
Wrong way alert	✓	
Highway exit reminder	✓	
Turn assist	✓	
Construction area pilot	✓	
Off-road road profile	✓	
Vehicle summon	✓	