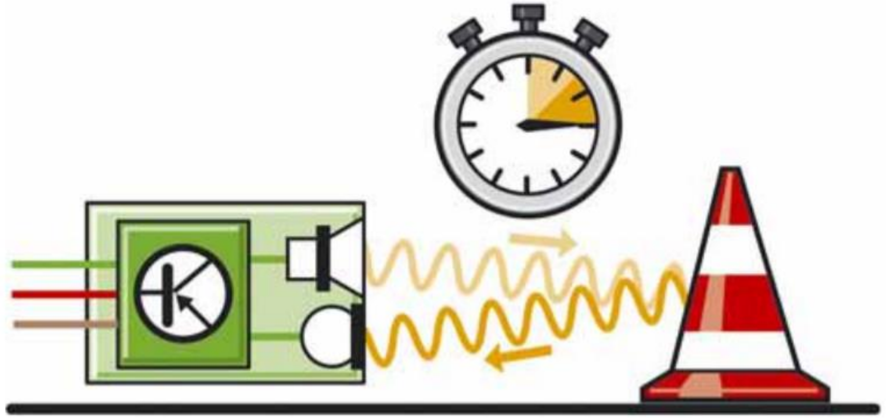
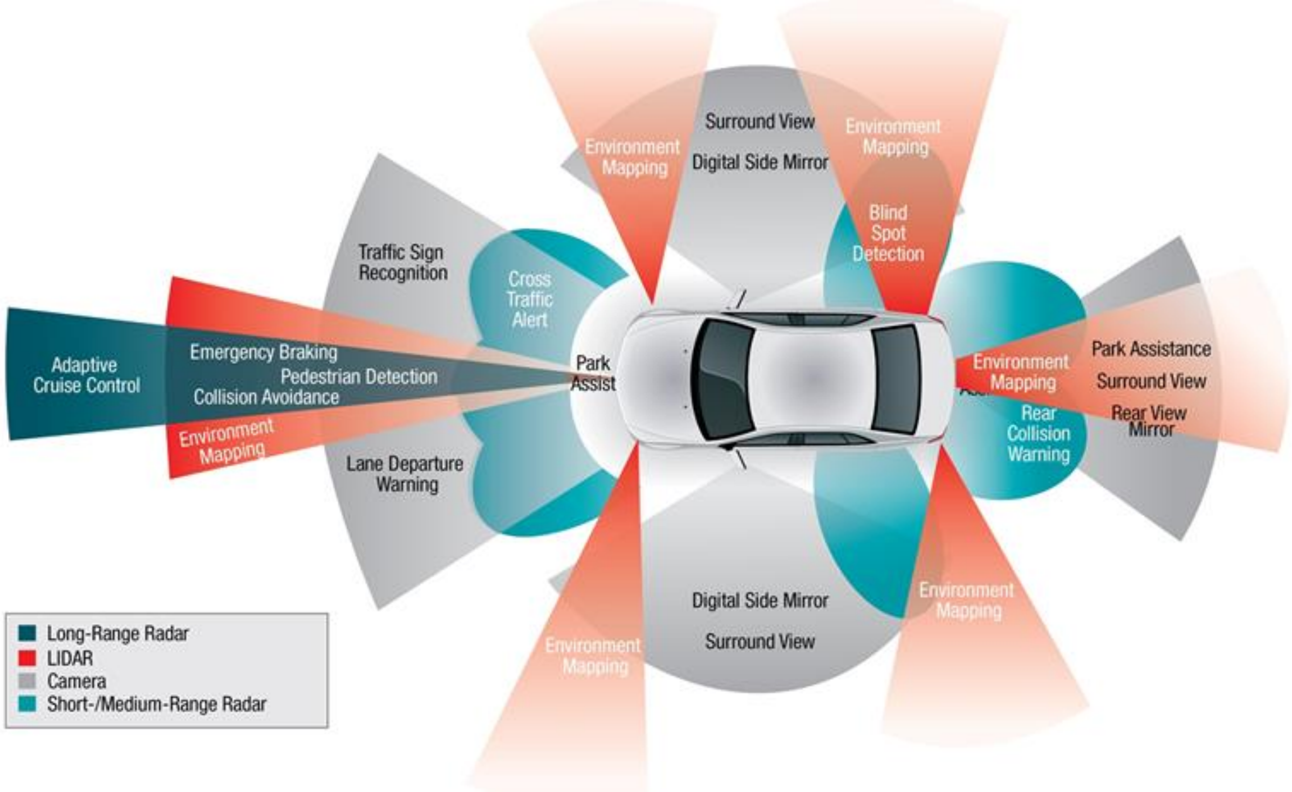
ADAS

Advanced driver-assistance systems





technical topics
enabling diagnostic expertise

Covid-19

House rules (adopted from Dept For Education)

Regular hand cleansing (hand sanitiser in entrance, class entrance and tea room)

Respiratory health: Catch it, bin it, kill it!

1M Plus rule wherever practical

Face masks optional in classroom

Face masks mandatory whilst moving around site (stairs, hallways), and where 1m plus not possible (group work in workshop)

Drinks: 4 persons in team room at any one time. Tea machine, disposable cups/stirrers, individual sugar sachets

Food: Food eaten at desk/in workshop area, food prepped Covid safe establishments.

Introductions

Author: James Dillon

Session Aim

To understand the technology behind Advanced Driver Assistance Systems and to enable diagnosis, repair and calibration.

To achieve IMI ADAS Calibration Accreditation

IMI Qualification

Module Overview

This module is designed to ensure that the candidate has the ability to calibrate Advanced Driver Assistance Systems (ADAS).

The candidate will be required to identify and correctly interpret information relating to a specific vehicle and its ADAS features to determine which method of calibration is required.

The candidate will be required to identify/locate and follow software-specific recalibration methods during the assessment process. They will also be required to use the correct tools and equipment in order to demonstrate their ability to calibrate two ADAS sensors on a vehicle with a minimum of two operating systems.

The candidate will ensure that by the end of the assessment the vehicle system(s) are operating as required and all advanced safety features are correctly configured to set parameters or customer requirements.

Candidate Profile

The technician should be working in the automotive industry and must have relevant diagnostic experience to ensure that they are familiar with the skills, knowledge and techniques required to calibrate ADAS systems.

IMI Knowledge Assessment

Knowledge Requirements	
The candidate must know and understand:	
1.1	Safe working practices and Health and Safety guidelines
1.2	Technical information sources
1.3	Types of ADAS diagnostic equipment
1.4	Relevant tools and equipment used when carrying out ADAS component calibration
1.5	The calibration environment set by the manufacturer's instructions i.e. targets, lighting, and radar boards
1.6	Types of ADAS sensors and their function i.e. Optical, Radar, Lidar, and Ultra-sonic
1.7	Features of ADAS system operation i.e. steering, braking, lane departure warning, driver assistance and parking
1.8	Workplace procedures for completing and storing documentation relating to ADAS calibration
1.9	Customer interaction (which systems can/can't be calibrated)
1.10	The ADAS Code of Practice
1.11	Static, dynamic and hybrid system calibration
1.12	Wheel alignment principles
1.13	The purpose of fault codes and why they are generated

Author: James Dillon

IMI Practical Assessment

Skills Requirements	
The candidate must demonstrate the ability to:	
2.1	Protect the vehicle prior to removing any components to prevent damage to the vehicle during the assessment
2.2	Remove and replace MET components adhering to safe working practices and manufacturer's procedures
2.3	Identify ADAS features in vehicle set-up
2.4	Ensure the calibration environment set by the manufacturer's instructions i.e. targets, lighting, and radar boards
2.5	Ensure all equipment is fit for purpose prior to commencing work
2.6	Select and use diagnostic equipment for fault code reading and calibration process
2.7	Carry out calibration of two ADAS sensors on a vehicle that has a minimum of two operating systems i.e. Autonomous Emergency Braking (AEB) front/rear proximity sensors and lane departure warning
2.8	Ensure all information is captured and reported appropriately throughout the calibration activity and as required by the assessment process
2.9	Show awareness of the ADAS Code of Practice
2.10	Ensure all ADAS systems are switched on after calibration has been completed
2.11	Use Personal Protective Equipment (PPE)
2.12	Follow Health and Safety guidelines
2.13	Work within given time constraints

ADAS – key descriptor?

Advanced driver-assistance systems (ADAS), are electronic systems that aid a vehicle driver while driving.

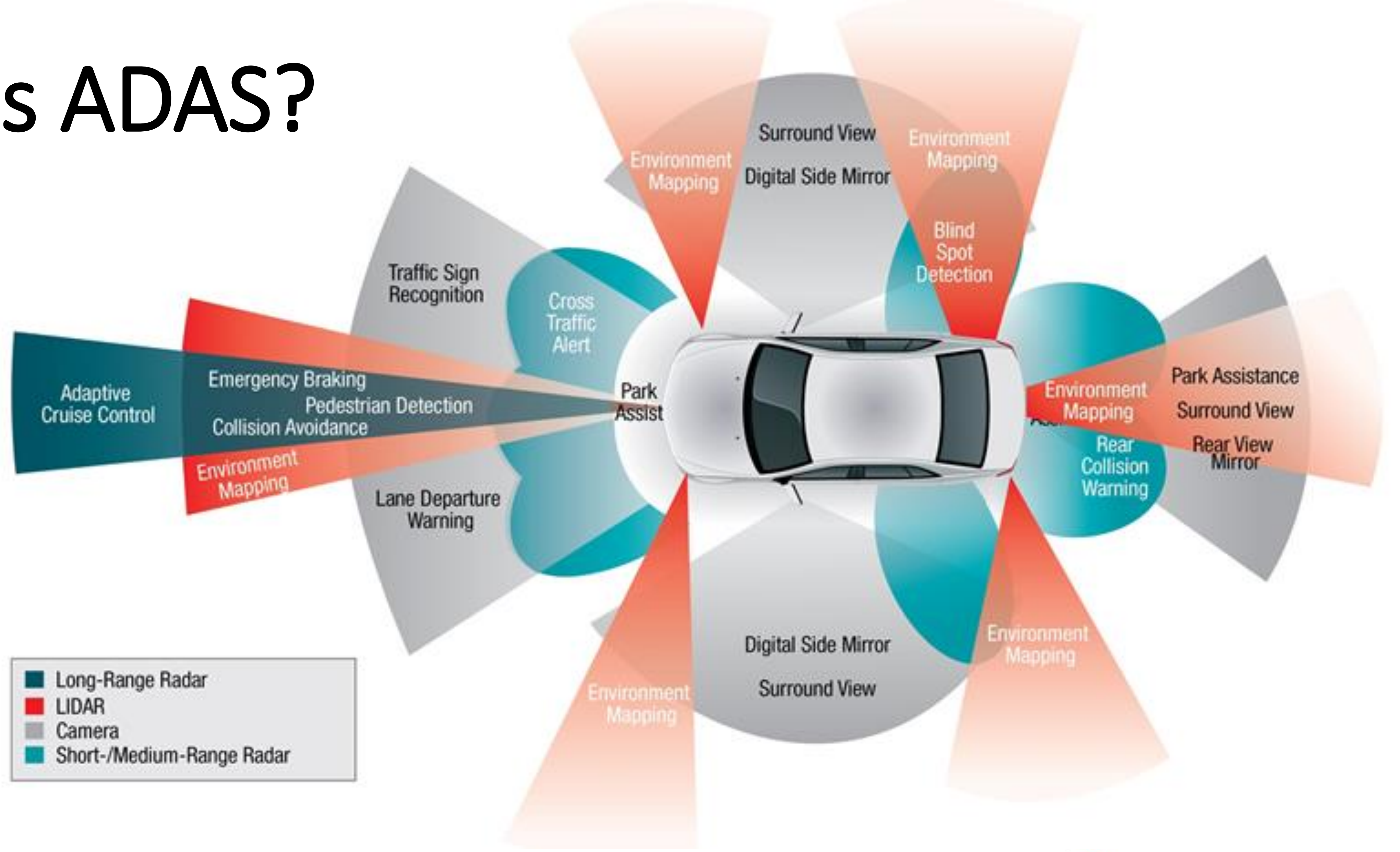
Key systems in the ADAS ecosystem?

- Automatic wipers / Headlamps
- Parking sensors
- Automatic Parking
- Automatic Cruise Control
- Adaptive lighting
- Blind Spot Monitoring
- Collision avoidance system
- City Safety
- Cross Traffic Alert
- Driver drowsiness detection
- Electronic stability control
- Hill descent control
- Lane departure warning system
- Night Vision
- Surround View system (360 camera)
- Satellite Navigation
- Tyre-pressure monitoring system
- Traction control system
- Traffic sign recognition

Key ADAS acronyms?

Handout

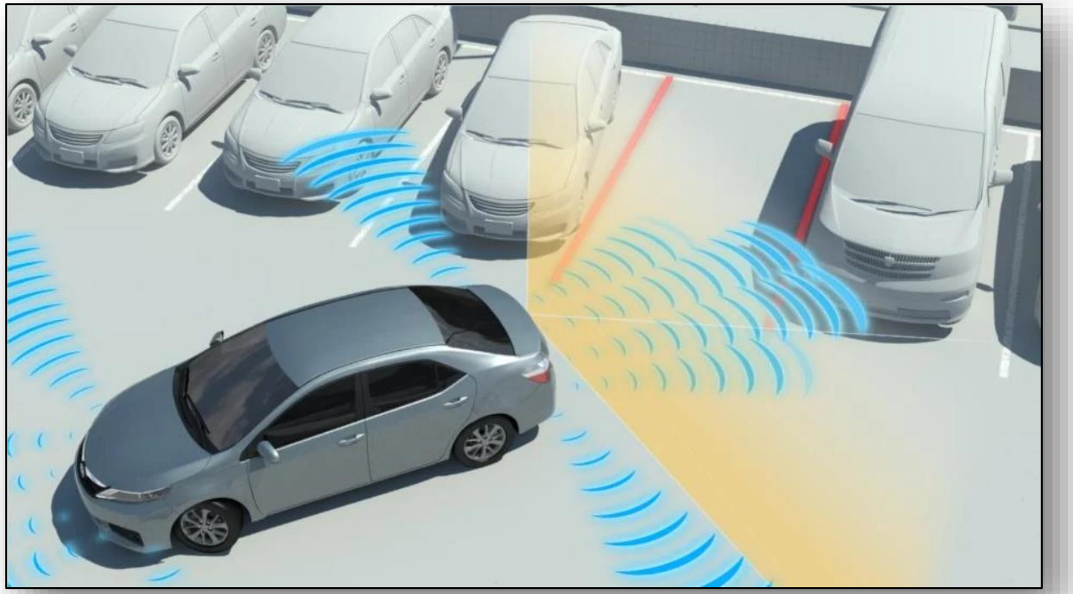
What Is ADAS?


Surround View
Digital Side Mirror
Environment Mapping
Environment Mapping
Blind Spot Detection
Traffic Sign Recognition
Cross Traffic Alert
Adaptive Cruise Control
Emergency Braking
Pedestrian Detection
Collision Avoidance
Environment Mapping
Park Assist
Lane Departure Warning
Environment Mapping
Park Assistance
Surround View
Rear View Mirror
Rear Collision Warning
Digital Side Mirror
Surround View
Environment Mapping
Environment Mapping
Long-Range Radar
LIDAR
Camera
Short-/Medium-Range Radar

Ultrasonics

Used for

- Short range detection
- Parking distance control
- Pedestrian / cyclist detection
- Pre-2010 40 kHz frequency
- Newer 48, 58 and 68 kHz



Range 0.02-4m

Measures at the speed of sound = 343 metres per second in air

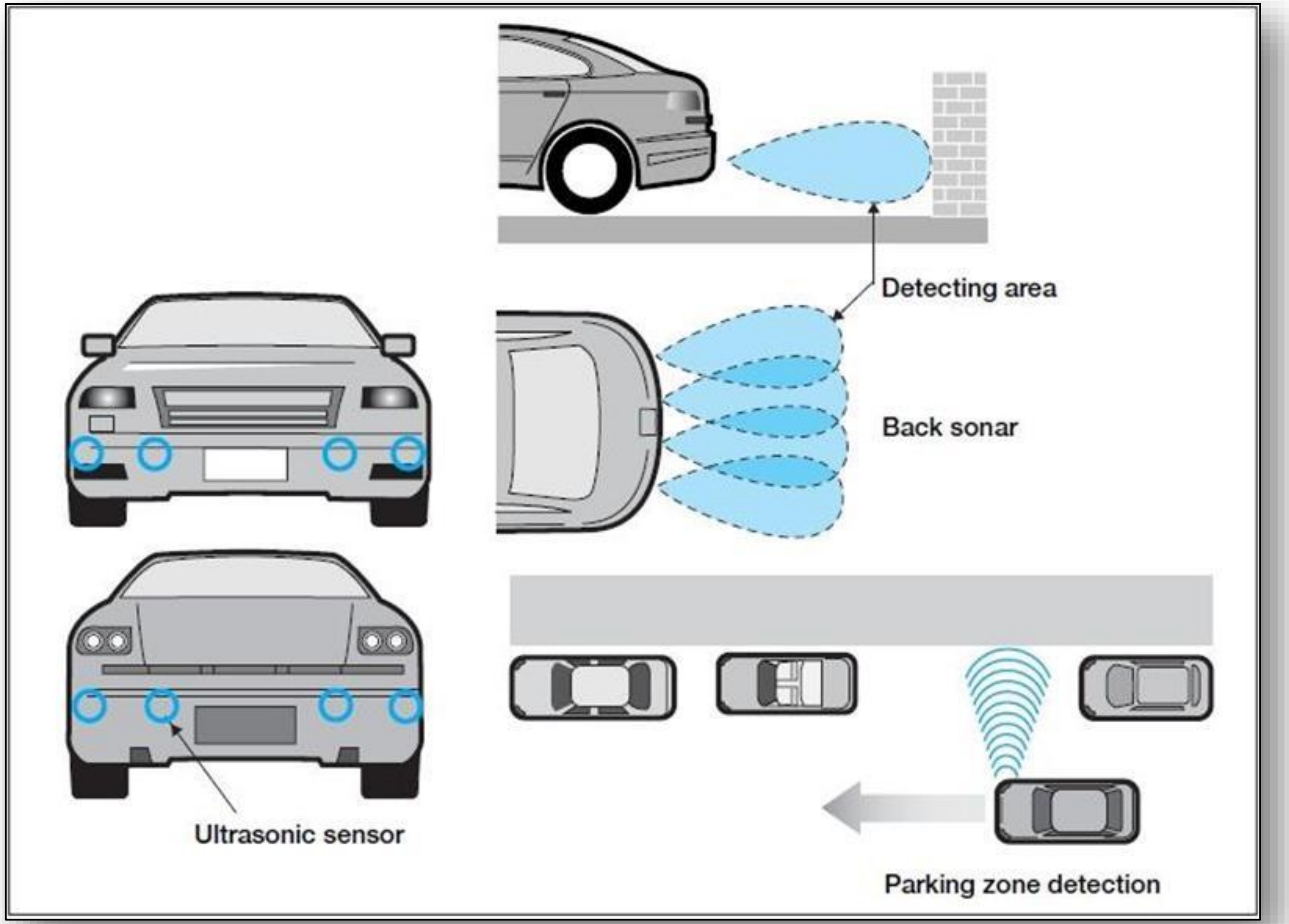
Ultra-sonics

Ultrasound has several characteristics which make it so useful and that have led to its use in many electronics applications.

Since the audible frequency range is said to be between 20Hz and 20kHz, ultrasound generally means acoustic waves above 20kHz.

✓it is inaudible to humans and therefore undetectable by the user.
✓ultrasound waves can be produced with high directivity.
✓they are a compressional vibration of matter (usually air).
✓they have a lower propagation speed than light or radio waves.

Parking Sensors

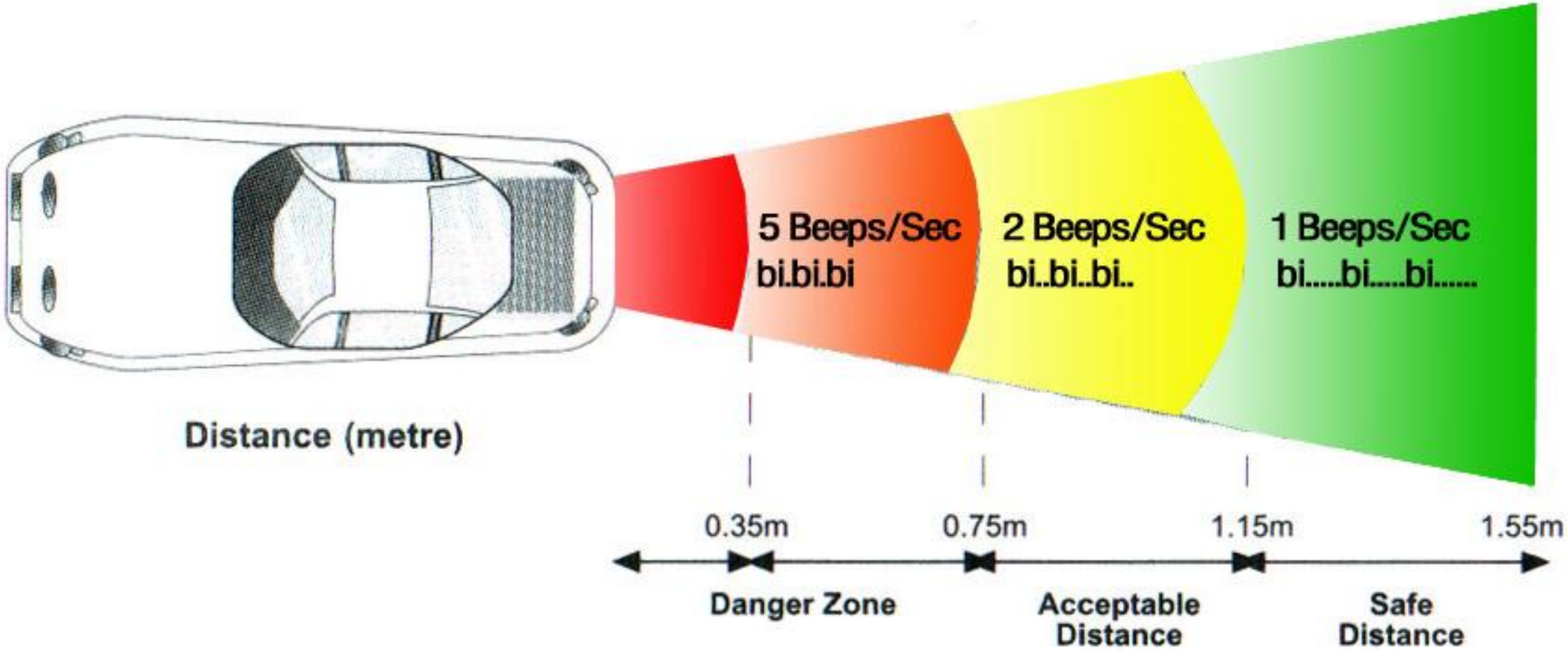


The sensor array is positioned so as not to leave any undetected areas.

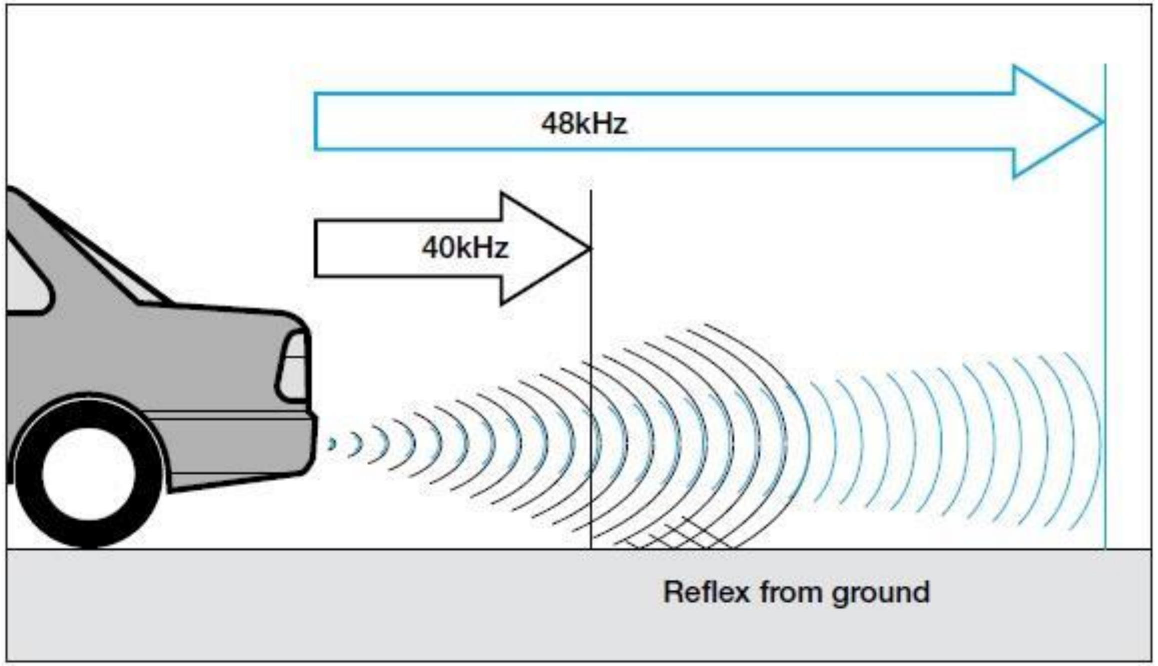
Add-on towbars and wheel/tyre/suspension modifications can cause false object detection/triggering

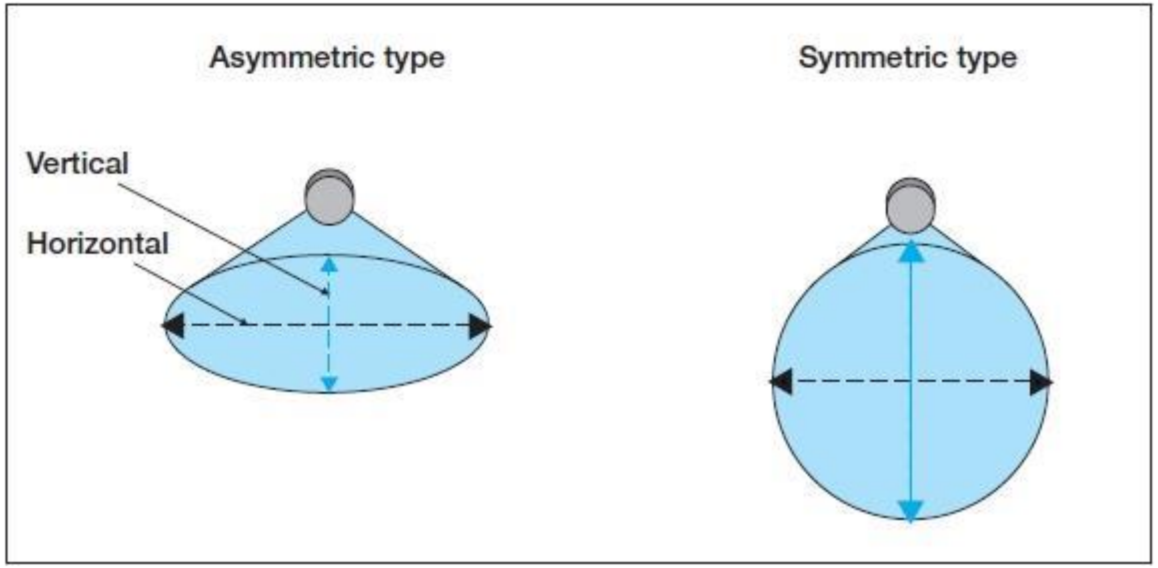
Author: James Dillon

Ultra-sonic sensors



Sensor Symmetry



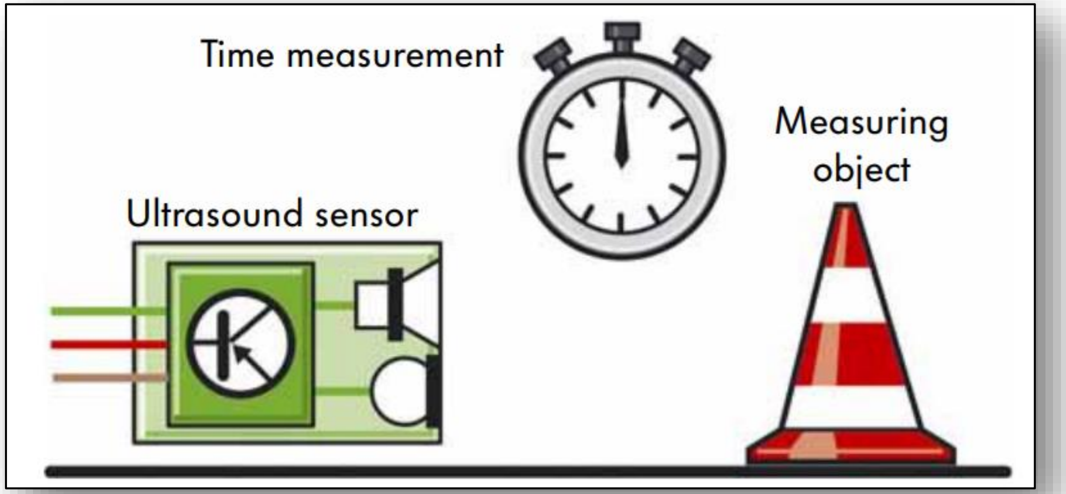


By using higher frequency and selecting an appropriate amplifier (gain), we can increase the influence of ground objects, such as wheel stoppers. While narrower vertical directivity improves sensor usability, wider horizontal directivity can provide wider coverage with fewer sensors. ***'Asymmetric' ultrasonic sensors are used in such situations.***

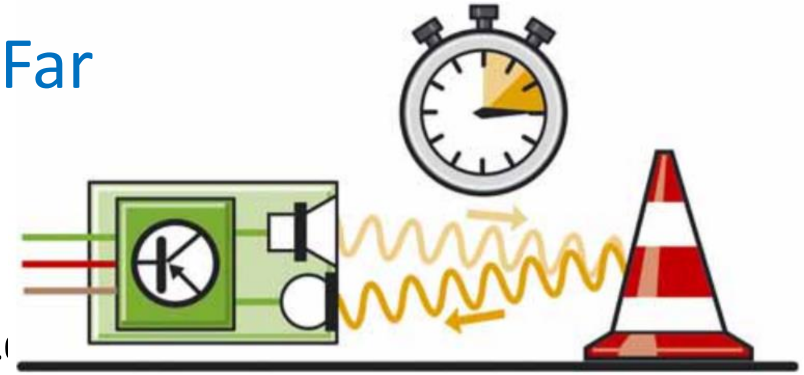
Author: James Dillon

Ultrasonics

Ultrasound sensors are small transmitters and receive units. The principle is based on the ultrasound sensor transmitting an inaudible sound in the ultrasonic range. This sound travels through the surrounding medium (e.g. air) at a constant speed in the form of sound waves.

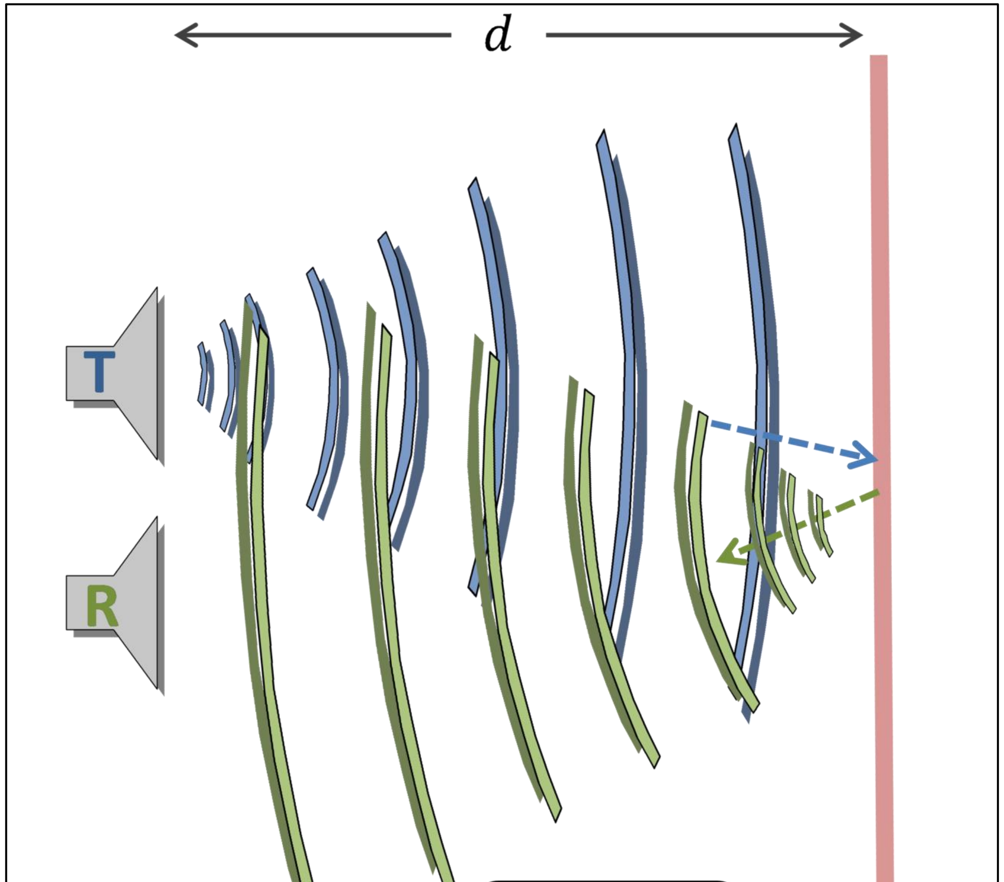


Far



Near

Time of flight Calculation



$$d = \frac{c\,\Delta t}{2}$$

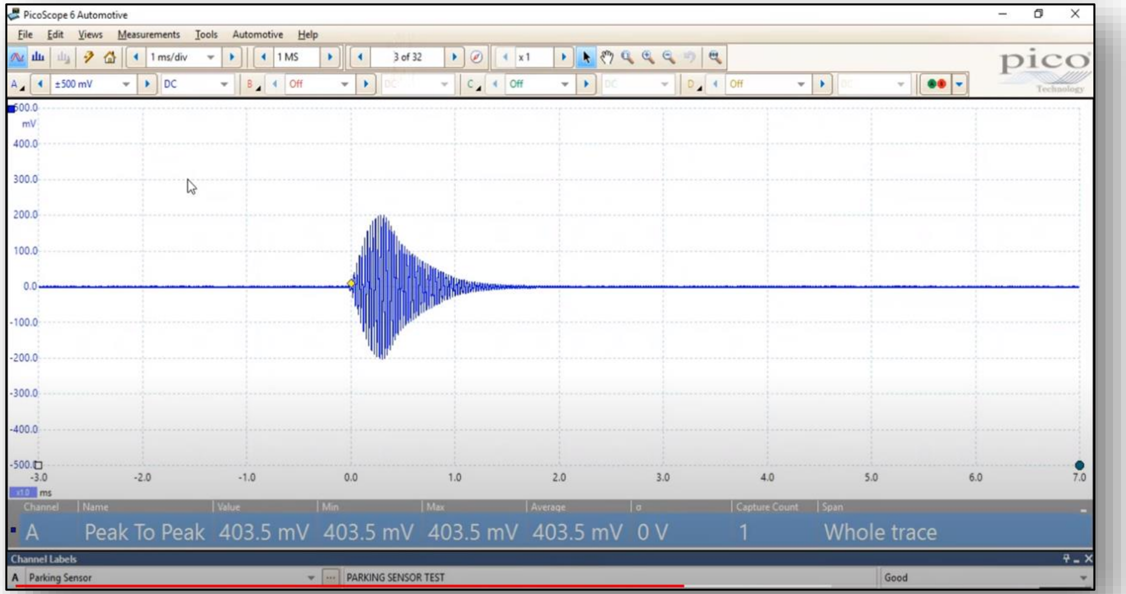
Transmit and receive.

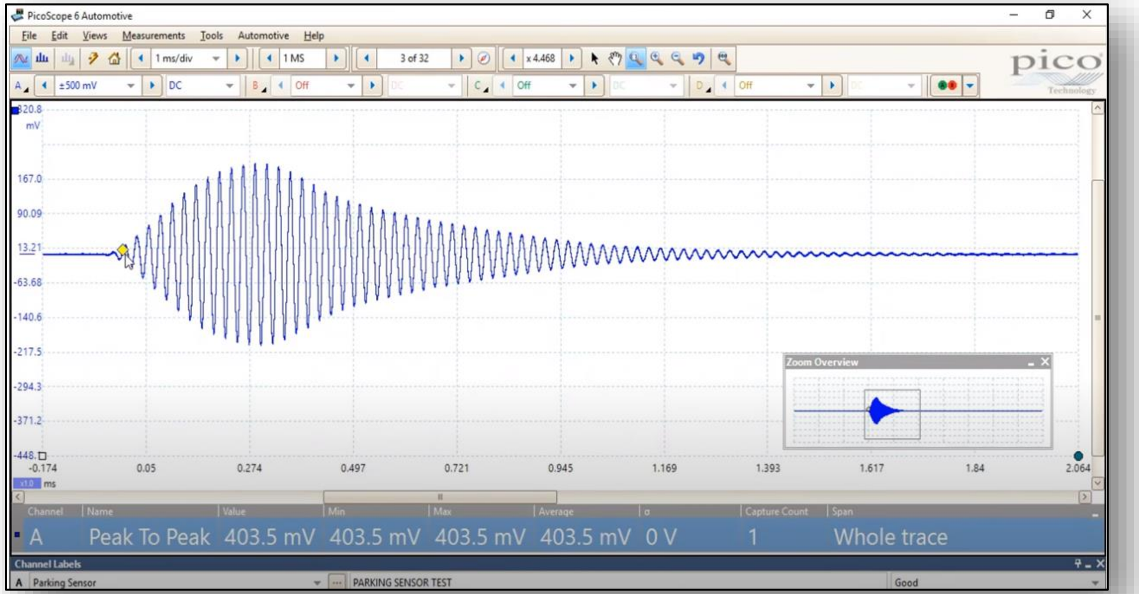
d = distance

c = speed of sound

Δt = time difference (between transmit and receive)

Time of flight





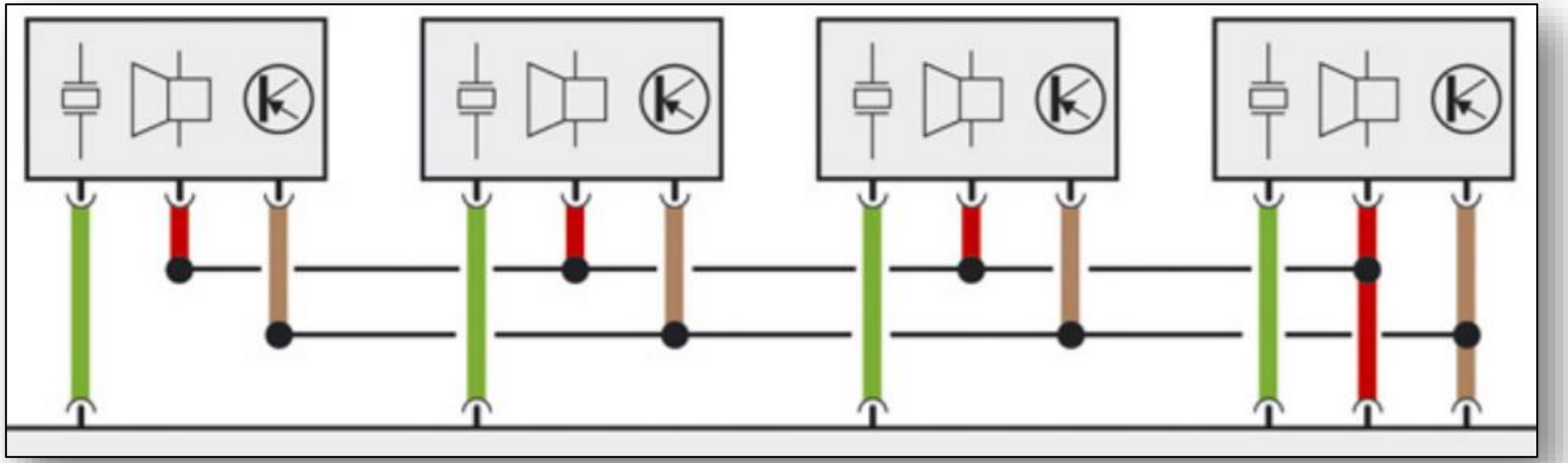
Ultrasonic sensors are driven by intermittent waves called burst waves. Burst waves normally have 20 cycles of repeating waves with the same frequency as the nominal frequency of the sensor.

The interval between bursts must be sufficiently longer than the time it takes for the wave to reflect back from the target.

Methods of testing the Sensor

Power, ground & control signal.

Meter or scope.



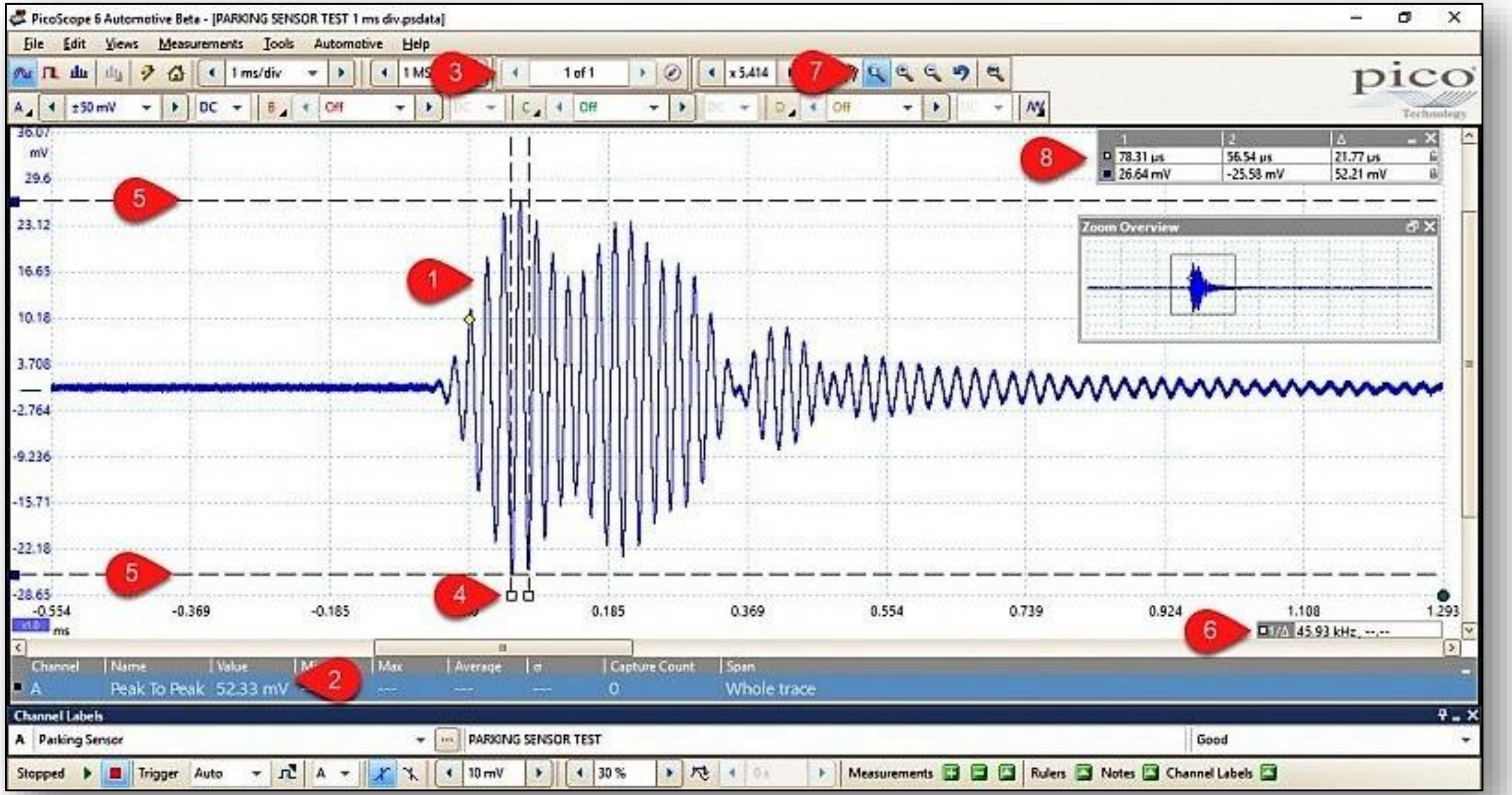
Ultrasonic Testers

A shorted sensor may prevent the entire system from operating.

The power circuit may be protected internally (MOSFET), and be pulsed quickly on start-up then disappear,

Methods of testing the sensor

1) Trigger
2) Peak Voltage
3) Buffer
4) Time Cursors
5) Peak V Cursors
6) Frequency Count
7) Zoom Control
8) Measurements



Parking Sensors with Camera

- ✓ Simple rear view camera linked to steering angle. Visually assists parking maneuvers.
- ✓ Basic graphic Overlay shows travel direction.
- ✓ Arc image is used during corner reversing for anticipated trajectory.

Practical - Ultrasonic sensors

- Ultrasonic Detection – Pico example (see the pulses)
- Ultrasonic Detection – Omitec Sensor Detector (hear the pulses).
- Ultrasonic Detection – Live data (what the computer sees).
- Information ‘fusion’ - how the vehicle works out the parking aid display camera and sonics

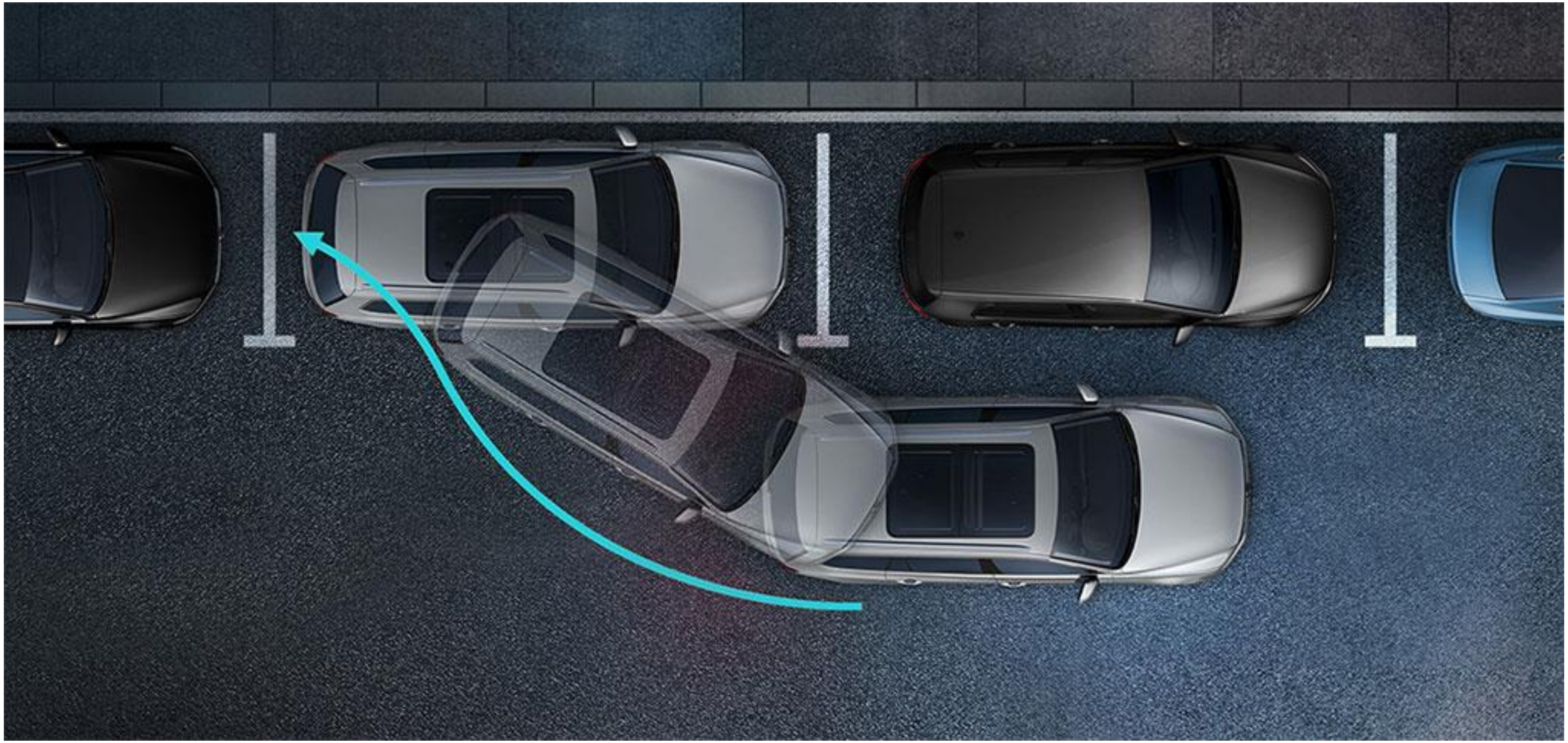
Pros and Cons of Ultrasonic

List the pros and cons of ultrasonic sensing

- Pros

- Cons

Park Assist Systems



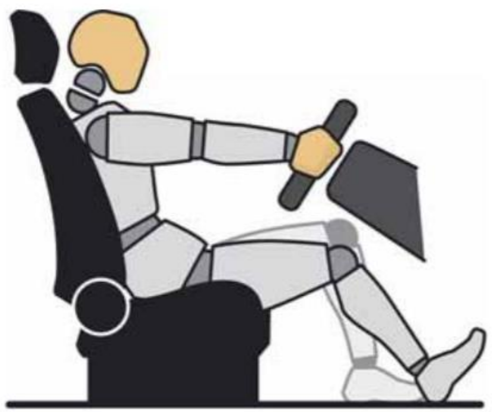
Park Assist – Ultrasonics, cameras, sensors and actuators

- ✓ In addition to the PDC sensors, the Park Assist system also has an ultrasound sensor on each side of the vehicle at the front to search the areas alongside the vehicle for a parking space.

- ✓ The system also uses trailer detection, ABS, wheel speed, steering angle, brake and accelerator pedal positions, gear selector position and electronic power steering (rack).

Park Assist – modes of operation

- ✓ Park Assist has park distance control and parking steering functions.
- ✓ The driver simply needs to operate the accelerator, clutch and brake pedals.



Driver Choices

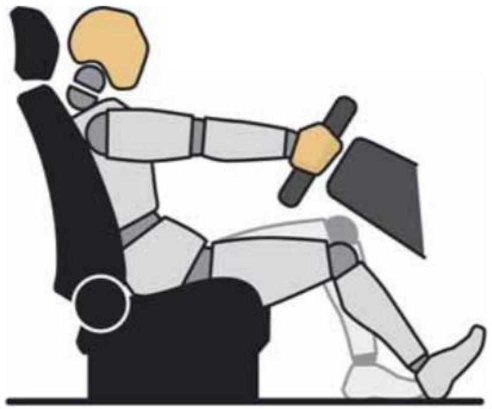
Manual Parking – no assistance

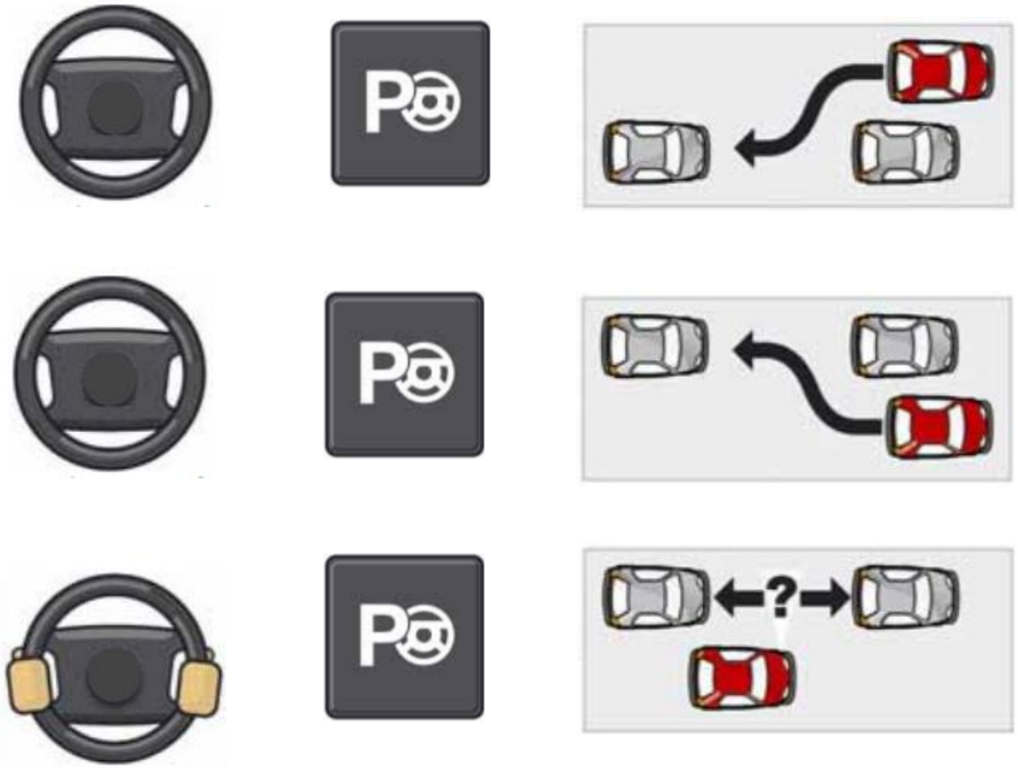
Manual Parking – parking sensors

Auto Parking – parking assistance

Park Assist – modes of operation

Driver Choices



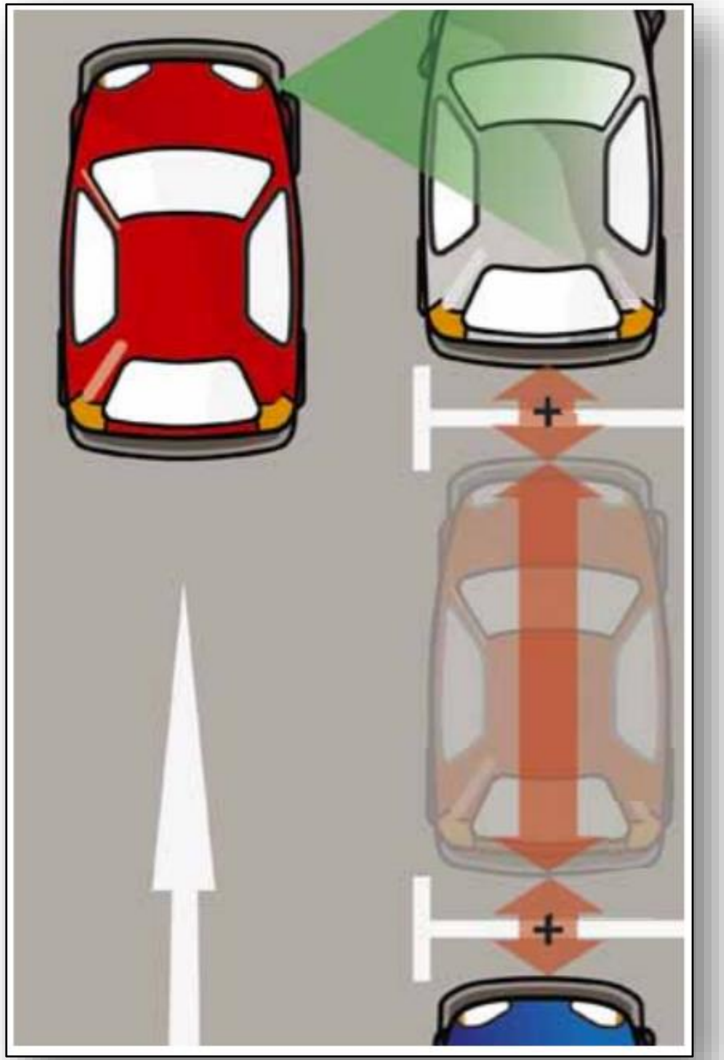


Auto Parking – parking reverse right

Auto Parking – parking reverse left

Manual Parking – side scanning space size

Park Assist – space determination



The minimum size of a parking space is determined by the vehicle length and a required manoeuvring space plus a safety distance. The total length is measured so that the vehicle can be parked in a single parking procedure.

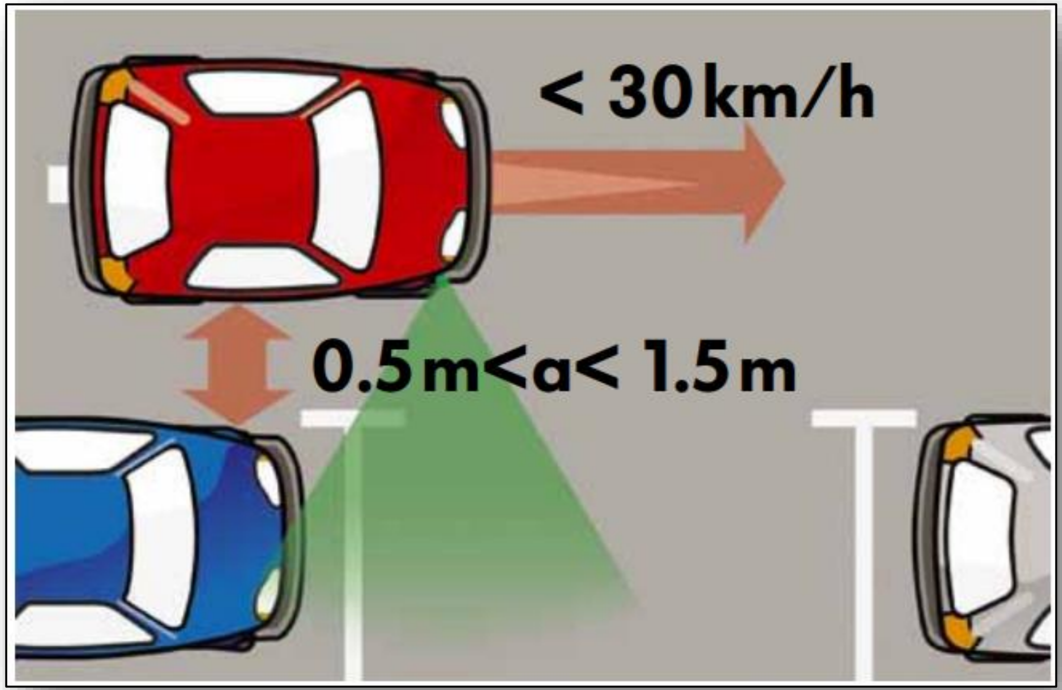
This means that the vehicle can be positioned by Park Assist so that the driver will only have to drive forward manually to achieve an optimum position in the parking spot.

Author: James Dillon

Park Assist – side scanning

Side scanning a parking space is carried out on both sides of the vehicle with an ultrasound sensor.

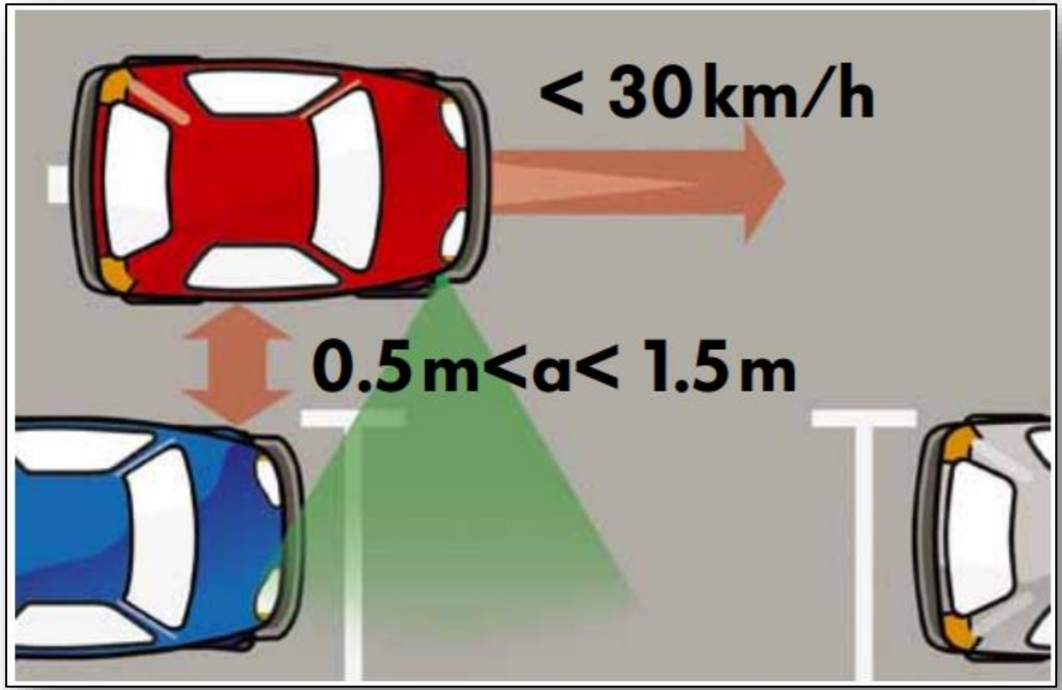
The measurement is carried out by the front right sender for parking assistant steering on the right-hand side of the vehicle.



The vehicle speed needs to be less than 30km/h. The Park Assist sensors are switched off between 30km/h and 45km/h.

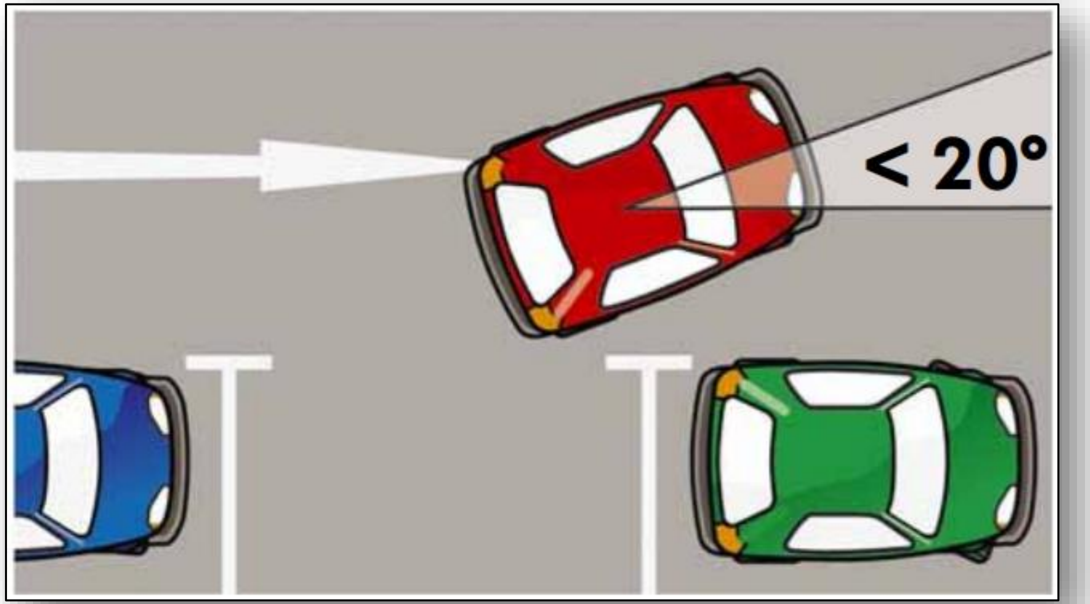
Park Assist – side scanning

If the speed is below 30km/h while you are searching for a parking space and the distance from the kerb at which the car passes is greater than 0.5m and less than 1.5m, the Park Assist will measure out the right hand side of the road for a suitable parking space.



The result of the process is shown to the driver in the dash panel display using graphics to depict the vehicle and roadside.

Park Assist – side scanning



If the system establishes that the vehicle reaches a passing angle of more than 20° from the kerb or the line of parked cars, the Park Assist presumes that the driver, for example, wants to turn into another street, for example, and stops the search procedure.

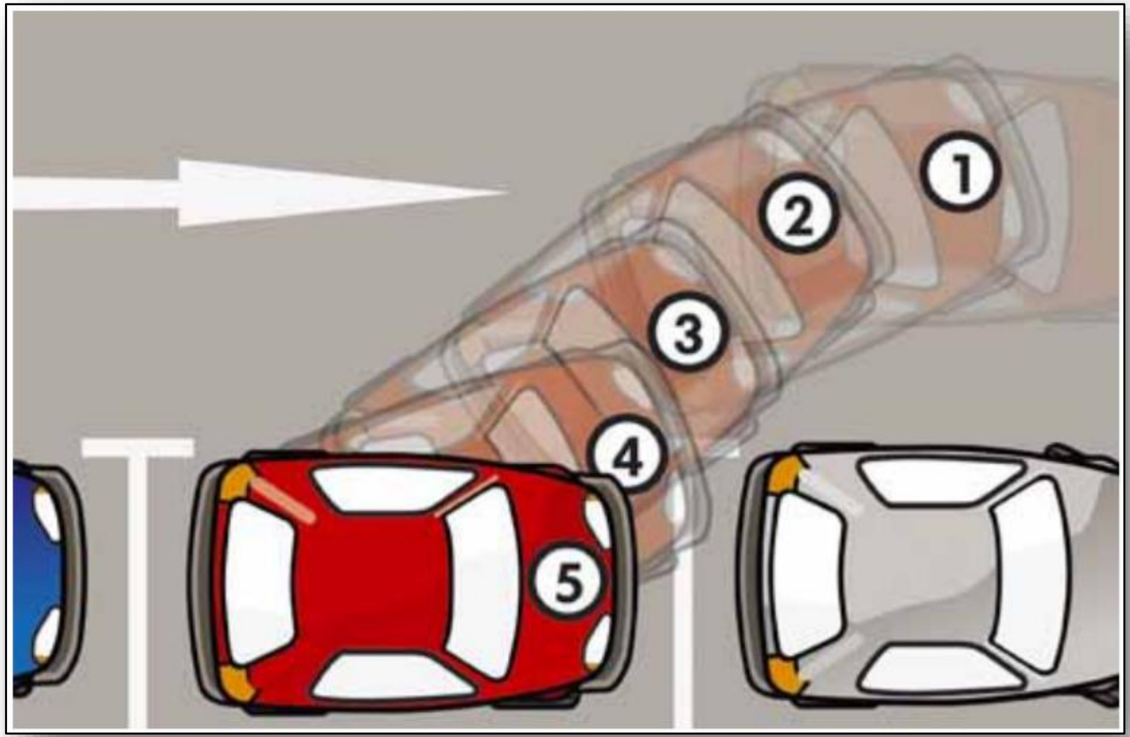
To determine the passing angle, several lines can be monitored by the Park Assist and compared with the vehicle longitudinal axis: 1. a line that is formed by other parked cars 2. the kerb 3. walls Only the line that is closest to the vehicle is used.

This prevents misinterpretations, if the kerb and walls are not parallel.

Park Assist – robot, not intelligent

The manoeuvring procedure for reversing into a parking space is broken down into five movement segments in the control unit for parallel parking assist.

This is necessary as the system does not have a direct optical control facility to react to unexpected developments during the manoeuvre.



In simple terms, it has a standard parking manoeuvre stored in its "memory" and plays it back in the five steps when it is required.

Practical – Park Assistance Video

https://www.youtube.com/watch?v=nLDxuINYJU4

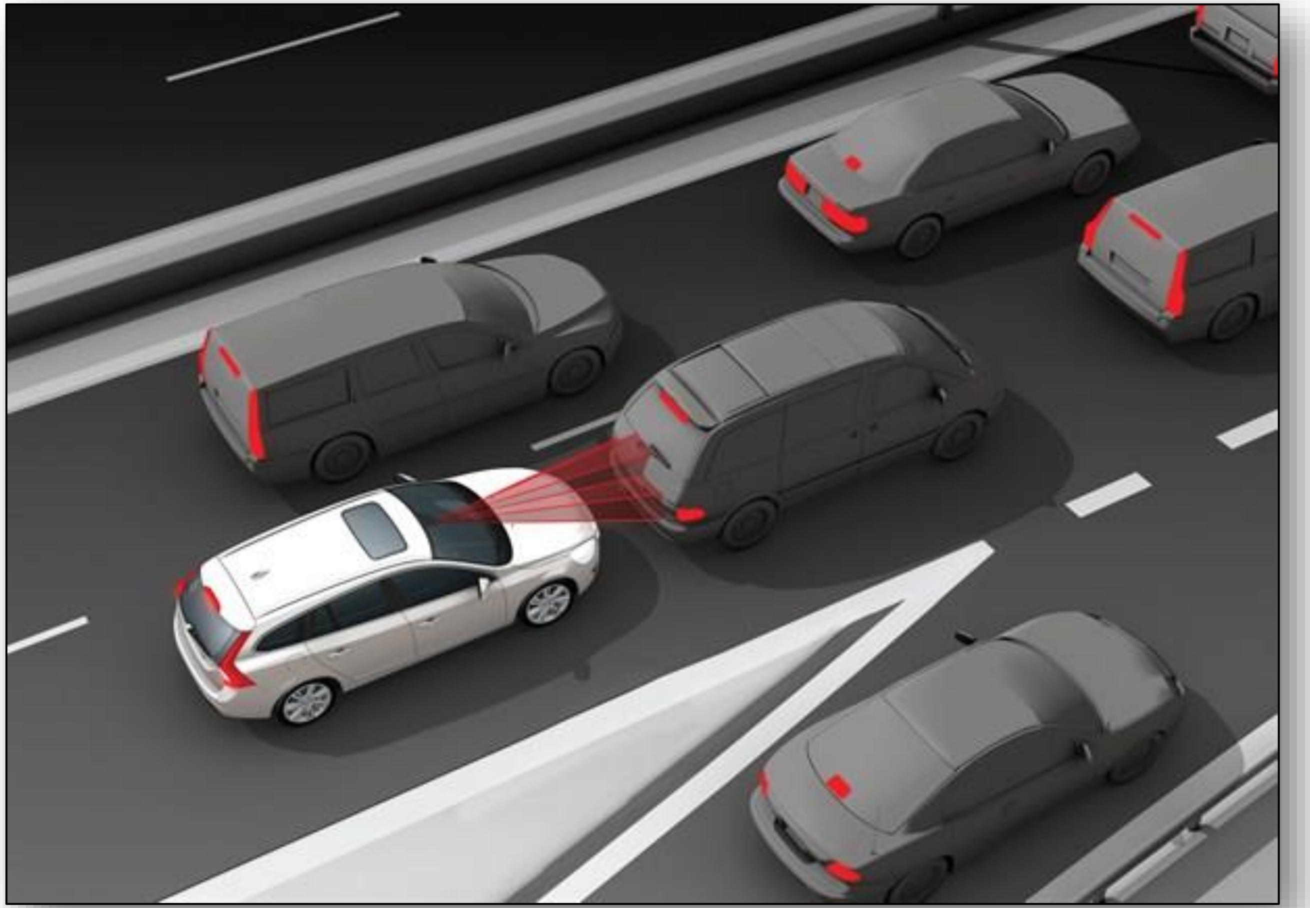
Author: James Dillon

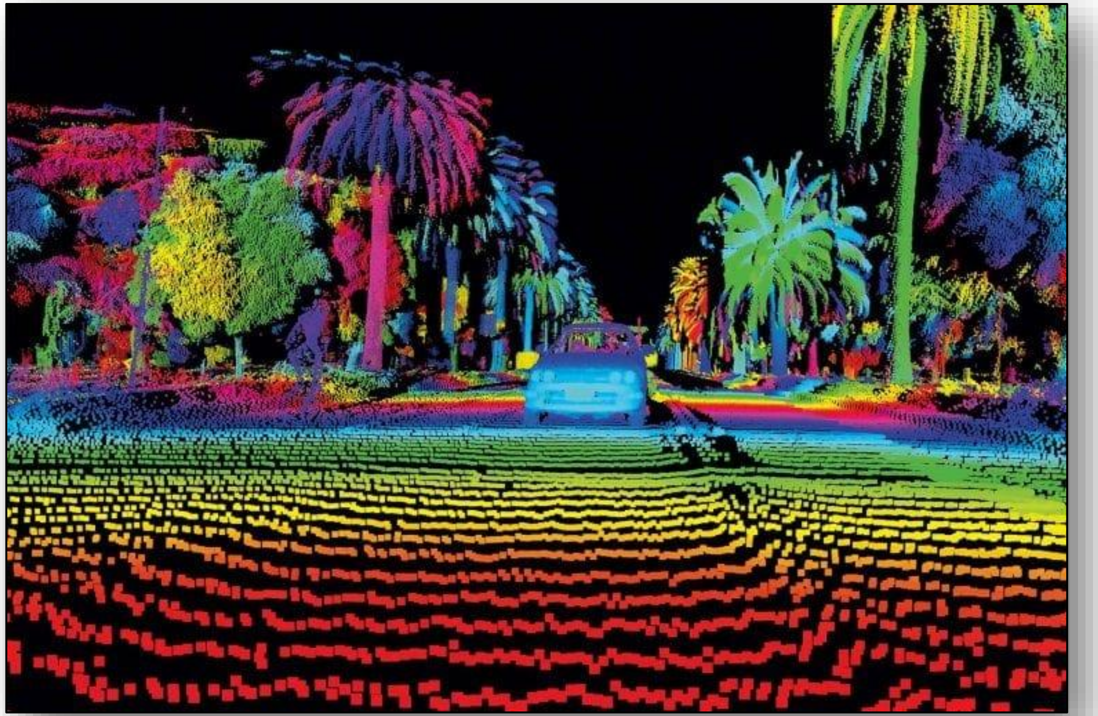
Discussion Question:

What's elements of vehicle sysmes are required to turn a Park Assist vehicle into a fully autonomous vehicle?

Author: James Dillon

LiDAR





Author: James Dillon

Optical Sensors - Terms

Field of View (FOV): Defines angular area of perceivable field of sensor.
Density: Angular step size between sample points. Can be different horizontally and vertically.
Resolution: Generally *FOV x Density.*

Depth Accuracy: Difference between measured range and actual range.
Depth Resolution: Step size between possible measurement ranges (along measurement axis)

Minimum and Maximum Range: Defines distances that are perceivable to the sensor. May vary by object material, brightness, reflectivity, etc.

Rate: Specified in "frames" or "points" per second, depending on modality.

LiDAR

Lidar (/ˈlaɪdɑːr/, also LIDAR, LiDAR, and LADAR) is a method for measuring distances (ranging) by illuminating the target with laser light and measuring the reflection with a sensor.

Differences in laser return times and wavelengths can then be used to make digital 3-D representations of the target. It has terrestrial, airborne, and mobile applications.

Measures at the speed of light 186,000 miles per second or 0.3 metres per nanosecond

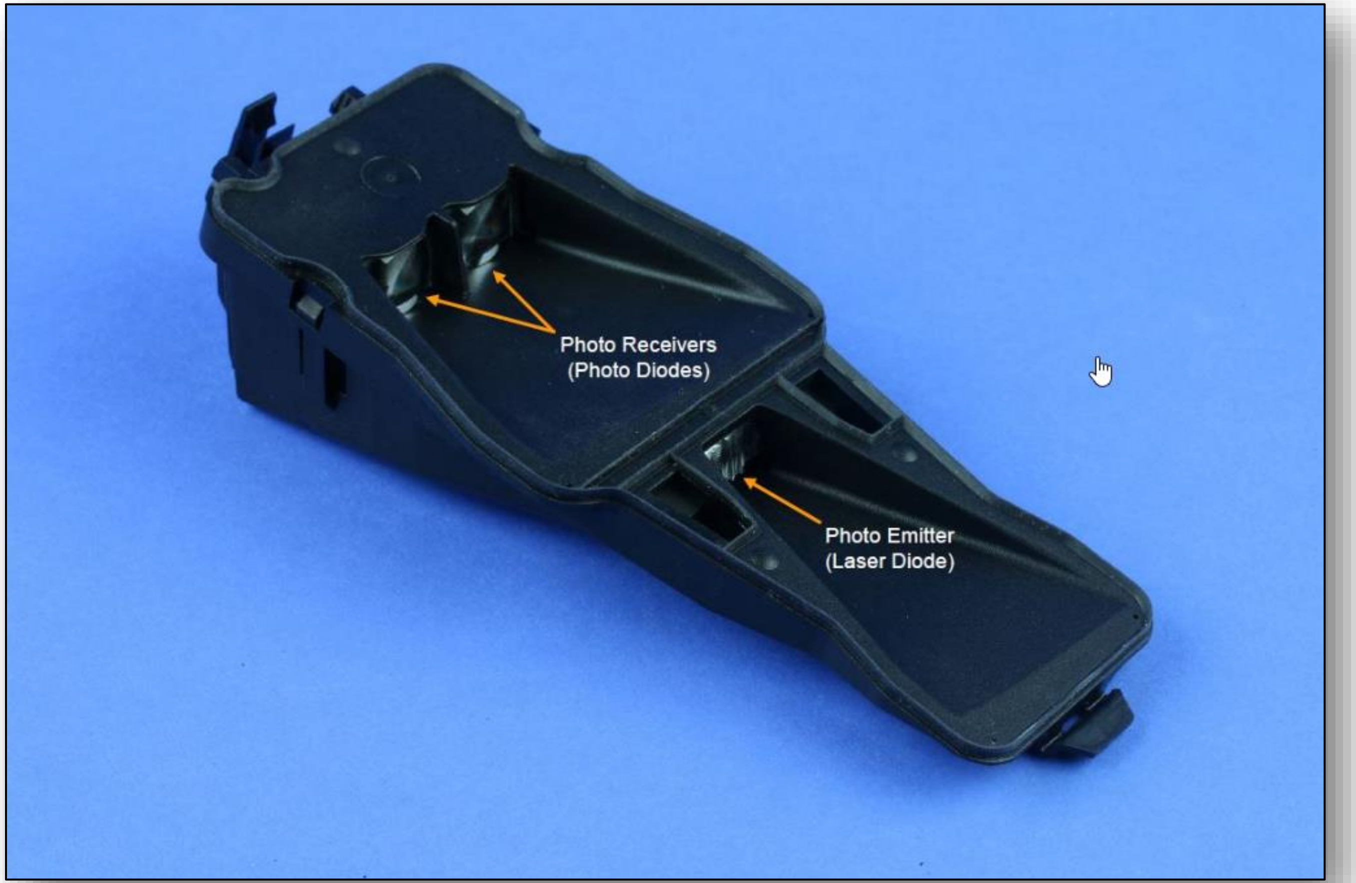
LiDAR

The word is a combination of light and radar. It is now also used as an acronym of "light detection and ranging" and "laser imaging, detection, and ranging". Lidar sometimes is called 3-D laser scanning, a special combination of a 3-D scanning and laser scanning.

Used for

- Short range imaging
- Pedestrian / cyclist detection
- City safety
- Range 1-200m

LiDAR



LiDAR uses safe, invisible laser beam pulses to detect objects both in motion and at rest. Each pulse travels through its environment, bouncing off objects and returning to sensors that create a digital "***3D point cloud***" of the environment.

The formula used to arrive at the precise distance of the object is as follows:

The distance of the object = (Speed of Light x Time of Flight) / 2

LiDAR – 3D Point Cloud

Author: James Dillon

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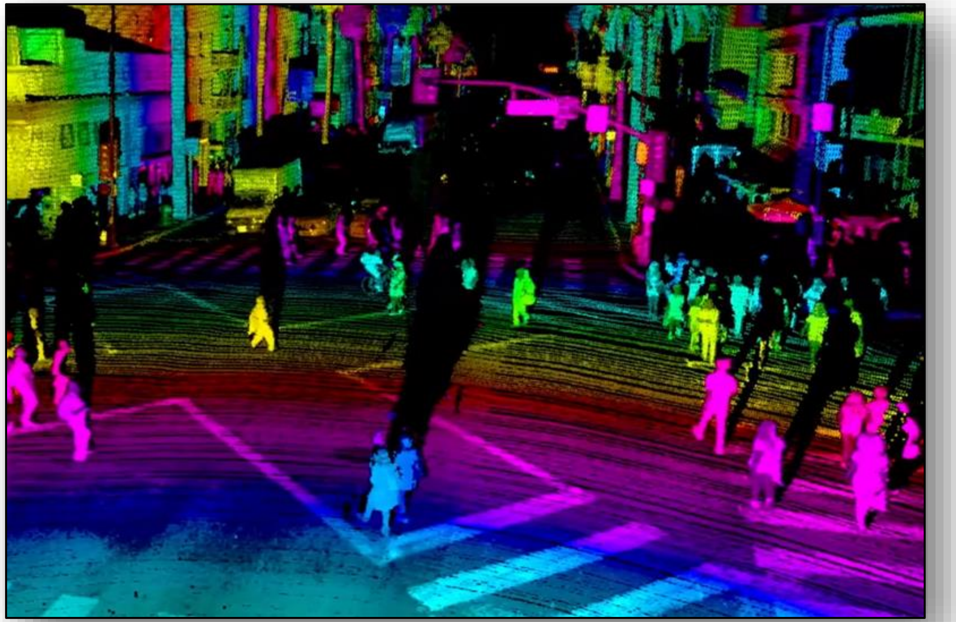
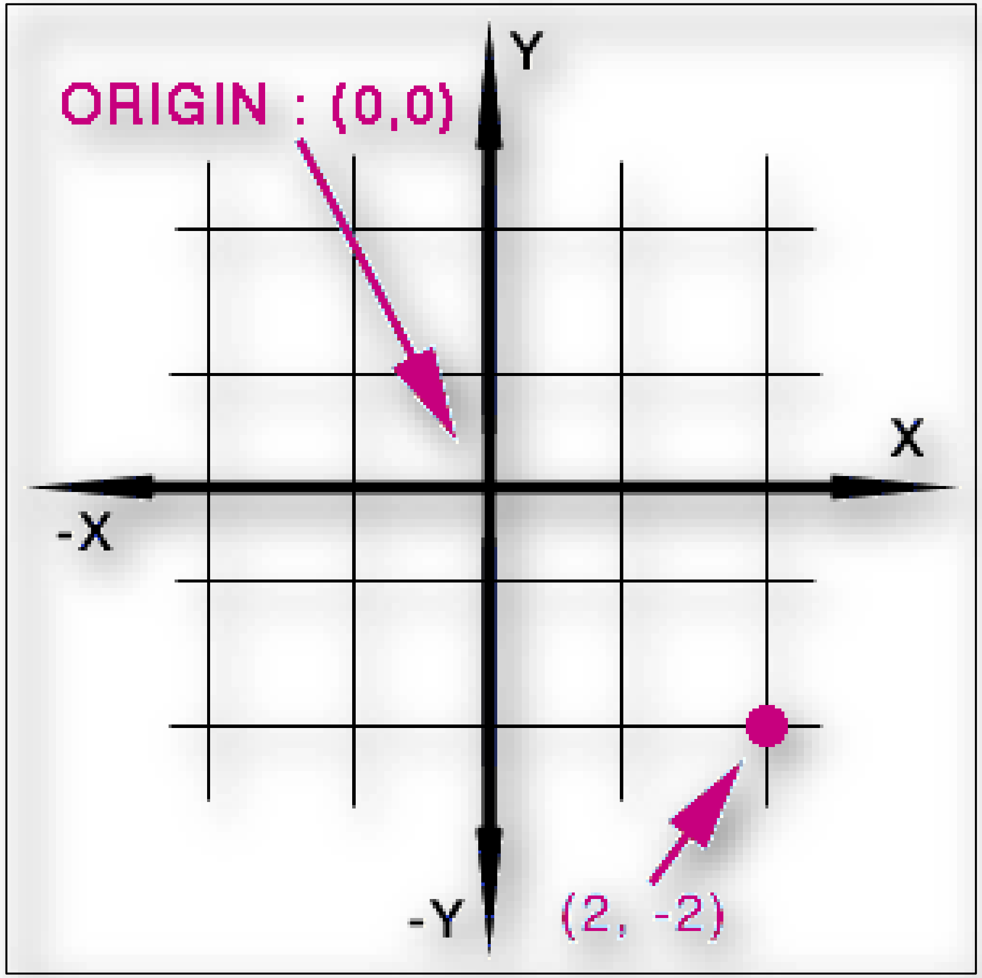
LiDAR – 3D Point Cloud

Then ***perception software***, which is where much of the ***AI*** magic lives, interprets this point cloud so you can literally see objects in 3D and determine precise distance, height, volume, speed, direction and even reflectivity of objects within its ***field of view***.

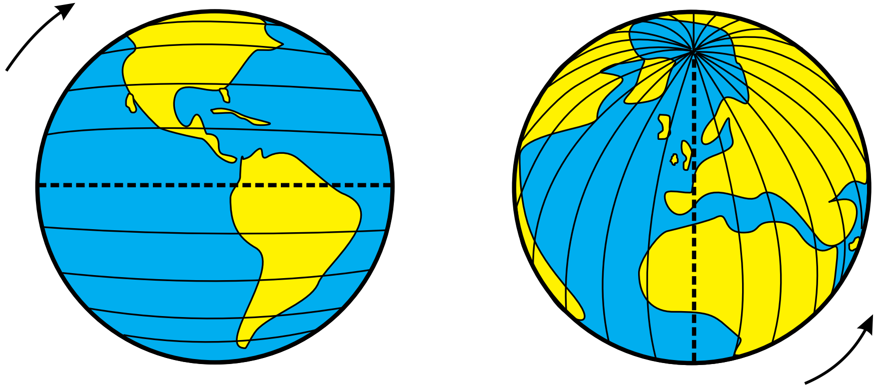


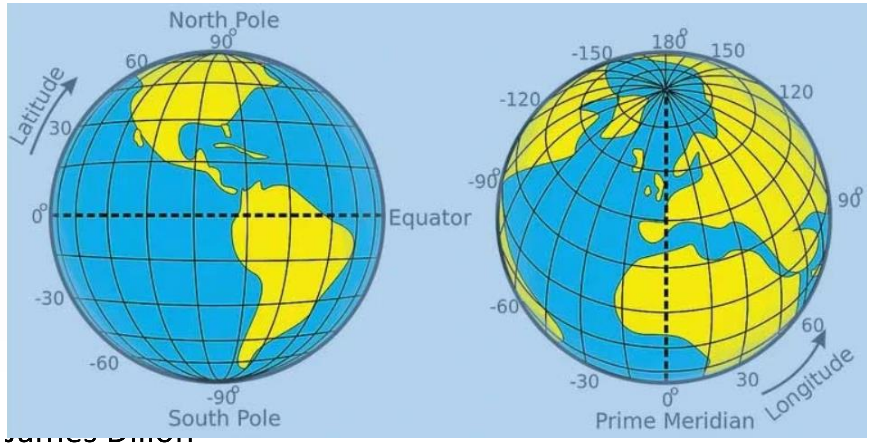
LiDAR sensors come in various shapes and sizes, with some projecting multiple beams sweeping a 360° circle while others shining multiple vibrating beams in a pixel density rich cone.

2d x and y = position

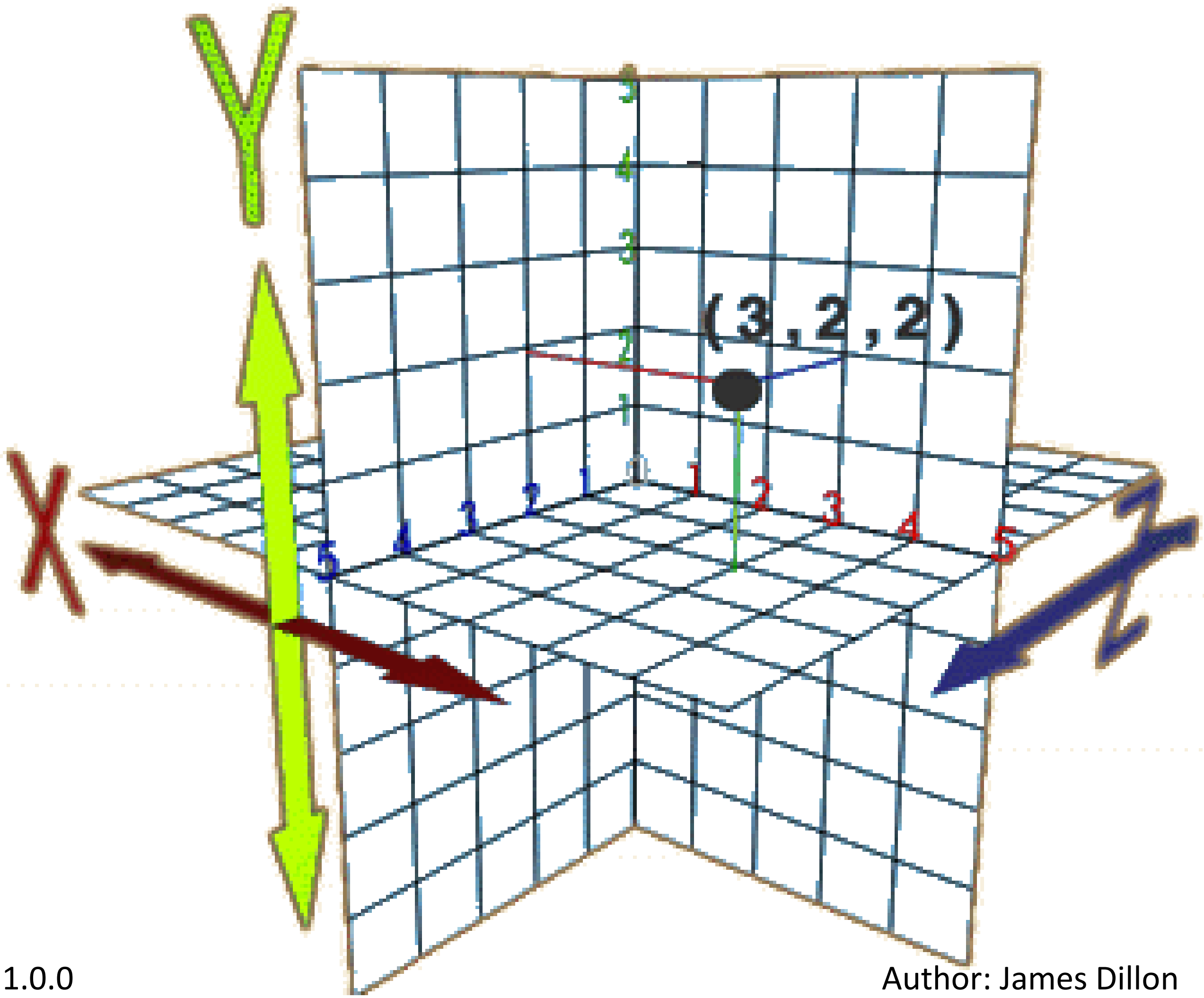


With the Cartesian coordinate system, you can locate any point in using the x and y coordinates.





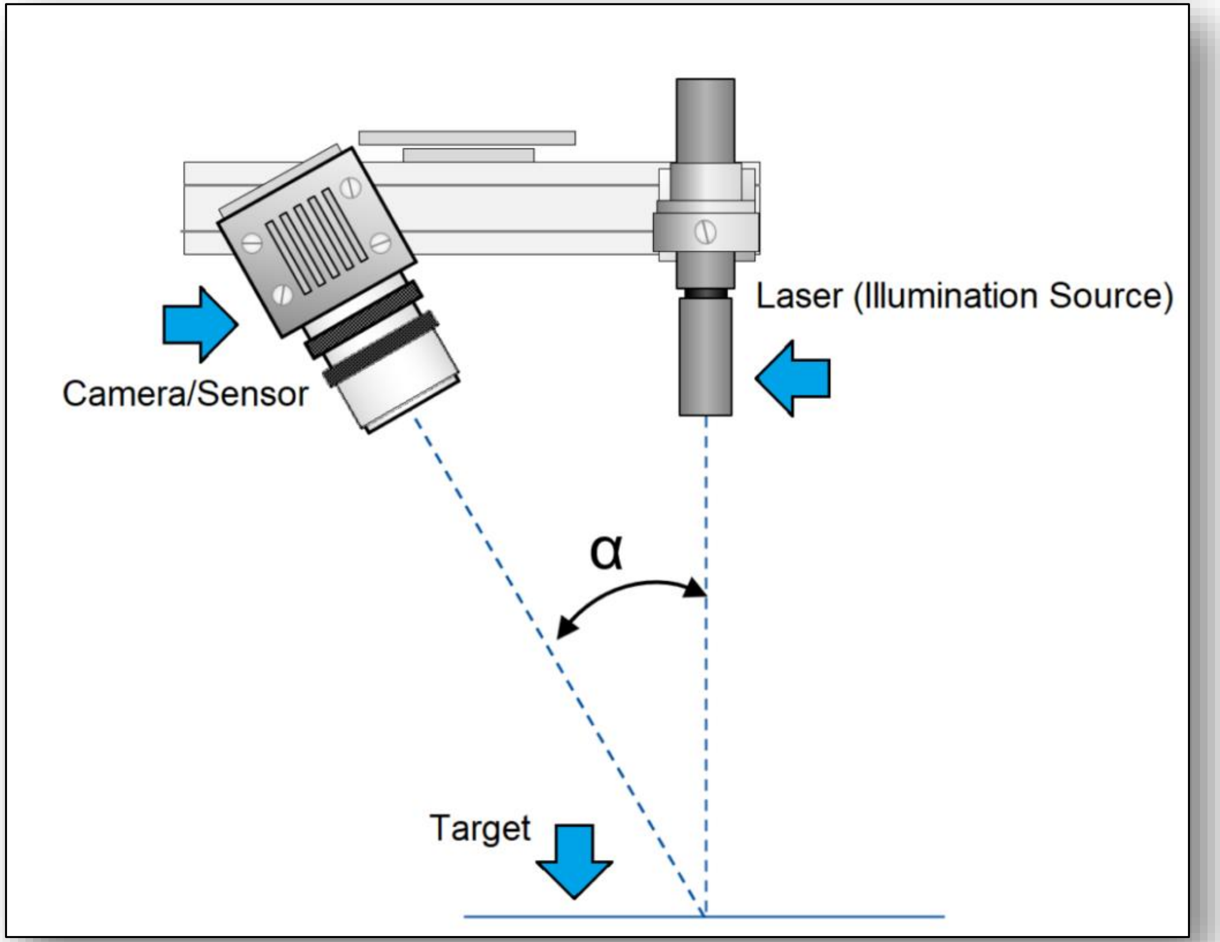
From 2d to 3d – z = distance/depth



With the Cartesian coordinate system, you can locate any point in space using the three coordinates.

For example, if x = +3, y = +2, and z = +2, a point would be located to the right of, above, and in front of the point of origin.

LiDAR – Triangulation to calculate Z



Laser Triangulation is a machine vision technique used to capture 3-dimensional measurements by pairing a laser illumination source with a camera.

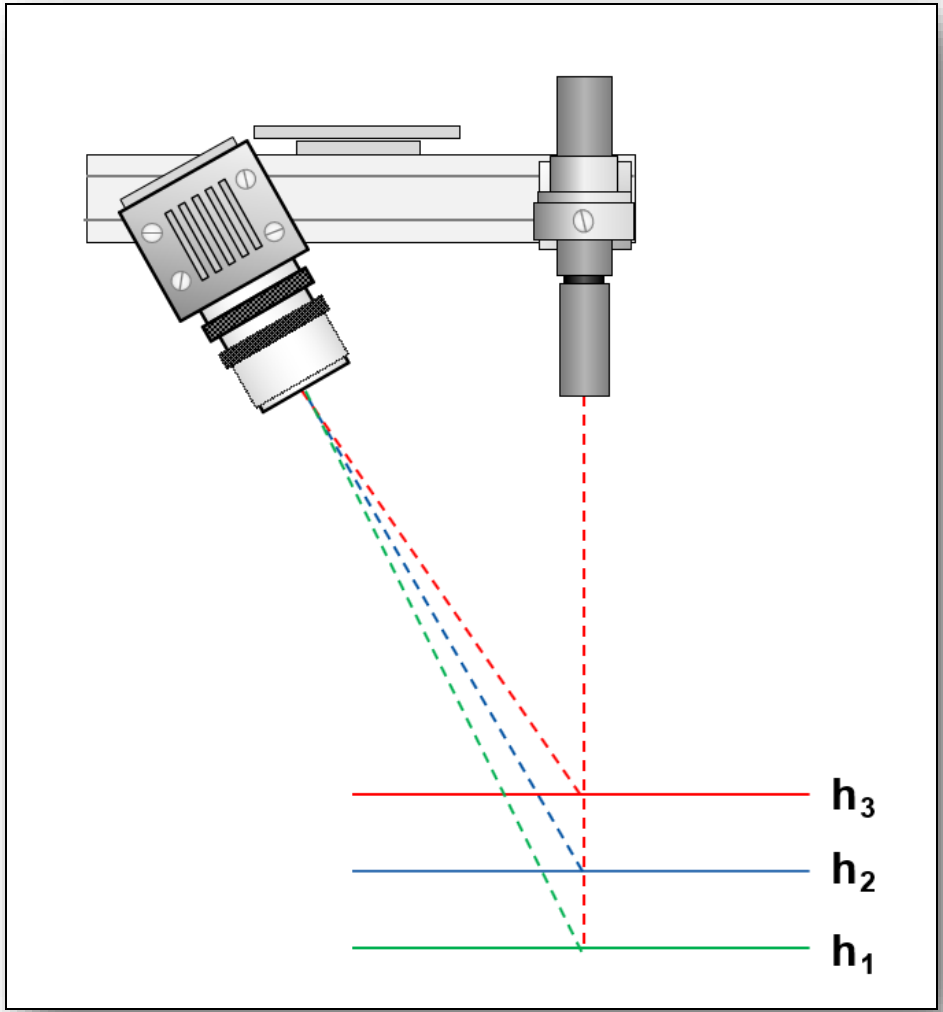
The laser beam and the camera are both aimed at the target (as shown in Figure 1), however by adopting a known angular offset (α) between the laser source and the camera sensor, it is possible to measure depth differences using trigonometry.

Author: James Dillon

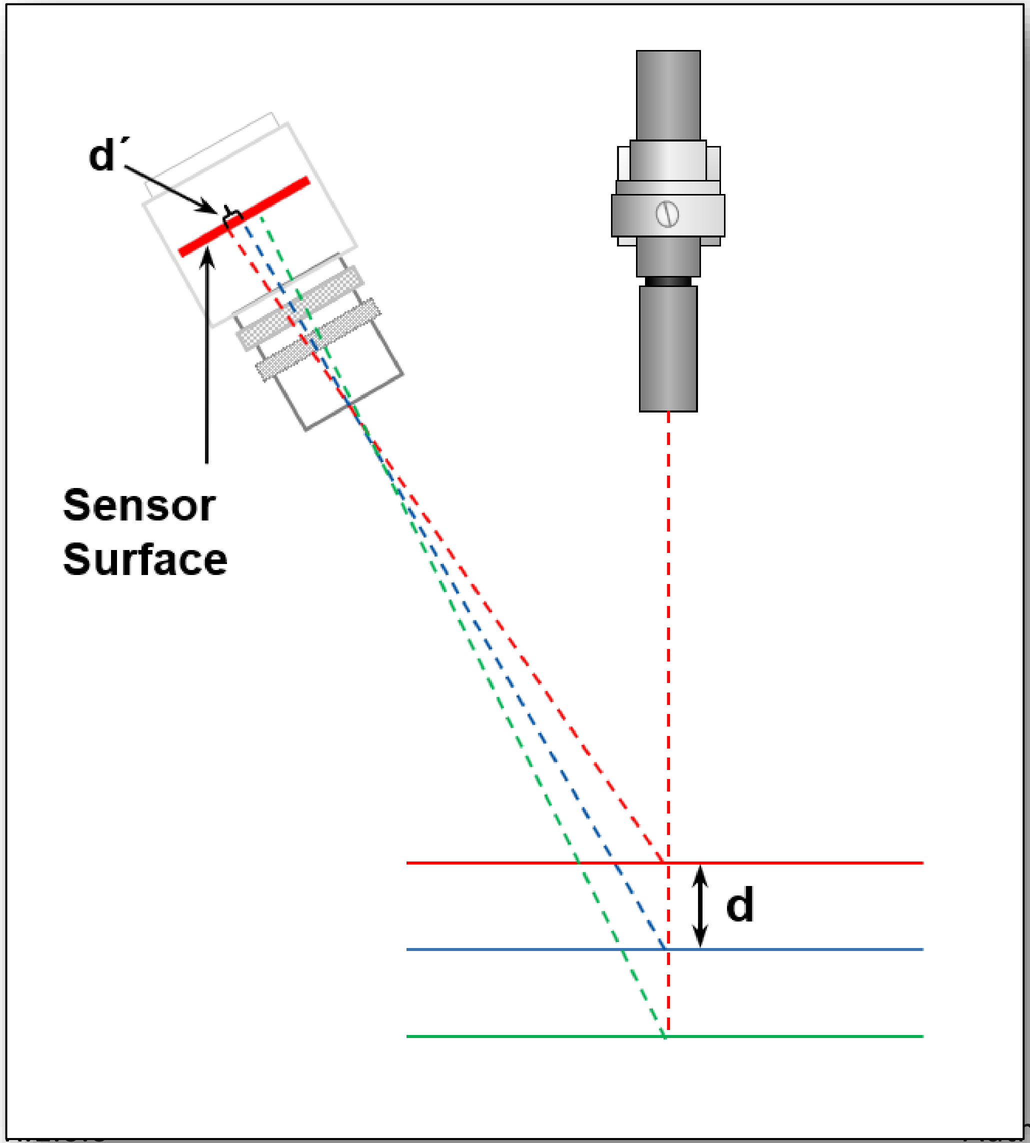
LiDAR – Triangulation to calculate Z

The red, green, and blue dotted lines in the figure illustrate how the reflected laser light will strike different sensor locations, depending on the distance between the laser source and its target (or “surface”), h1, h2, h3.

The position where the reflected laser light strikes the sensor’s surface is dependent on the vertical offset of the target from the laser/camera assembly.



LiDAR – Triangulation to calculate Z



As the distance between the laser light source and inspection point changes, so changes the location on the sensor where the light is detected.

Changes from the nominal vertical distance (denoted by distance d from line h2 in Figure 2) will produce proportional changes in position (d’) at the sensor. Larger changes in vertical distance will result in a larger positional deflection at the sensor.

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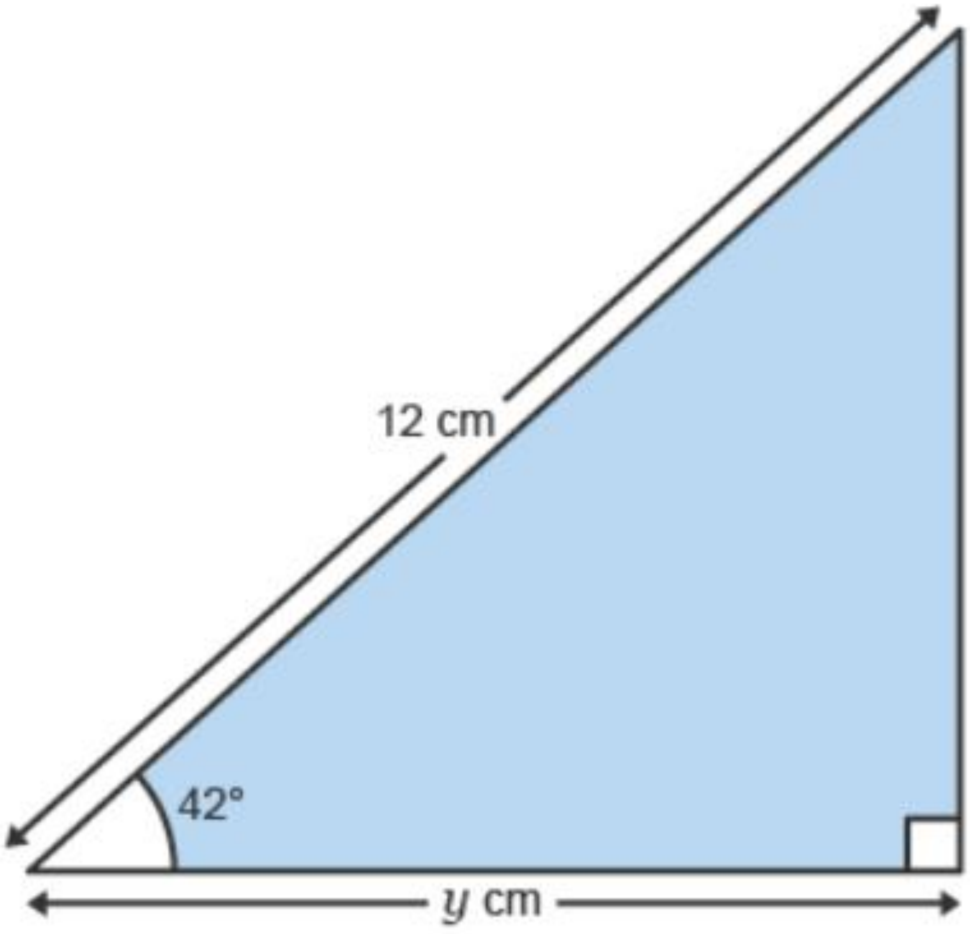
LiDAR – Triangulation to calculate distance



$$\sin(x^\circ) = \frac{opposite}{hypotenuse}$$

$$\cos(x^\circ) = \frac{adjacent}{hypotenuse}$$

$$\tan(x^\circ) = \frac{opposite}{adjacent}$$

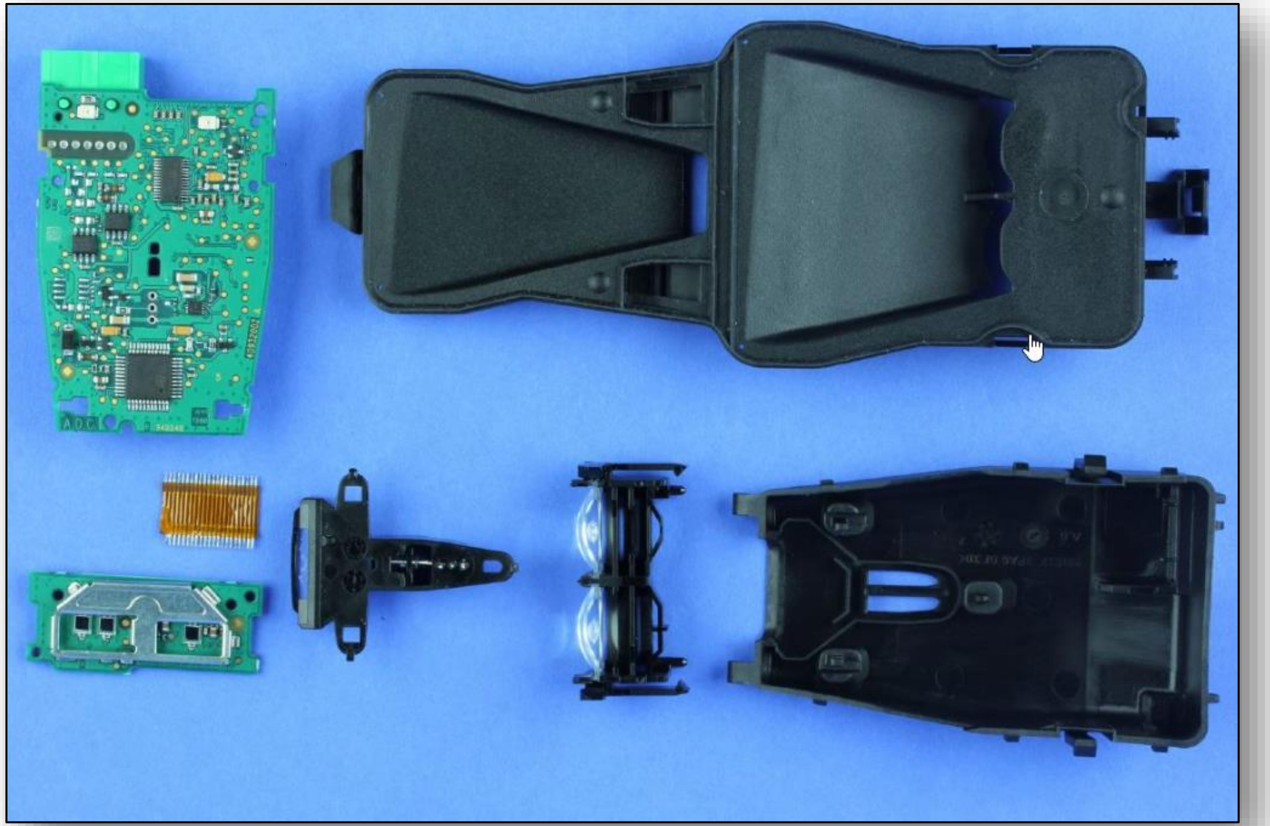
$$\cos(x^\circ) = \frac{adjacent}{hypotenuse}$$

In this case we have $\cos(42^\circ) = \frac{y}{12}$

$$12 \times \cos(42^\circ) = y$$

$$y = 8.917\ldots$$

LiDAR – sensor overview



The processing and calculation is done onboard the device.

Information regarding distance is shared with the vehicle via the network (CAN, FLEXRAY, ETHERNET).

Self diagnosis is programmed in to the device.

Screen cleanliness (interior screen between the device and the inner windscreen) is critical. Many OEM's specify that this area is cleaned during service, requiring the detachment of the sensor from its housing.

LiDAR

Advantages

- Easy image processing
- Fast measurements are possible
- Very good angular positional accuracy

Disadvantages

- Can be affected by sunlight, rain and fog

Author: James Dillon

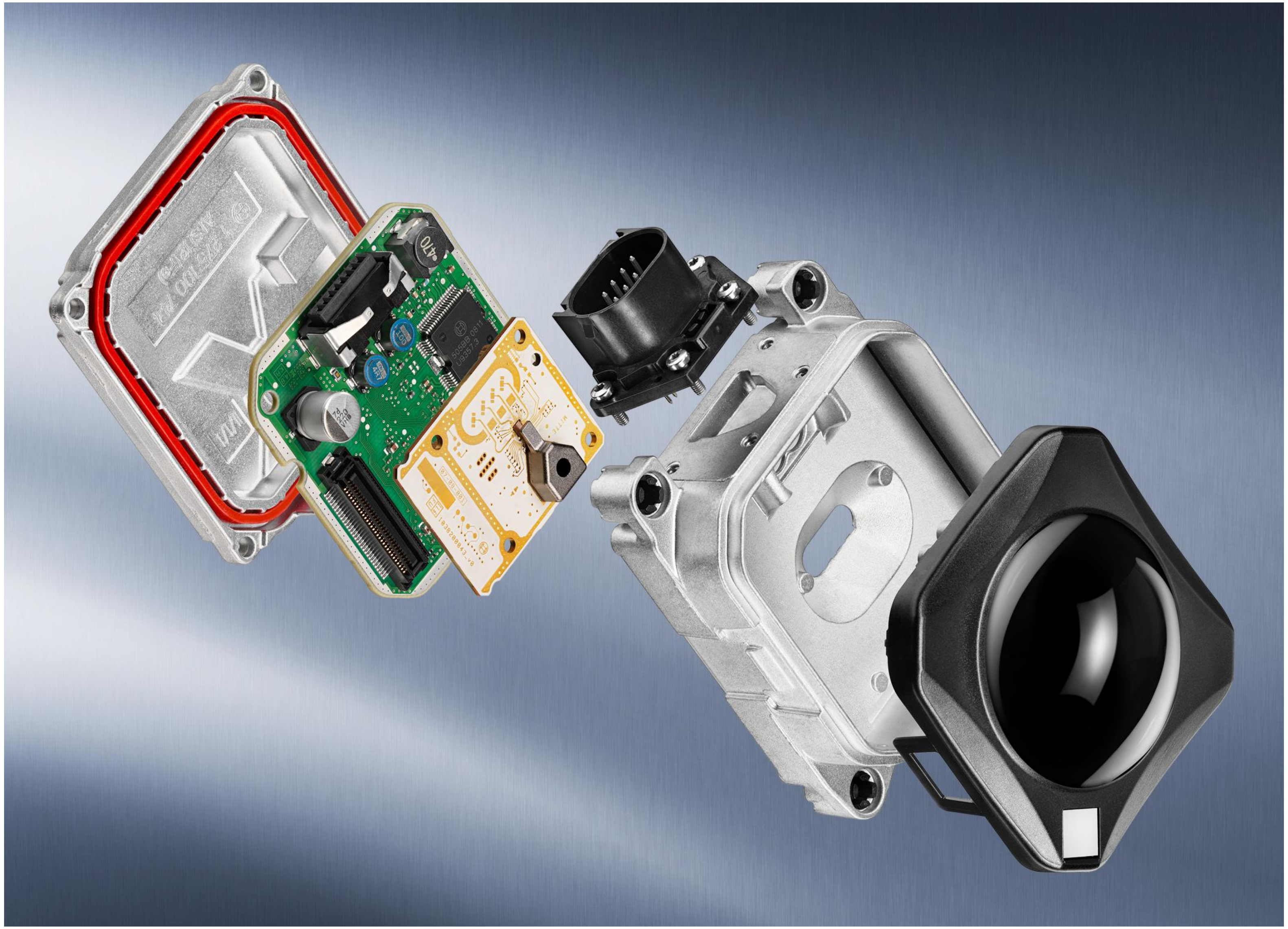
LiDAR – Scan demo

ZED camera Module and Laptop

Lidar Scan Demo

Author: James Dillon

Radar



RADAR

Used for

- Medium and Long range imaging
- Automatic Cruise control
- Automated braking
- Lane change assist

Range 0.36-160m

Author: James Dillon

RADAR

Advantages

- Not affected by sunlight, rain and fog
- Easy image processing

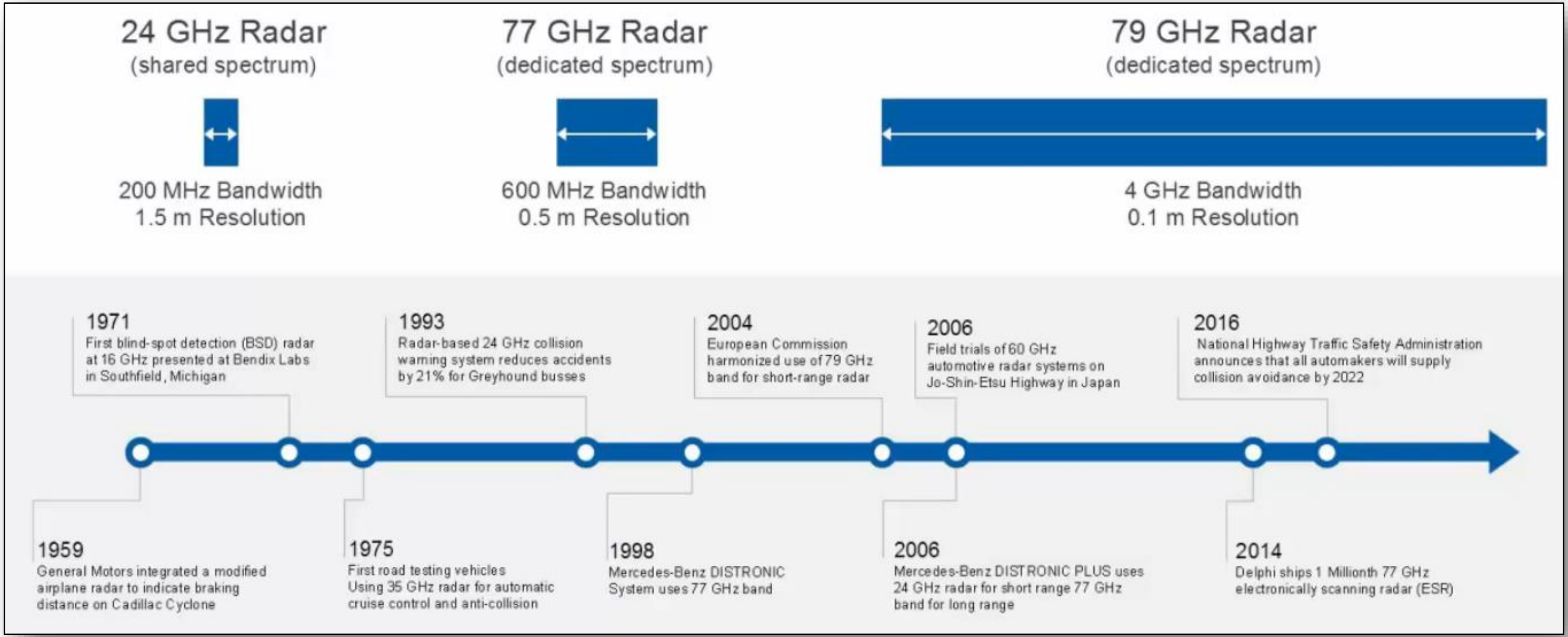
Disadvantages

- Does not see colours

RADAR

Technical features	MRR	MRR *rear*
Frequency range	76 ... 77 GHz	76 ... 77 GHz
Detection range	0.36 ... 160 m	0.36 ... 80 m
Field of view (horizontal) Main antenna Elevation antenna	 ±6° (160 m) ±9° (100 m) ±10° (60 m) ±25° (36 m) ±42° (12 m)	 ±5° (70 m, main beam direction) ±75° (close range)
Measuring accuracy Distance Speed Angle	 0.12 m 0.11 m/s ±0,3°	 0.12 m 0.14 m/s ±0,8°
Object separation capability Distance Speed Angle	 0.72 m 0.66 m/s 7°	 0.72 m 1.4 m/s 7°
Cycle time	~60 ms	~60 ms
Modulation	Frequency modulation (FMCW)	Frequency modulation (FMCW)
Max. number of detected objects	32	32
Dimensions (W x H x D) in mm	70 x 60 x 30 (without connectors) 70 x 82 x 30 (with connectors)	70 x 60 x 30 (without connectors) 70 x 82 x 30 (with connectors)
Weight	~190 g	~190 g
Power consumption	4.5 W	4.5 W

Radar

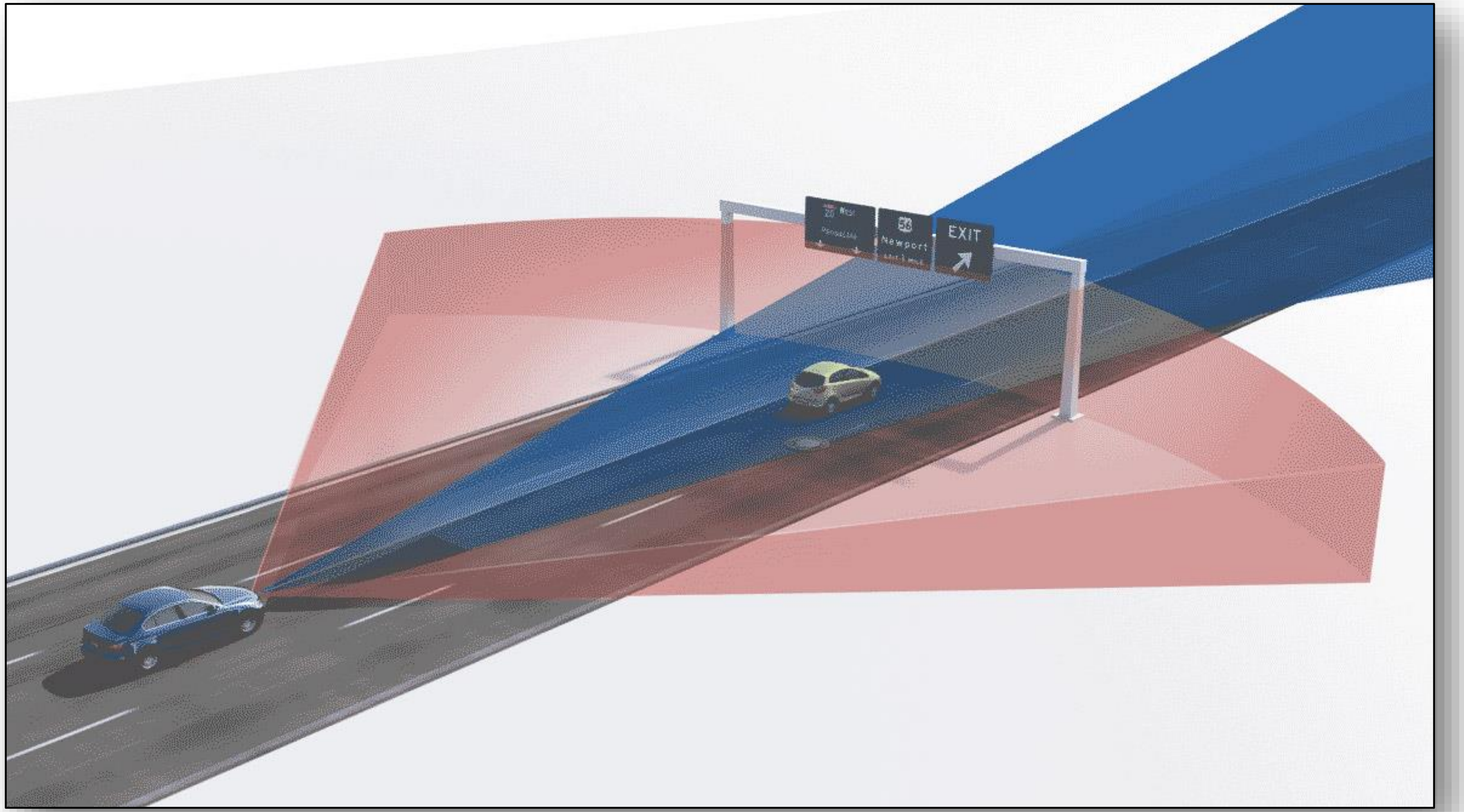


24 GHz Radar
(shared spectrum)
200 MHz Bandwidth
1.5 m Resolution
77 GHz Radar
(dedicated spectrum)
600 MHz Bandwidth
0.5 m Resolution
79 GHz Radar
(dedicated spectrum)
4 GHz Bandwidth
0.1 m Resolution
1959
General Motors integrated a modified airplane radar to indicate braking distance on Cadillac Cyclone
1971
First blind-spot detection (BSD) radar at 16 GHz presented at Bendix Labs in Southfield, Michigan
1975
First road testing vehicles
Using 35 GHz radar for automatic cruise control and anti-collision
1993
Radar-based 24 GHz collision warning system reduces accidents by 21% for Greyhound busses
1998
Mercedes-Benz DISTRONIC System uses 77 GHz band
2004
European Commission harmonized use of 79 GHz band for short-range radar
2006
Mercedes-Benz DISTRONIC PLUS uses 24 GHz radar for short range 77 GHz band for long range
2006
Field trials of 60 GHz automotive radar systems on Jo-Shin-Etsu Highway in Japan
2014
Delphi ships 1 Millionth 77 GHz electronically scanning radar (ESR)
2016
National Highway Traffic Safety Administration announces that all automakers will supply collision avoidance by 2022

Radar

By focusing the main antenna on a narrow main lobe with an opening angle of ±6 degrees, the system is capable of reacting to vehicles in front at long range (up to 160 meters) and performing exceptionally well at higher speeds while also minimizing interference from vehicles in adjacent lanes.

Thanks to the elevation antenna, the system achieves an opening angle of ±42 degrees at close range - so a pedestrian stepping out into the road from behind a parked car, for example, is detected at an early stage.



Radar

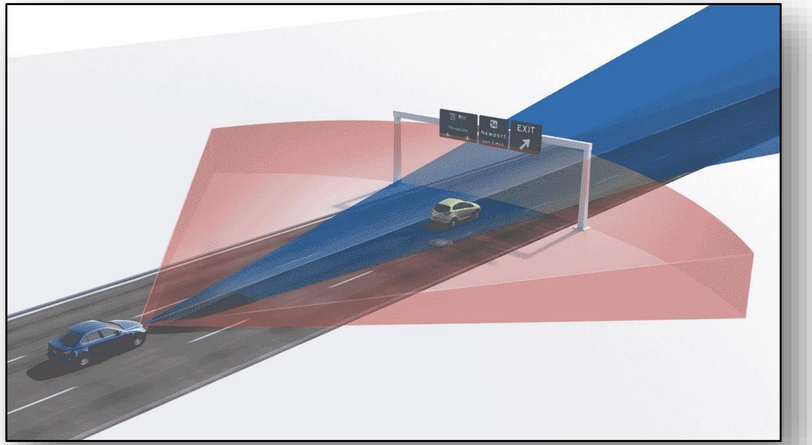
Operating principle

The radar sensor's main task is to detect objects and measure their speed and position relative to the movement of the vehicle in which it is fitted.

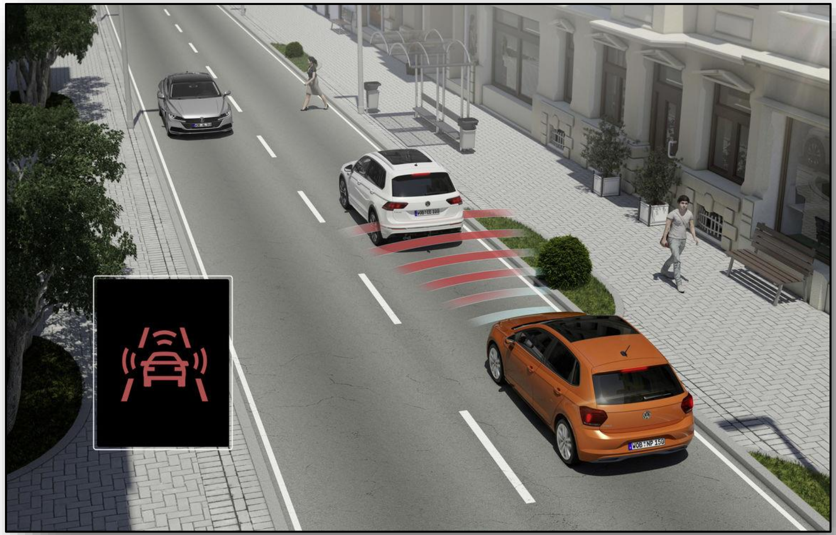
To do this, the MRR sends frequency-modulated radar waves in a frequency range of 76 to 77GHz via the transmitting antenna. These waves are reflected by objects in front of or behind the vehicle.

The relative speed and distance between the vehicle and other objects is determined on the basis of the Doppler effect and the delay. Both generate frequency shifts between the sent and received signal.

By comparing the amplitudes and phases of the radar signals measured by the four antennae, it is possible to infer the position of the object.



Radar Emergency Braking



If the predictive emergency braking system determines that the distance to the preceding vehicle is becoming critically short at a vehicle speed above <u>30km/h (18mph).</u> it prepares the braking system for potential emergency braking.

If the driver does not react to the hazardous situation, the system warns the driver via an audible and/or visual signal, followed by a short but noticeable brake jerk.

The system then initiates partial braking to reduce the speed and give the driver valuable time to react. As soon as the driver presses the brake pedal, the system provides braking support.

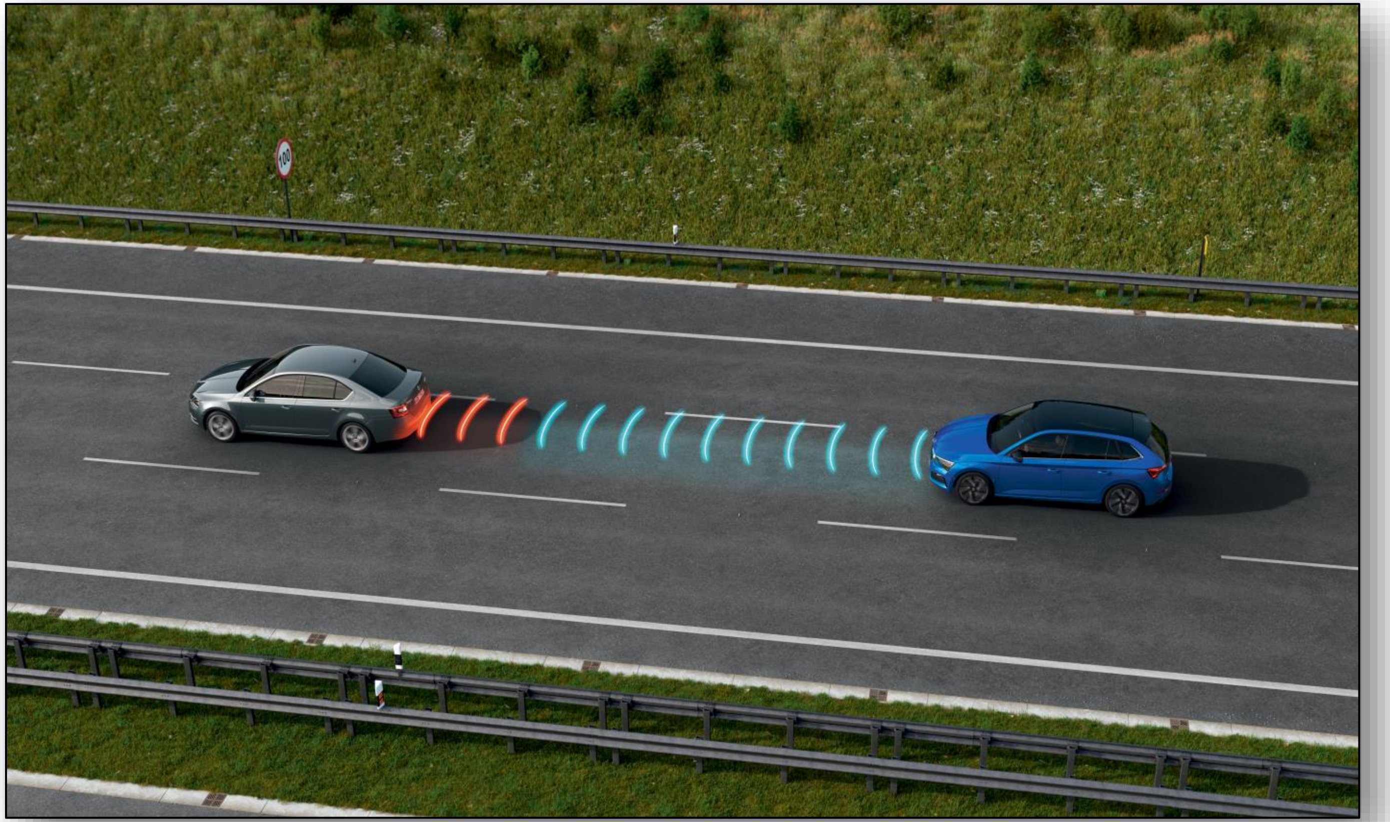
To do this, the system continuously calculates the degree of vehicle deceleration required to avoid the collision. If the system detects that the driver has failed to apply sufficient brake force, it increases the braking pressure to the required level so that the driver can attempt to bring the vehicle to a standstill before a collision occurs.

If the driver fails to react to the immediate risk of collision, and the predictive emergency braking system detects that a rear-end collision is unavoidable, it can - working in conjunction with a video camera - automatically initiate full braking.

As a result, the vehicle is traveling at significantly reduced speed when the collision occurs, reducing the severity of the crash for the passengers of both vehicles.

Radar

Adaptive Cruise Control (Mid Range Radar MRR)



Adaptive cruise control (ACC)

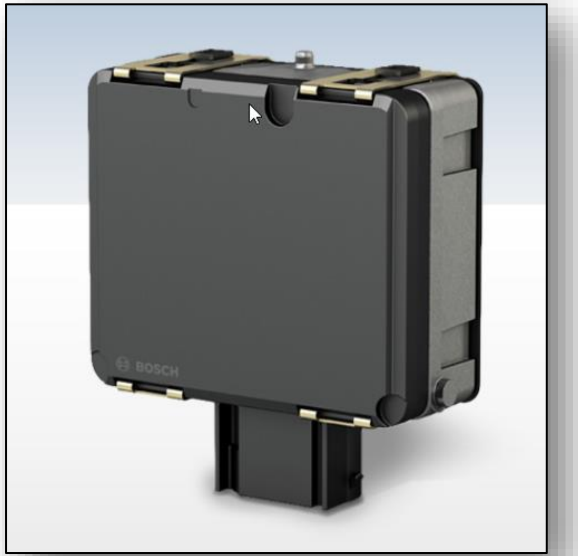
With a range of up to 160 meters and variable field of view, the MRR makes it possible to detect vehicles in front and vehicles merging at an early stage — making it the ideal basis for ACC systems.

At speeds of up to 150km/h (93mph) and a maximum relative speed of up to 80km/h (50mph), the system automatically maintains a set distance from the vehicle ahead by automatically reducing the power to the engine, braking or accelerating.

The ACC stop & go variant can also automatically apply the brakes until the vehicle comes to a standstill and will resume automatically when instructed by the driver.

Radar

Lane change assist (Blind spot)



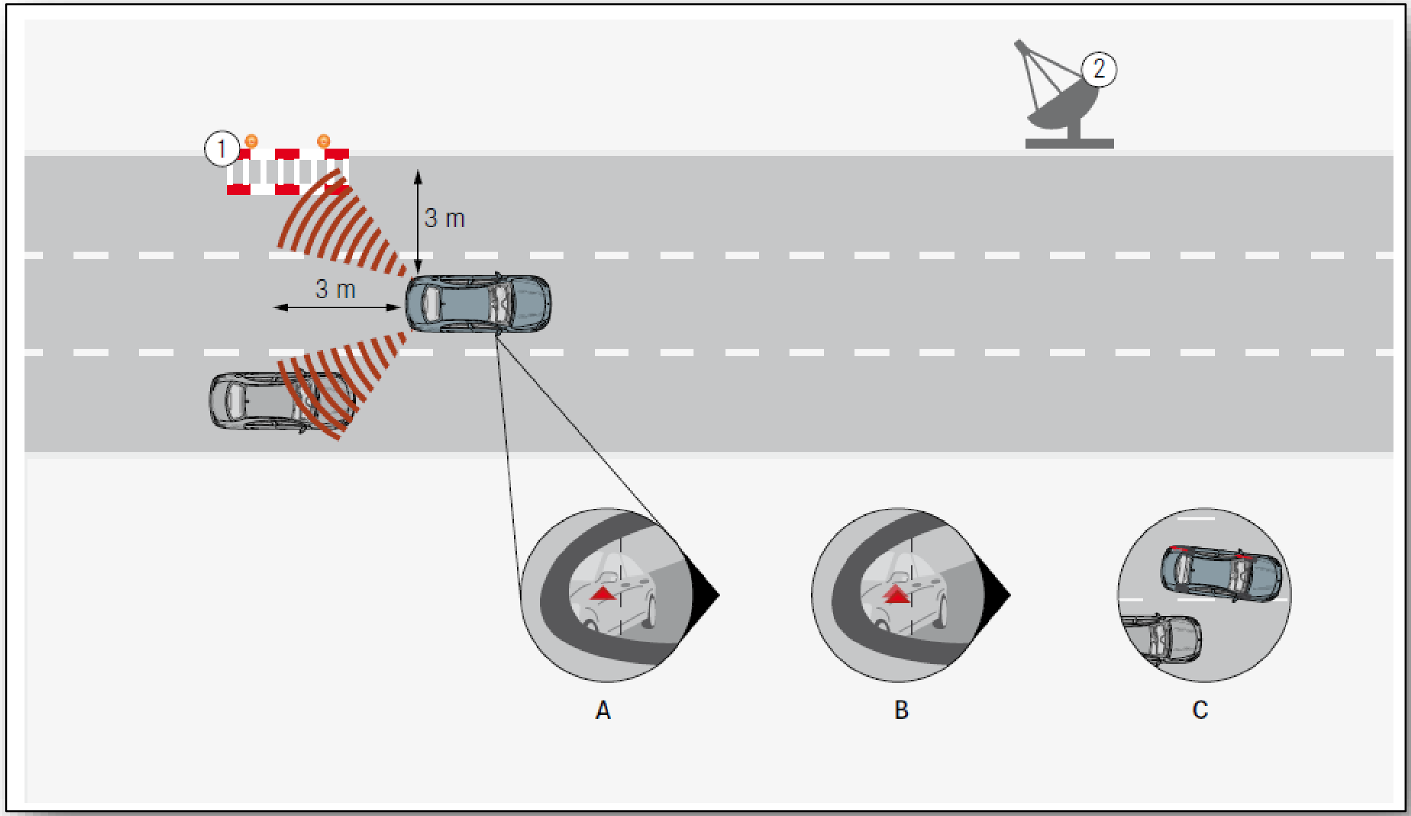
The lane change assist works by using two mid-range radar sensors that are concealed in the rear bumper – one on the left, one on the right.

These two sensors monitor the area alongside and behind the car.

Powerful control software collates the sensor information to create a complete picture of all traffic in the area behind the vehicle.

Radar

Active Blind spot



Active Blind Spot Assist

False warnings may be issued near guardrails or concrete sidewalls in roadwork zones

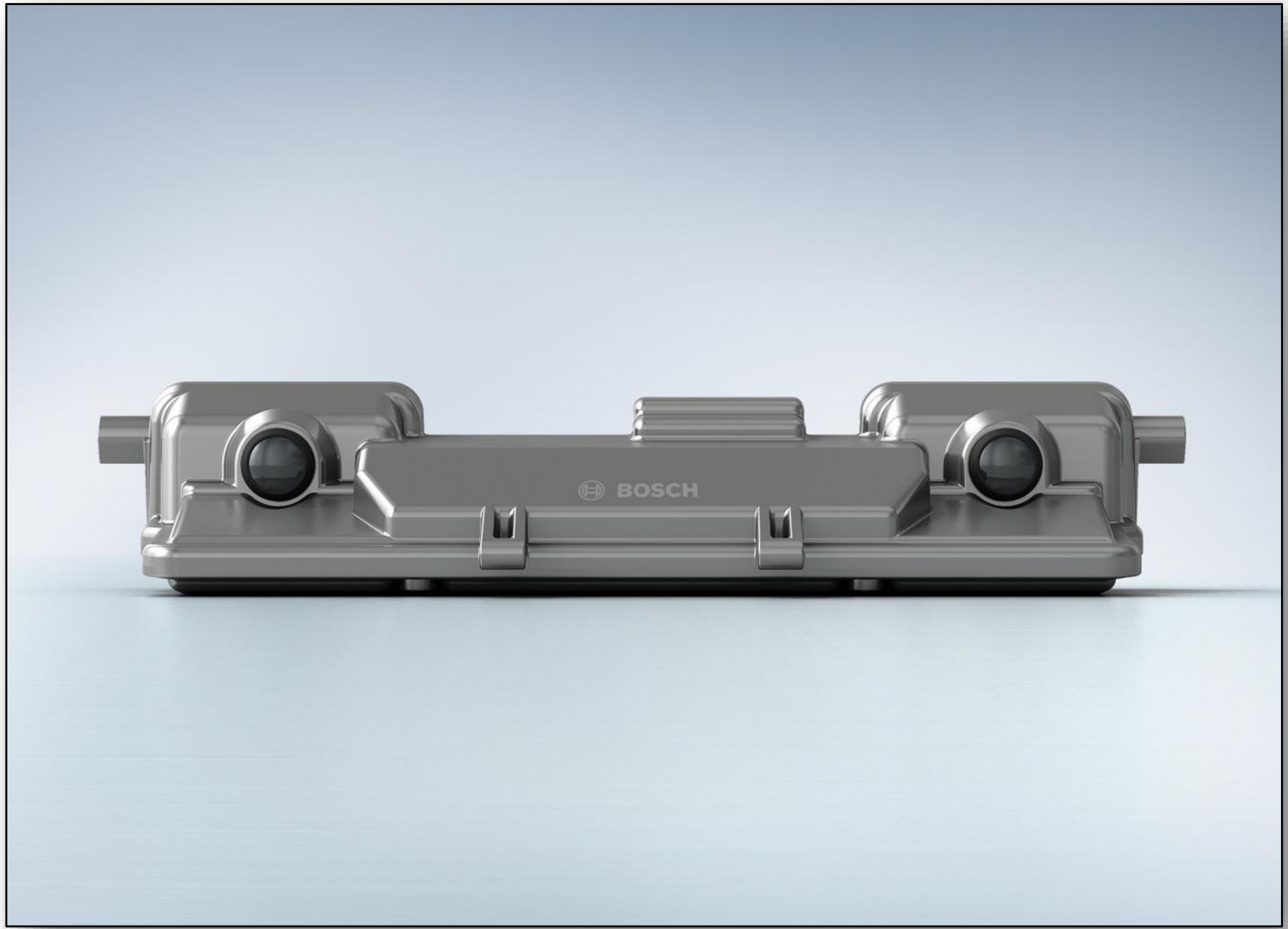
The system shuts off automatically in the vicinity of certain radio astronomy facilities by means of navigation data.

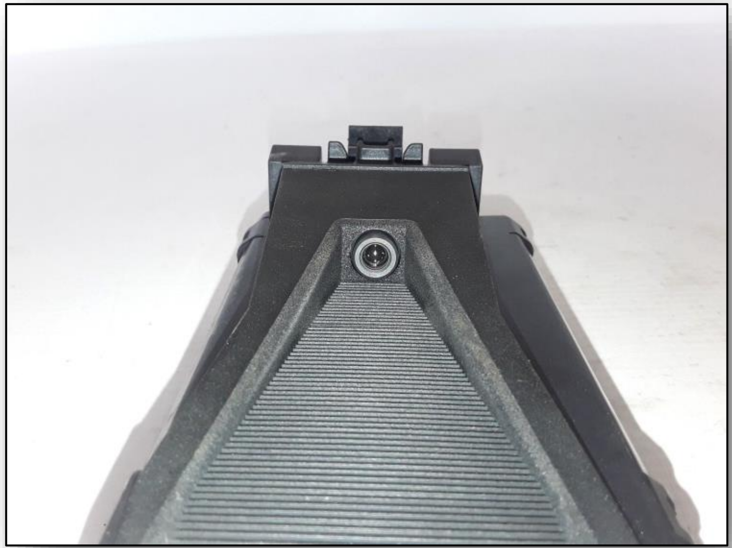
A Warning stage 1

B Warning stage 2: If the driver sets the turn signal despite the warning, the red triangle flashes and an acoustic warning also sounds in the instrument cluster.

C Warning stage 3: Course-correcting, single-sided brake system intervention if risk of side collision detected. (Only with Active Blind Spot Assist)

Camera systems





Camera

Used for

- Long and short range imaging
- Obstacle detection
- Lane keep assist
- Road sign recognition
- Automated braking

Camera

Advantages

- High levels of detail
- Only sensor that sees colour

Disadvantages

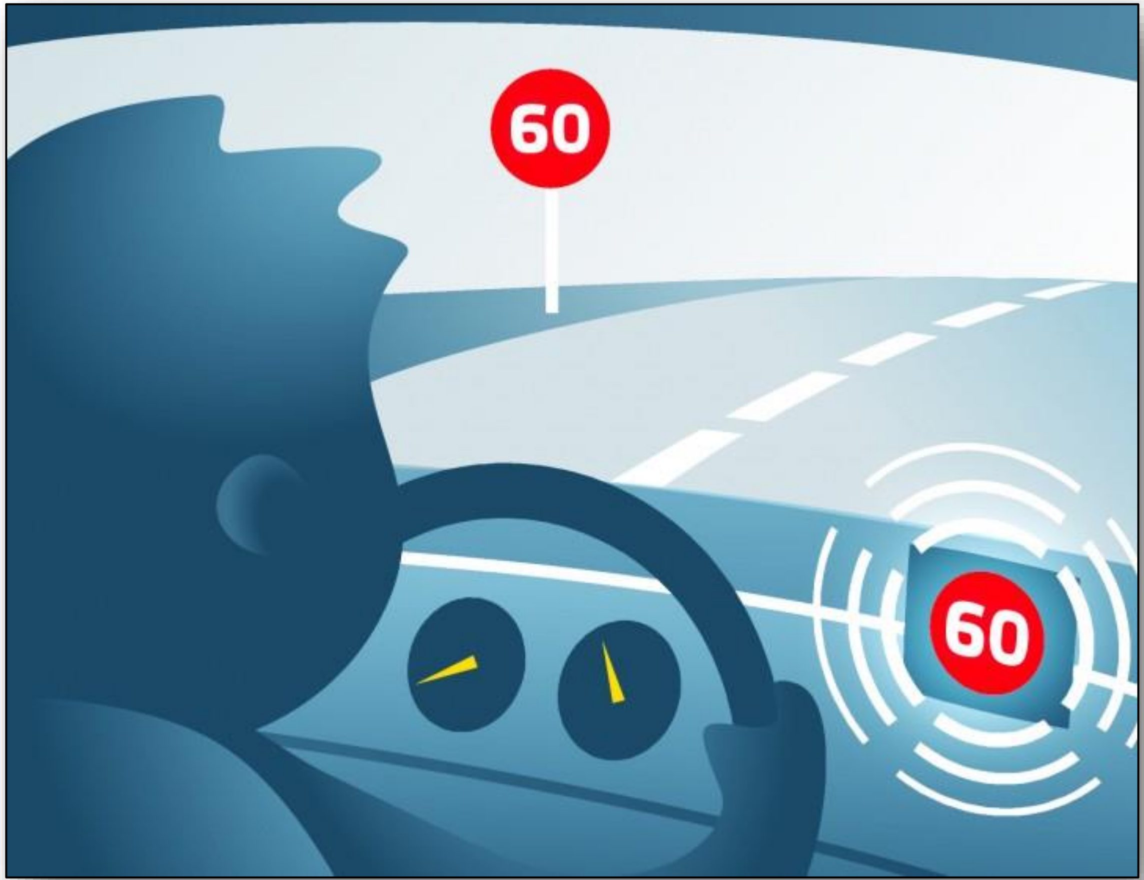
- Large processing power requirements
- Can be affected by light levels, rain and fog

Author: James Dillon

Camera

Technical features	
Imager size	1280 x 960 pixels
Field of view	
Horizontal	50° (nominal)
Vertical	28° (nominal)
Resolution	25 pixels/°
Frame rate	30 images/second
Exposure dynamic	110 dB
Wavelength	400...750 nm
Current consumption	<5.0 W (0.35 A at 14 V)
Operating temperature	-40 to +85°C (+105°C for CAN communication)
Interfaces	2x CAN or CAN+Ethernet Optional: FlexRay 2x digital in/out, windscreen heating

Camera systems
Traffic sign recognition (TSR)

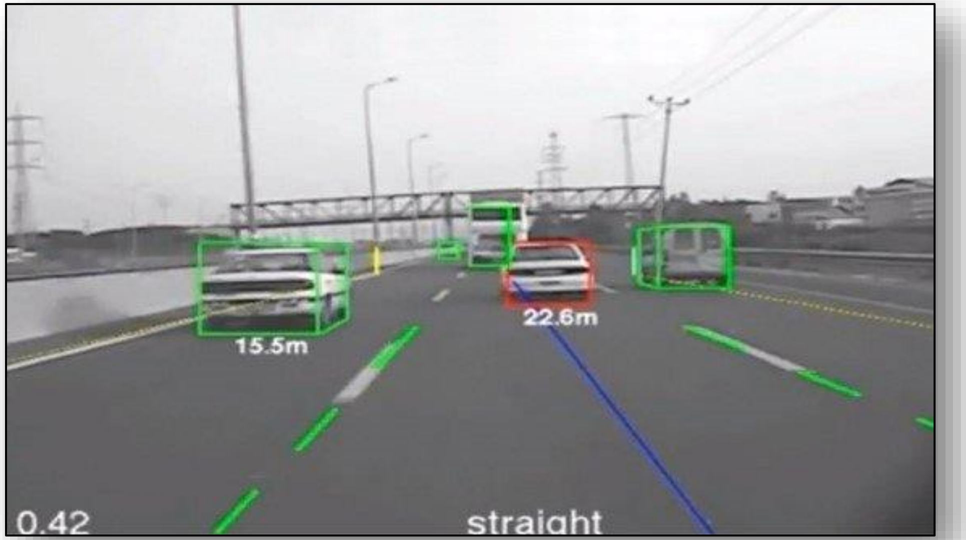


Euro NCAP data from 2018 show that camera-based traffic sign recognition systems have advanced and were fitted as standard equipment to nearly all new vehicle models tested in 2018.

Most of these systems are now able to function under conditional circumstances such as when a lower limit applies in rainy conditions e.g. on French motorways.

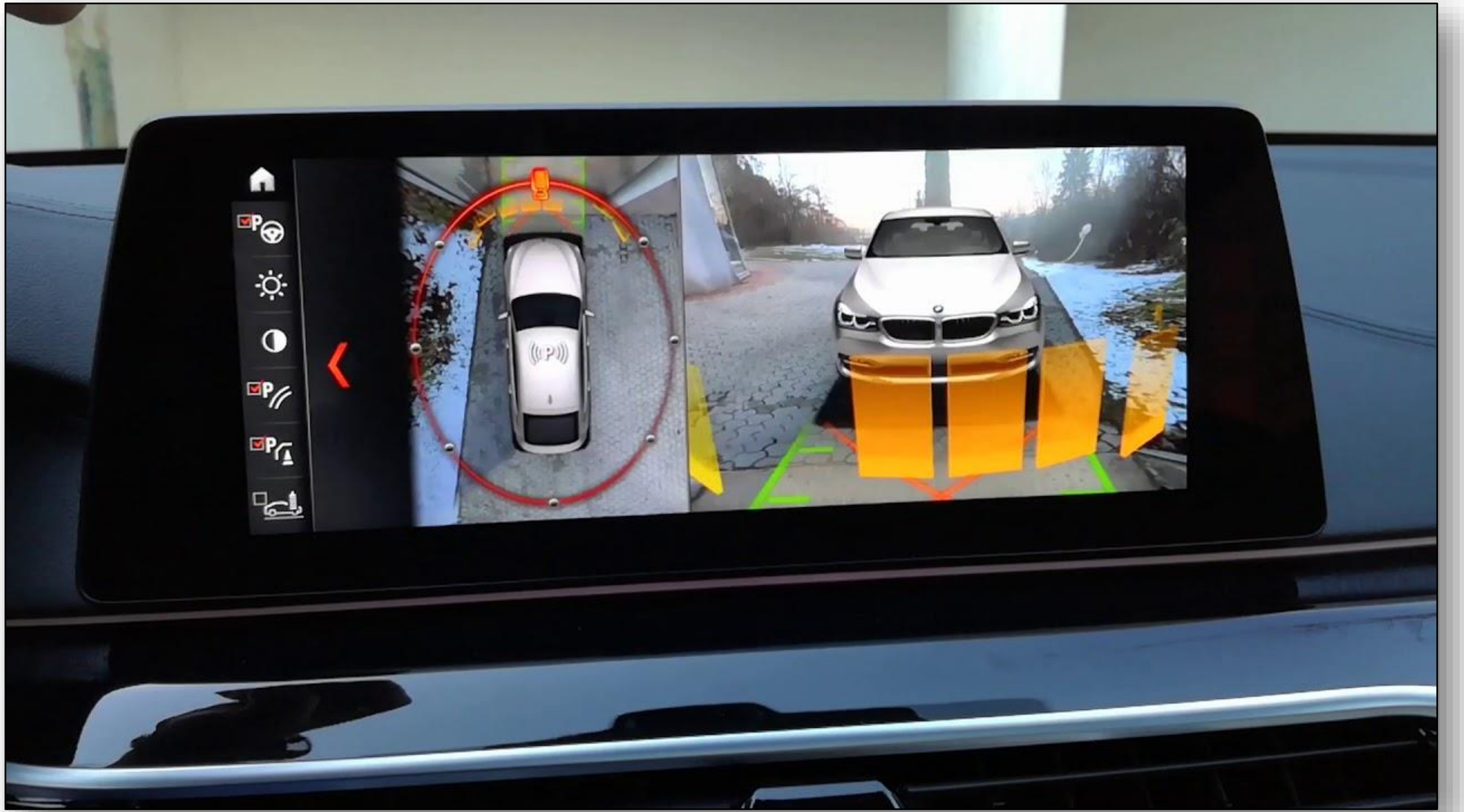
The data shows that most of the cars tested in 2018 were able to read the conditional sub-sign for rain and link this to the status of the windscreen wipers to determine the correct speed limit for the rainy driving conditions

Camera systems
Lane departure warning (LDW)



Author: James Dillon

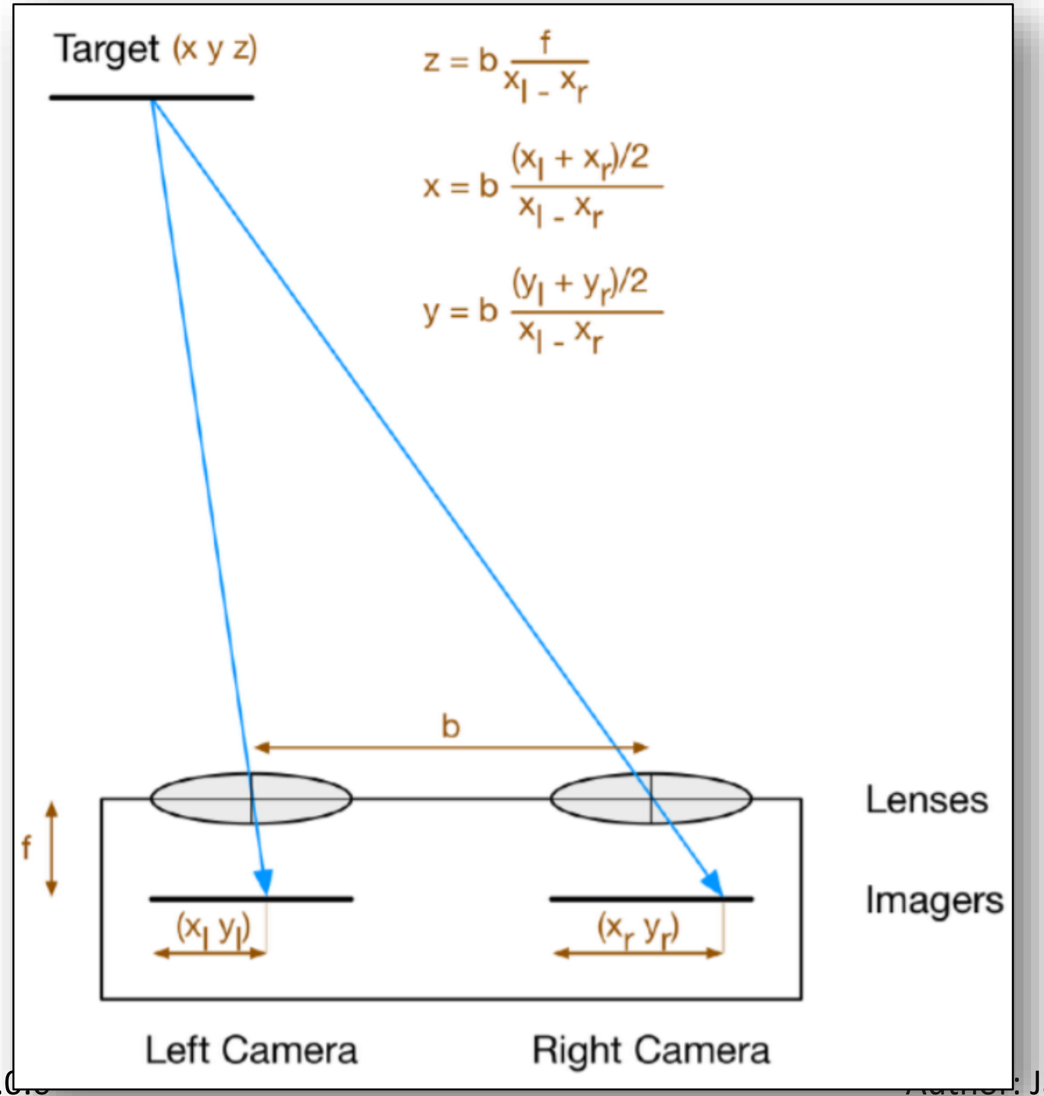
Camera systems
360-degree cameras



Stereo Camera systems

Author: James Dillon

Stereo Camera systems

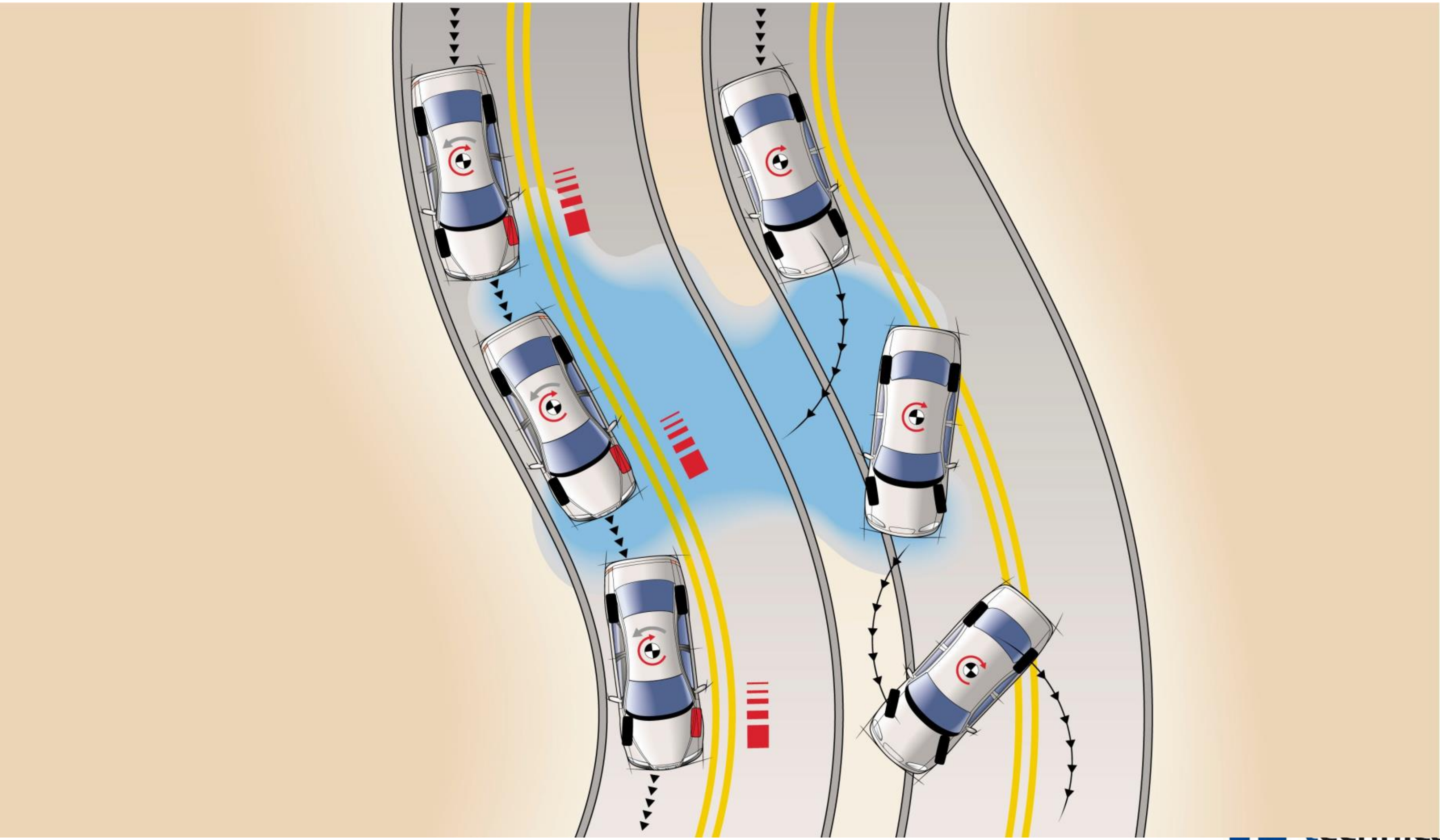


Features matches are found in left and right
cameras.

Different in lateral position (disparity) is inversely proportional to distance.

Automated Braking Systems

DTSC



Author: James Dillon

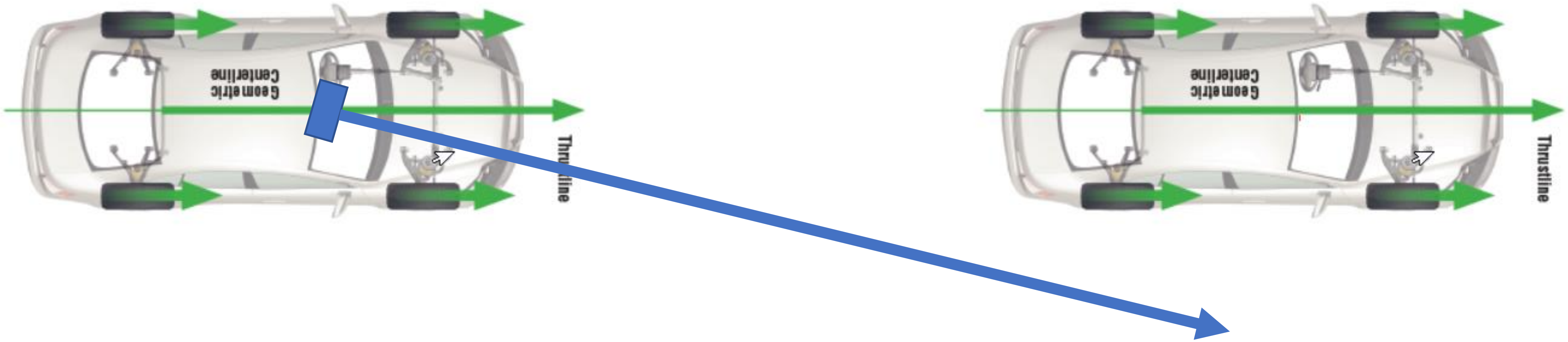
Camera Systems – Scan demo

ZED camera Module and Laptop

Stereo Camera Perception & Confidence

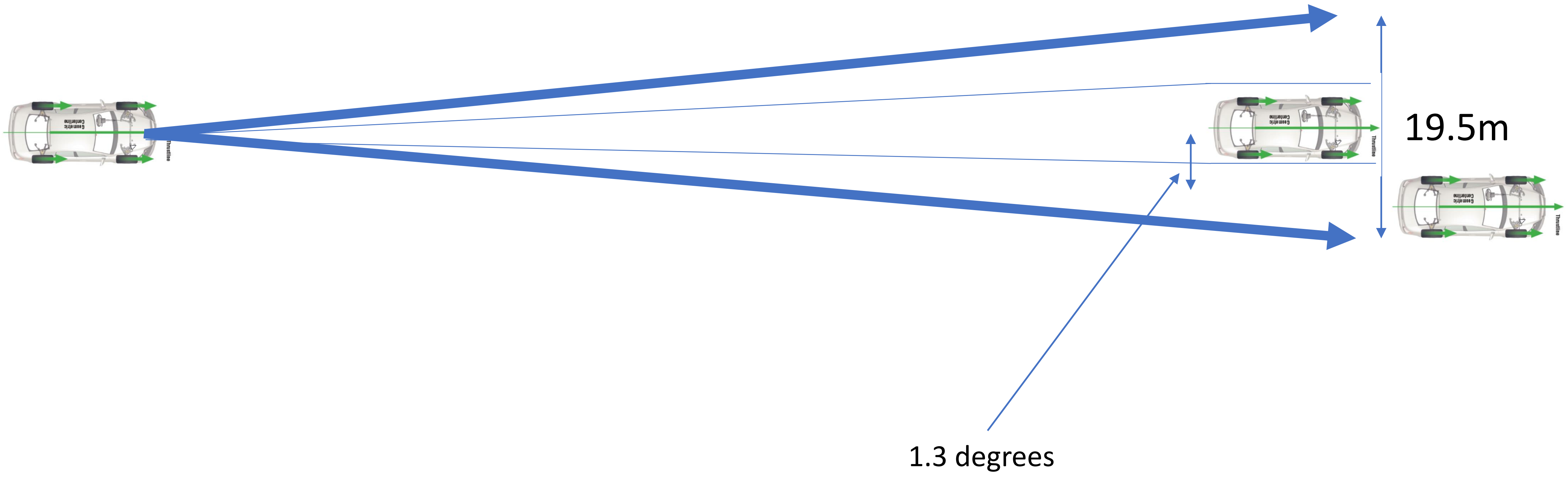
Author: James Dillon

The need for calibration



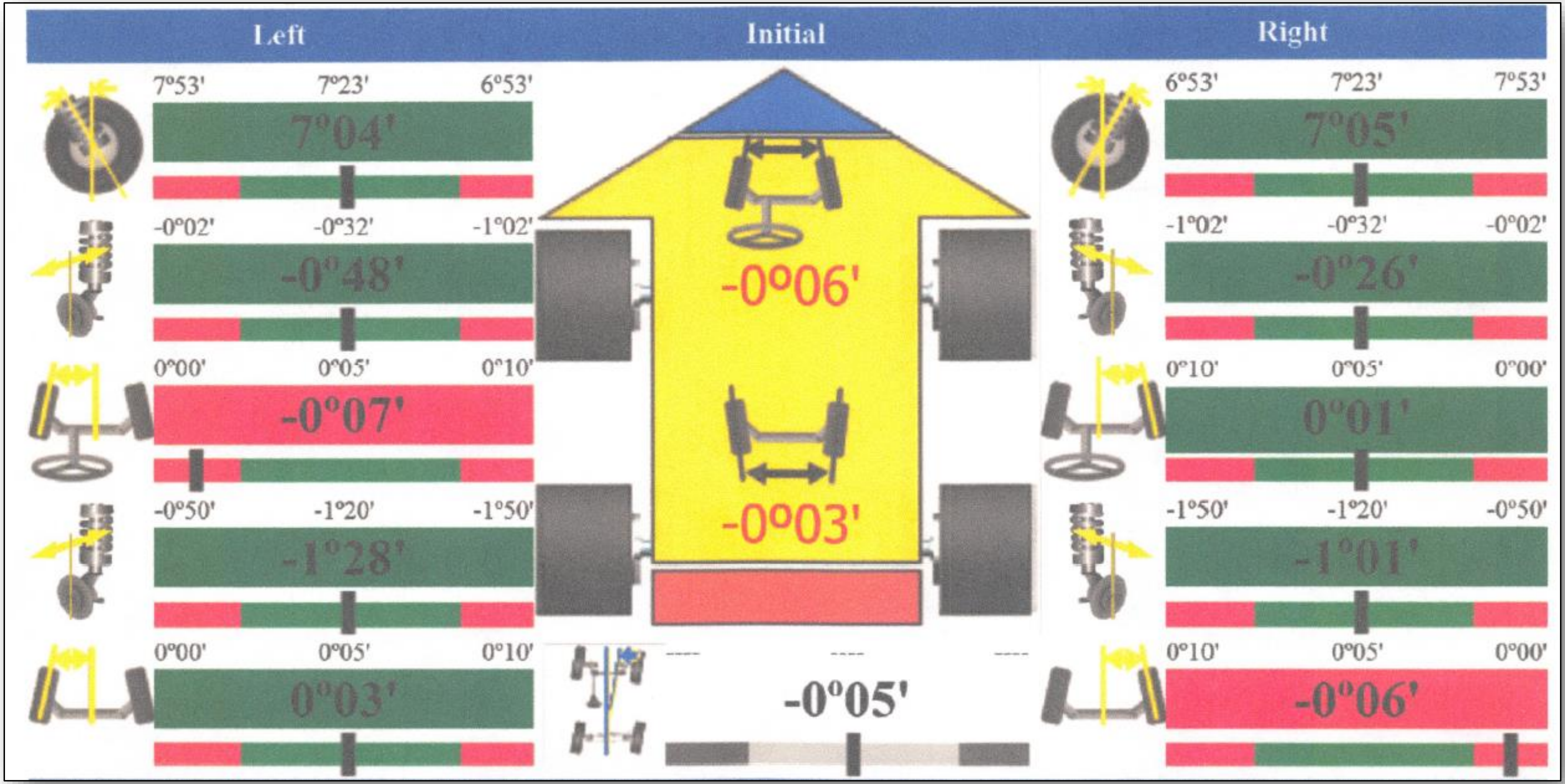
Mis-aligned camera / radar doesn’t see car in front

The need for sensor calibration



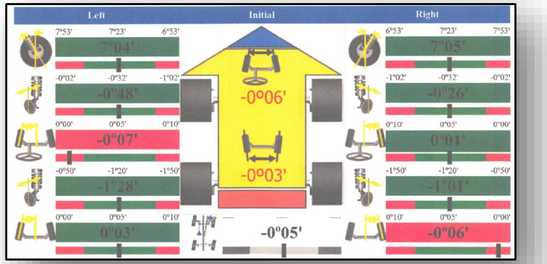
At 160m distance a 7 degree field of view is 19.5m across. A standard motorway lane is 3.65m wide, at 160 metres this represents 1.3 degrees. This is approx. 2.2 mm on the adjustment screw or bend on the bracket

Vehicle alignment



technical topics
enabling diagnostic expertise

Vehicle alignment – pre-assessment.



1) Remove any heavy items from the boot and passenger compartments. Do not remove any item or equipment that is supplied with the vehicle and normally kept in the vehicle.

2) Check all four tires for proper tire size, and adjust tire pressure to specifications.

3) Check the vehicle's ride height. Carrying out a successful wheel alignment with the vehicle's ride height incorrect is impossible.

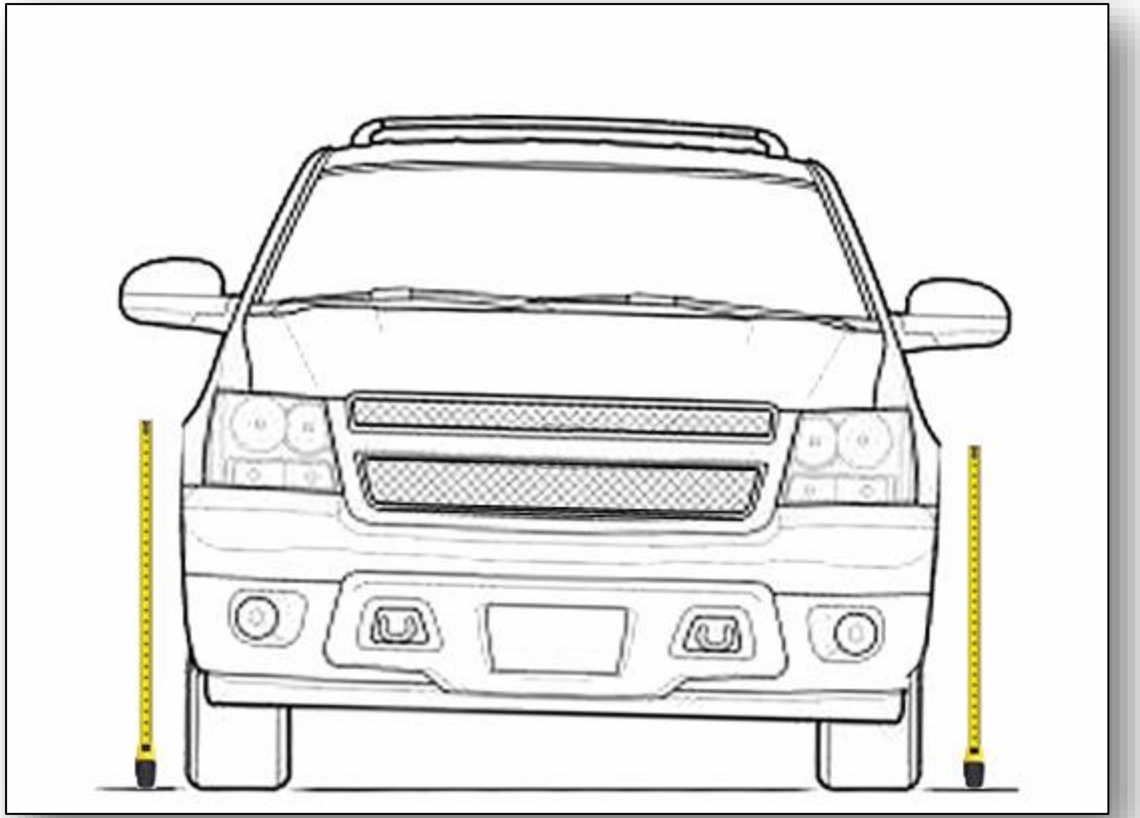
4) Check the play of the steering wheel. Excess play must be corrected before undertaking the wheel alignment.

5) Bounce each corner of the vehicle to check the correct functioning of the shock absorbers.

6) With the vehicle raised on a hoist or jack, inspect all suspension and steering components according to service information, including the wheel bearings. Repair or replace all damaged or worn suspension components prior to aligning the vehicle.

Author: James Dillon

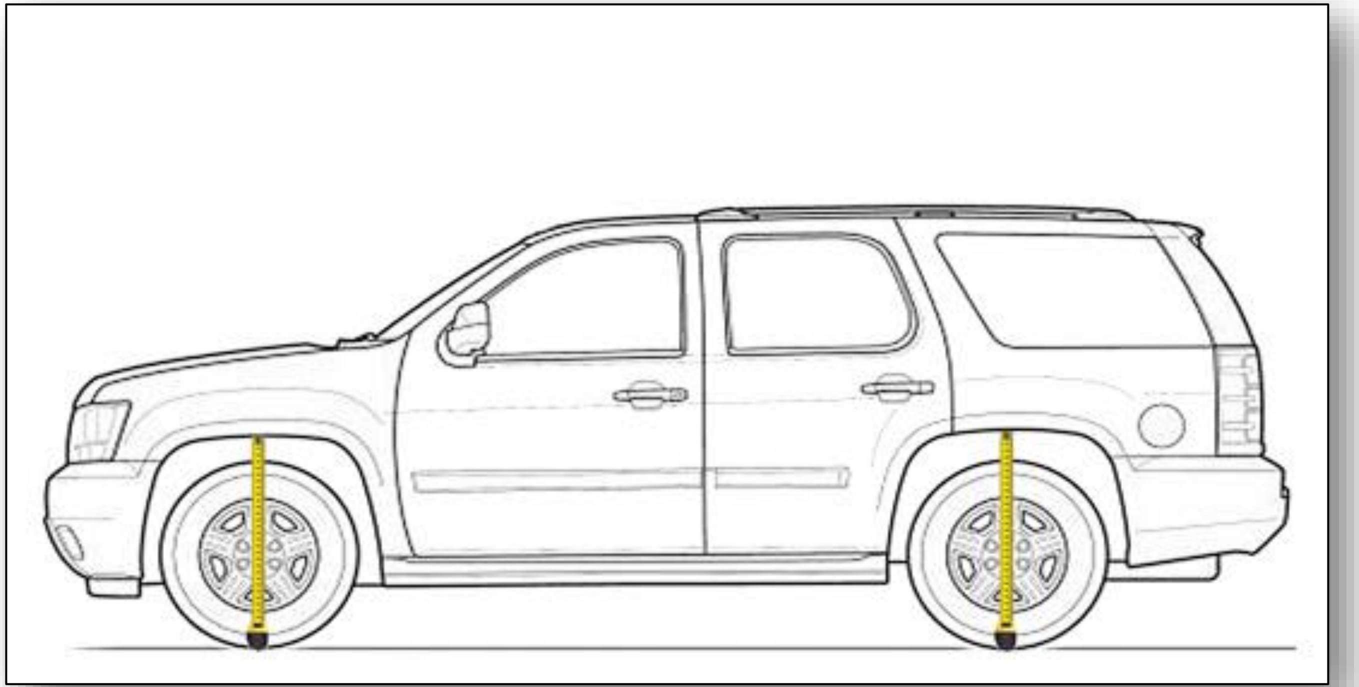
Vehicle alignment – Ride Height



Lateral ride height differences can lead to rotational deviation around the sensors axis, affecting their performance.

Q: How will the ADAS sensors detect there is lateral ride height deviation?

Vehicle alignment – Ride Height



Longitudinal ride height differences can lead to rotational deviation around the sensors centre line, affecting their performance.

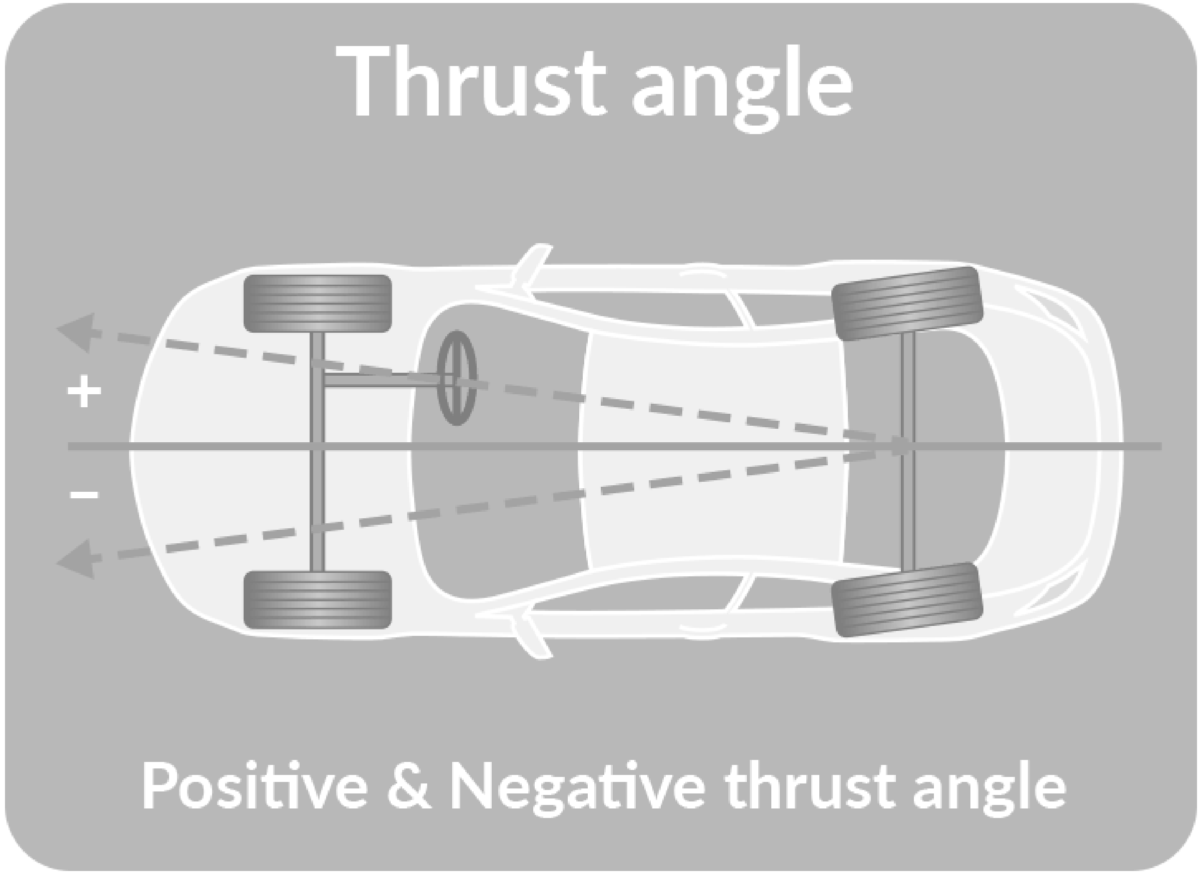
Q: How will the ADAS sensors detect there is longitudinal ride height deviation?

Vehicle alignment – Tyres

Tyre sizes, tyre wear differences (rotational size) and tyre pressures can all affect vehicle ride height.

Q: How will the ADAS sensors detect there is ride height deviation?

Wheel alignment – Thrust Angle

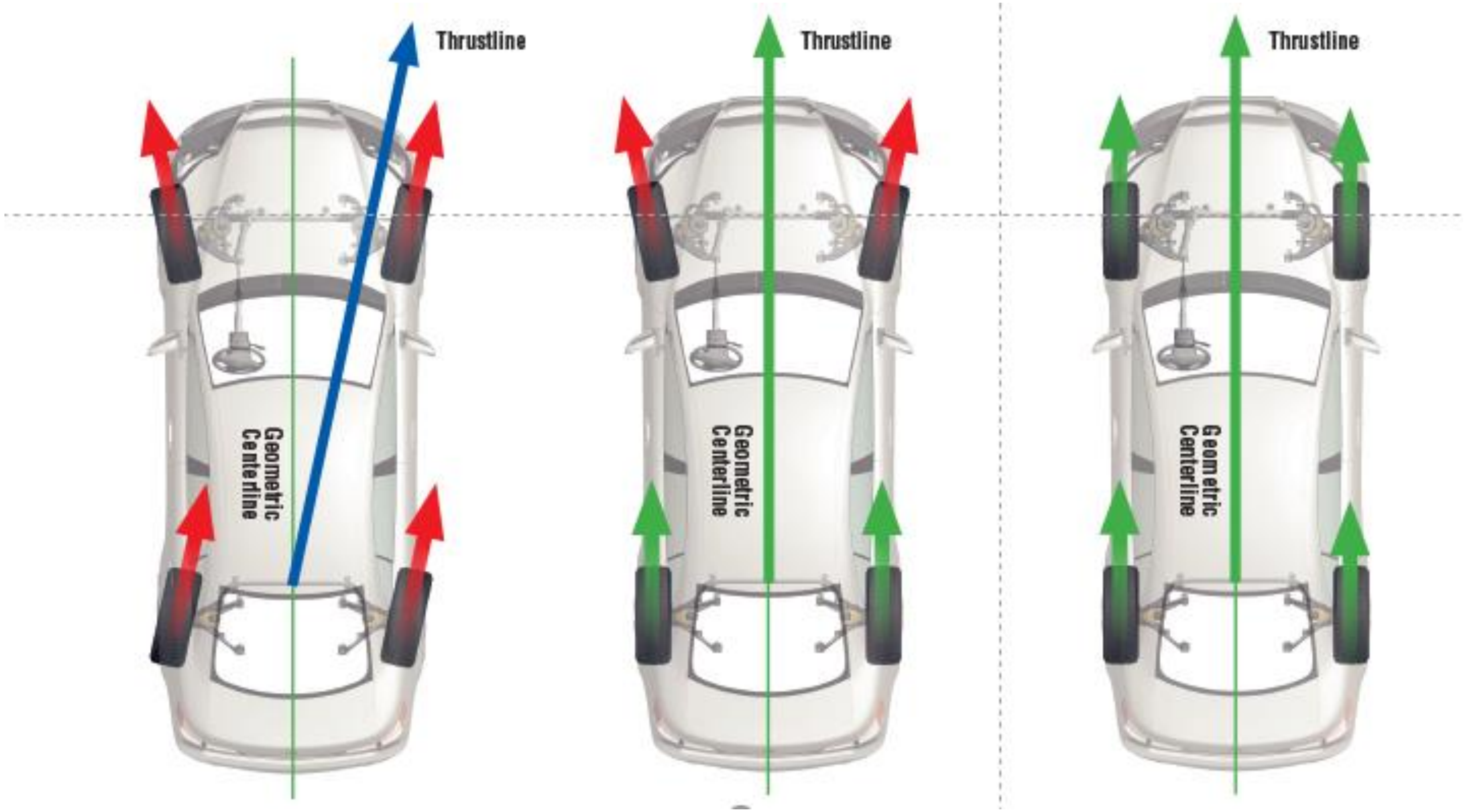


Thrust angle deviation can be positive (biased towards the drivers side)

Or negative (biased towards the passenger side.

Thrust angle deviation will cause ADAS misalignment, even when the sensors are aligned with respect to the frame of the vehicle.

Wheel alignment – Thrust Angle

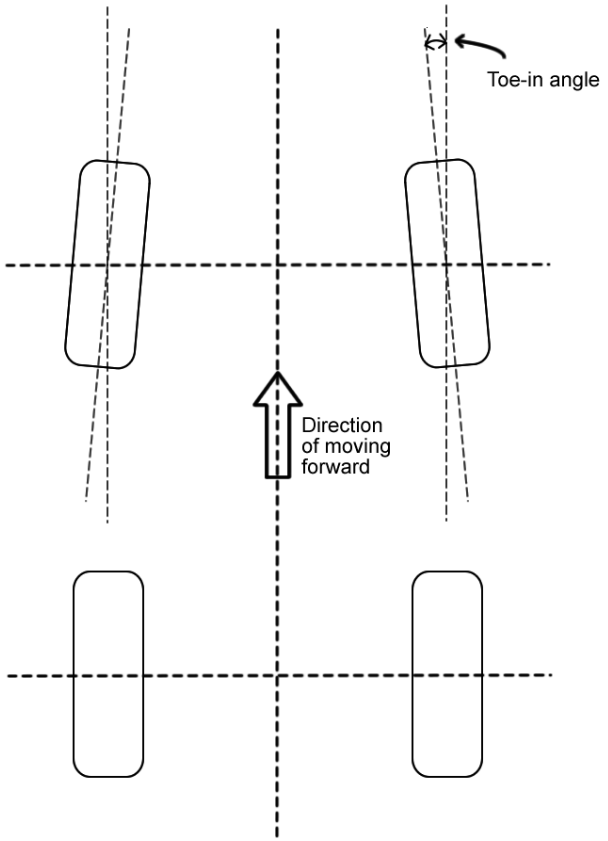


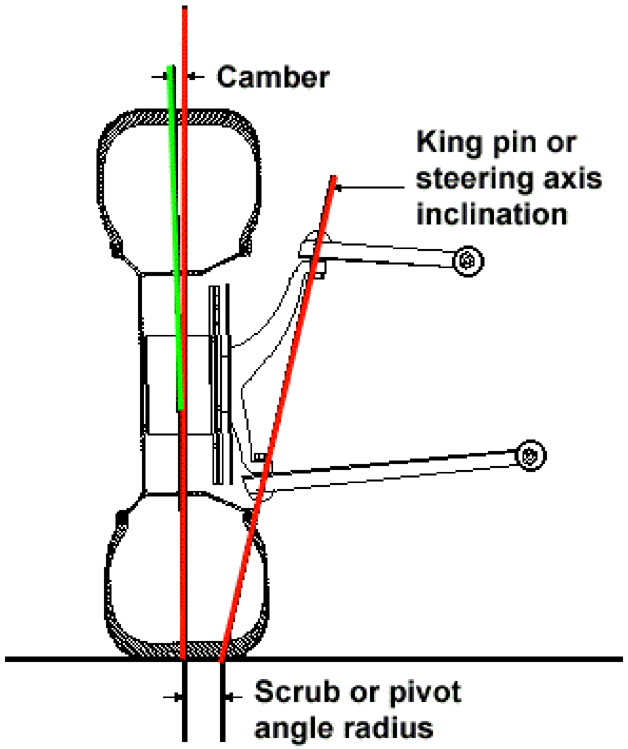
When carrying out wheel alignment, the rear toe and thrust angle should be set before the front alignment is carried out

Author: James Dillon

Wheel alignment

Handout





Raising or lowering the suspension can affect, toe camber and Caster angles.

Author: James Dillon

Repair work concerning ADAS Vehicles

Repair work concerning ADAS Vehicles

Pre-Calibration
Triage, Assessment &
Preparation

Before any work starts on the vehicle, assess if you have the capability to manage the full repair process.

R.1.0.0

Author: James Dillon

technical topics
enabling diagnostic expertise

Pre-Calibration Triage, Assessment & Preparation

Primary goal: *Assess whether the vehicle has ADAS sensors fitted, which systems they are enabling, and clearly identify the locations of the sensors using the following methods:*

1. Direct questioning of the vehicle owner.
2. Researching the vehicle model fitment information.
3. Use of 3rd party VIN or registration look up tools for fitment data.
4. Inspect the vehicle, refer to the repair planning guide
5. Use Diagnostic Tools to check vehicle data to verify what ADAS sensors are fitted.
6. Record what sensors are on the vehicle being repaired.

Where no ADAS sensors are fitted, record for audit purposes that no ADAS are fitted and no inspection, calibration and realignment is required.

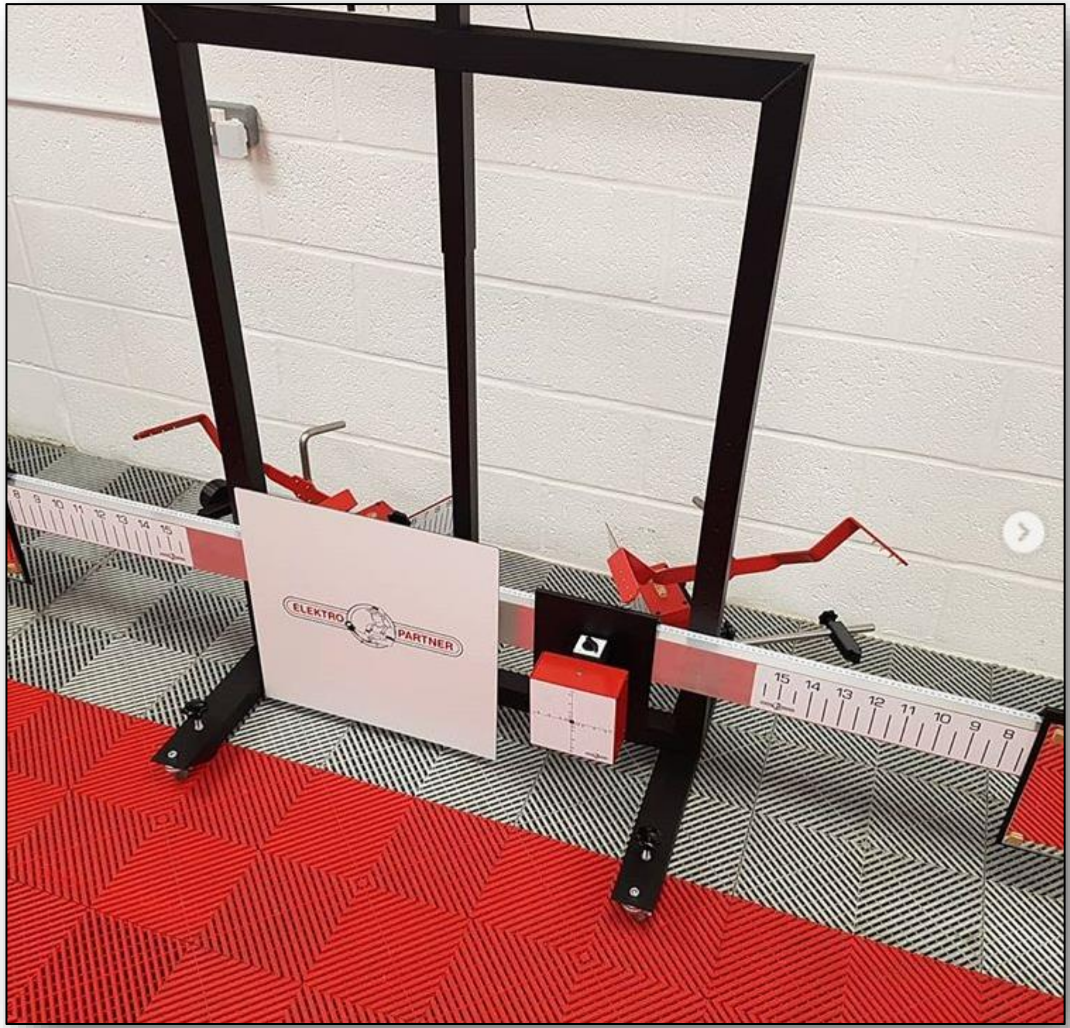
Repair work concerning ADAS Vehicles

Assessment Outcomes:

Do you have the capabilities to manage the full repair process?

It is your responsibility to validate and record the capabilities of any 3rd party to which you sublet ADAS calibrations.

ADAS Calibration



technical topics
enabling diagnostic expertise

When is there a requirement to calibrate (IIR)?

Inspection, realignment and calibration requirements must be considered in all repair situations where ANY of the following is included within the repair, service or maintenance procedure:

- ADAS sensors,
- parts likely to affect the operation and functionality of ADAS sensors, or
- vehicle geometry

Author: James Dillon

ADAS calibration industry guidance (IIR)

A repairer shall ***IN ALL CASES*:**

1. identify the presence, or not, of ADAS on the vehicle and ensure this is recorded.
2. where ADAS are present, ensure repair procedures clearly identify if inspection, realignment and calibration are required and why.
3. complete all relevant inspection, realignment and calibration activities as detailed within the repair procedures.
4. ***inspection, calibration, realignment and road tests shall be carried out by a currently competent person.***
5. ensure the calibration results confirm that the sensors are functioning within the vehicle manufacturer's technical specification.
6. produce fully verifiable and auditable records and provide a copy to the Owner / Work Provider.

When do we need to calibrate?

Typical workshop cases include:

- After windscreen replacement
- Body repairs
- Wheel Alignment
- Suspension work
- Mechanical work that means front panel / bumper /radar mount is moved (e.g. Audi cambelt - longitudinal)

ADAS (IIR) Insurance Companies Mandating

- Accredited Insurance (Europe) Limited
- Admiral
- ageas
- Allianz
- MS Amlin
- AVIVA
- AXA
- 1st Central / skyfire
- CGICE
- CHUBB
- co op
- Covéa Insurance
- Direct Line Group
- ERS
- esure
- FBD
- Insurance Corporation – the insurer of choice for islanders
- LV= Liverpool Victoria
- Markerstudy Group
- Aioi Nissay Dowa Insurance Europe – MS&AD Insurance Group
- Munich RE
- NFU Mutual
- Premier
- QBE
- QEL – QIC Europe Limited
- RSA
- SAGA
- TESCO Underwriting Limited
- Trinity Lane
- USAA
- ZURICH

ADAS Calibration – Competent Person (IIR)

All inspection, calibration and realignment activities should be completed by currently competent persons.

Competence should be proven through relevant and up to date, industry recognized, certified assessments or training programs with assessed outcomes.

ADAS Calibration

Static calibration? Or Dynamic calibration?

Author: James Dillon

ADAS Calibration

Handout

Static calibration Example: VW Group (Skoda Superb) Adaptive Cruise Control.

Supporting Documentation: OEM (Odis) and Aftermarket (Bosch).

Supporting background info: TT Calibration Record Sheet

ADAS Pre-Calibration Triage Practical

Calibration Record Handout

Demo Vehicle : VW Group (Skoda Superb).

Task: Use the calibration record sheet.

1. Direct questioning of the vehicle owner.
2. Researching the vehicle model fitment information.
3. Use of 3rd party VIN or registration look up tools for fitment data.
4. Inspect the vehicle, refer to the repair planning guide
5. Use Diagnostic Tools to check vehicle data to verify what ADAS sensors are fitted.
6. Record what sensors are on the vehicle being repaired.

Author: James Dillon

ADAS Pre-Calibration Questions……

What systems does the demo vehicle have?

Systems ______________________________________

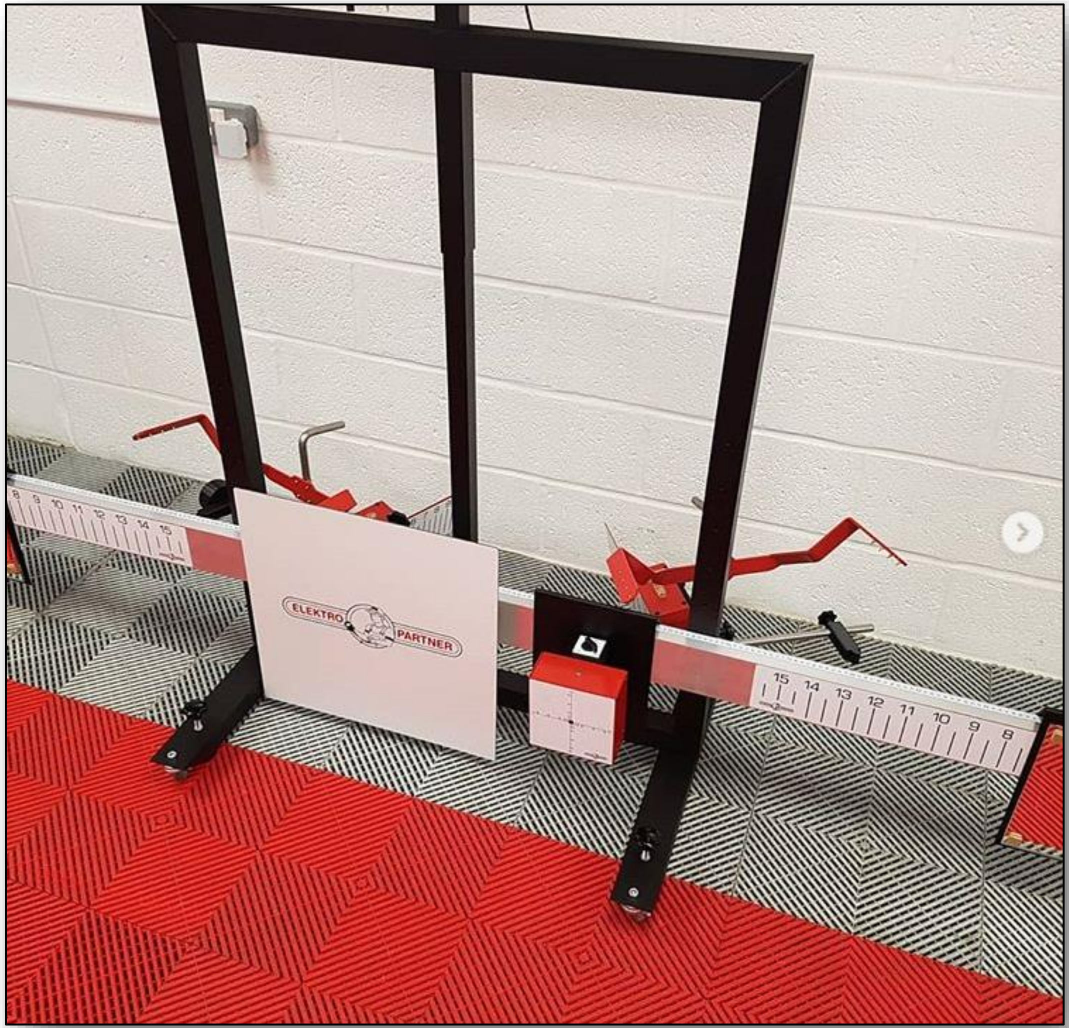
Is the ACC sensor calibration static or dynamic?

Calibration Type _________________________________

What is the max vehicle slope allowance?

Systems ______________________________________

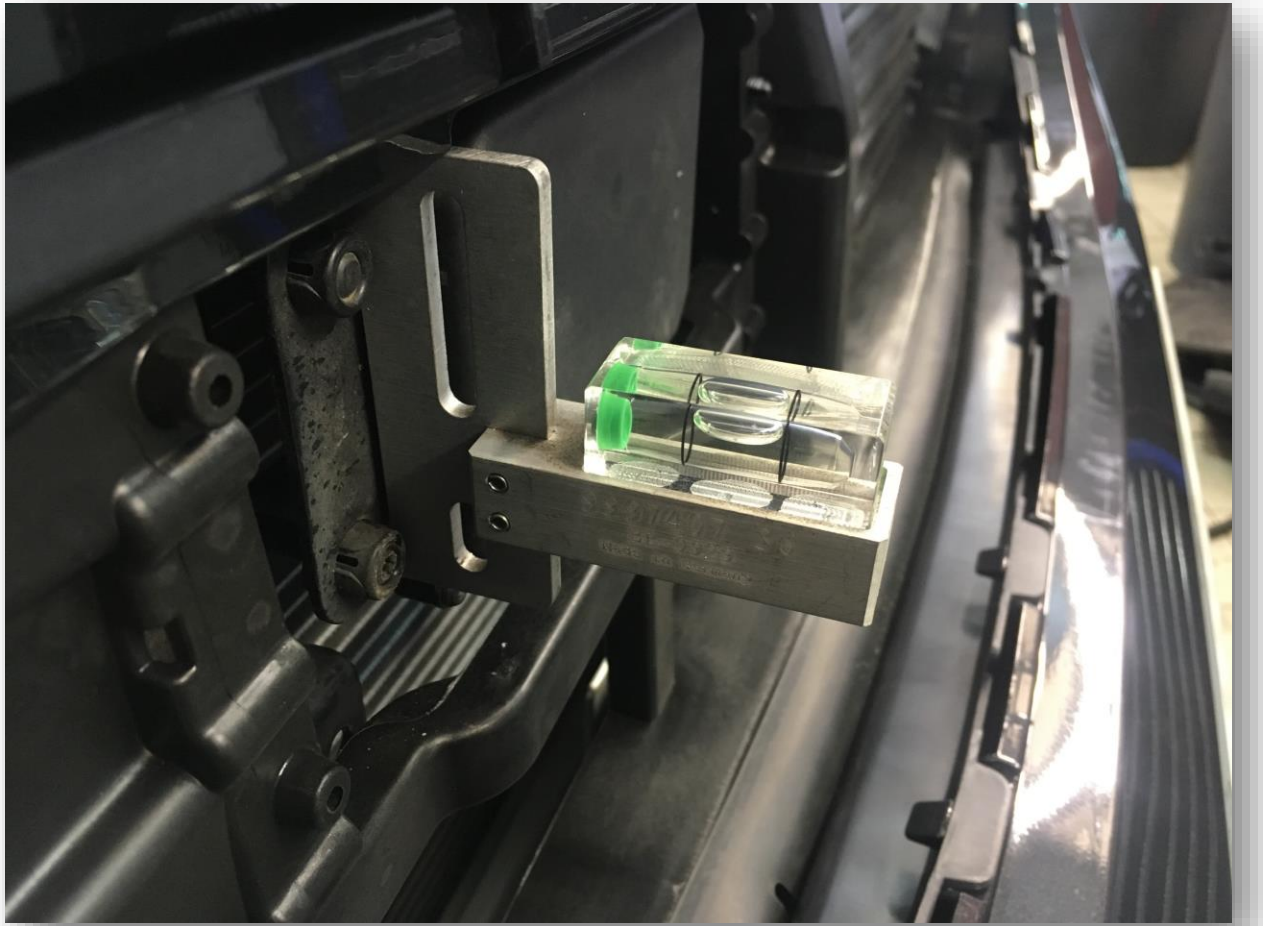
Equipment Requirements



Equipment Requirements

Bosch
Skoda Handout

Dynamic and static calibrations may need to be initiated using a scan tool.



The process
Dynamic Calibrations

Standard precondition for dynamic calibration procedure of front windscreen camera

- Front windscreen and headlamps must be clean
- Low beam must be turned on
- Correct tyre pressure
- The road test can only be carried out in dry weather, and there can be no snow on the road surface

The process
Dynamic Calibrations

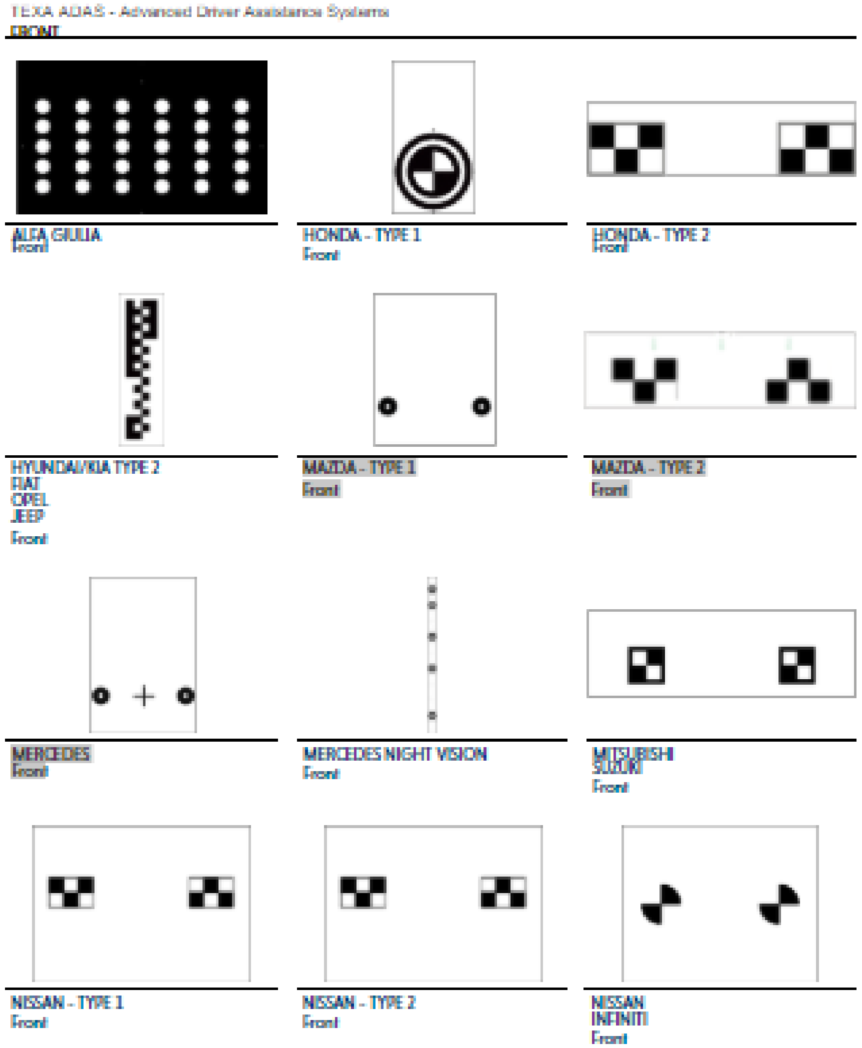
- During the road test, keep the speed above 60 km/h (37 mph), preferably approx. 80 km/h (49 mph)
- Find a suitable straight stretch of road with no sharp bends
- Drive as close as possible to road markings, guardrails, signs and buildings during the road test, keep a distance of 40-50 metres to cars ahead
- Stop the car, start the calibration procedure on the diagnostic tool
- Carry out the road test until the diagnostic tool sends a message that the procedure has been completed (may last 5-15 minutes)
  Windscreen wiper and washer can NOT be activated (if necessary, turn off automatic rain sensor).

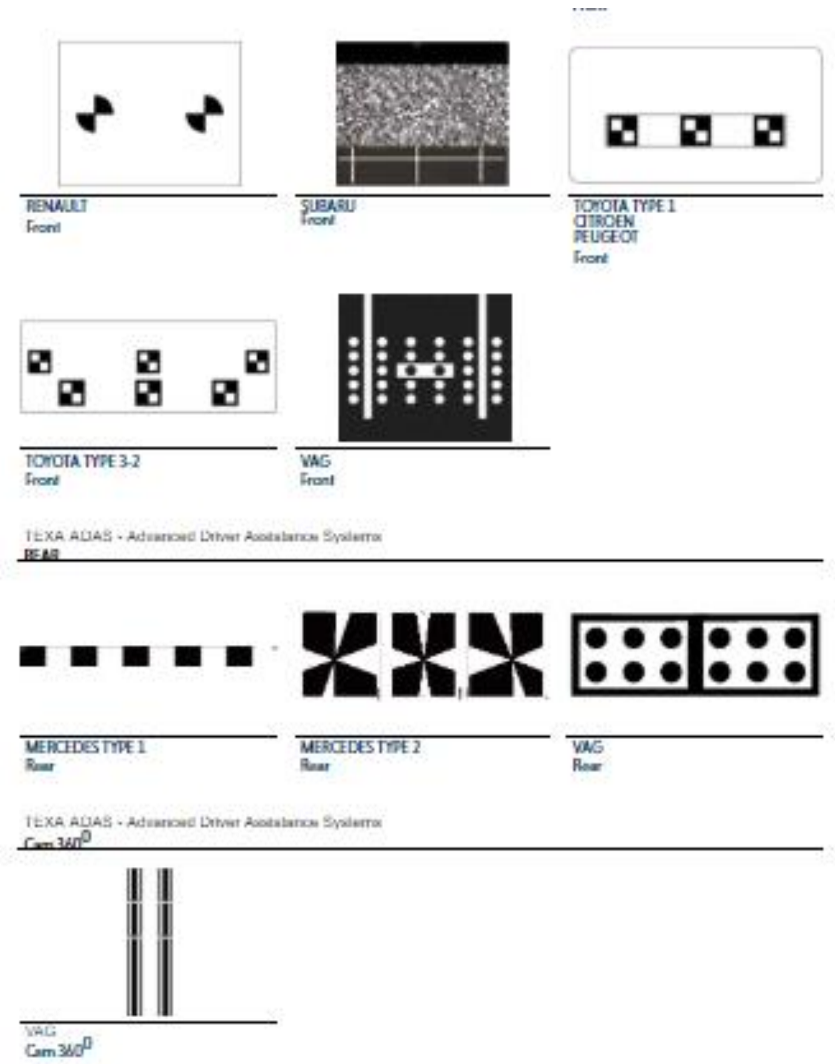
The process
Static Calibrations

Pre-conditions

- Wheel alignment checked and set
- Steering wheel straight ahead
- Steering angle sensor calibrated
- Vehicle loaded as per manufactures specification
- Vehicle sat on level workshop floor
- Lighting levels correct
- Correct tools and Alignment boards available

The process


TEXA ADAS - Advanced Driver Assistance Systems
FRONT
ALFA GIULIA
Front
HONDA - TYPE 1
Front
HONDA - TYPE 2
Front
HYUNDAI/KIA TYPE 2
FIAT
OPEL
JEEP
Front
MAZDA - TYPE 1
Front
MAZDA - TYPE 2
Front
MERCEDES
Front
MERCEDES NIGHT VISION
Front
MITSUBISHI
SUZUKI
Front
NISSAN - TYPE 1
Front
NISSAN - TYPE 2
Front
NISSAN
INFINITI
Front


RENAULT
Front
SUBARU
Front
TOYOTA TYPE 1
CITROEN
PEUGEOT
Front
TOYOTA TYPE 3-2
Front
VAG
Front
TEXA ADAS - Advanced Driver Assistance Systems
REAR
MERCEDES TYPE 1
Rear
MERCEDES TYPE 2
Rear
VAG
Rear
TEXA ADAS - Advanced Driver Assistance Systems
Cam 360°
VAG
Cam 360°

The process


ADAS Solutions
KALIBRERING AF VIDEOKAMERA
03:21:23
Sæt tavle i vater

The process
Camera Calibration VAG

- Connect Diag tool and read, save / print any fault codes
- Ensure wheel alignment / Rear wheel thrust angle is correct.
- Set Vehicle up on level floor
- Measure height from floor to each wheel arch and note down
- Attach wheel clamps
- Place Alignment rig in front of Vehicle 1500 from front axle centre line
- Use lasers on wheel heads to set rig central side to side
- Place mirrors on rig and set rig at 90 degrees to vehicle centre line
- Select correct alignment board
- Set the board to correct height (1700mm)
- Start calibration on diag tool
- Follow on screen instructions
- Calibration complete
- Read and print fault codes

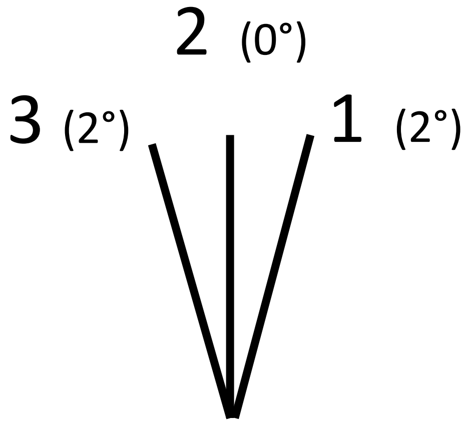
The process

Radar Calibration VAG

- Connect Diag tool and read, save / print any fault codes
- Ensure wheel alignment / Rear wheel thrust angle is correct.
- Set Vehicle up on level floor
- Attach wheel clamps
- Place Alignment rig in front of Vehicle 1200 from Radar to target
- Use lasers on wheel heads to set rig central side to side
- Place mirrors on rig and set rig at 90 degrees to vehicle centre line
- Set Setting beam at a suitable height for radar
- Aim Target laser at mirror on Radar
- Adjust screws so laser beam is reflected back into originating hole
- Start diag tool calibration procedure
- Follow on screen instructions
- Calibration complete
- Read and print fault codes

The process
Radar Calibration VAG

Handout



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IMI Practical Assessment

Skills Requirements	
The candidate must demonstrate the ability to:	
2.1	Protect the vehicle prior to removing any components to prevent damage to the vehicle during the assessment
2.2	Remove and replace MET components adhering to safe working practices and manufacturer's procedures
2.3	Identify ADAS features in vehicle set-up
2.4	Ensure the calibration environment set by the manufacturer's instructions i.e. targets, lighting, and radar boards
2.5	Ensure all equipment is fit for purpose prior to commencing work
2.6	Select and use diagnostic equipment for fault code reading and calibration process
2.7	Carry out calibration of two ADAS sensors on a vehicle that has a minimum of two operating systems i.e. Autonomous Emergency Braking (AEB) front/rear proximity sensors and lane departure warning
2.8	Ensure all information is captured and reported appropriately throughout the calibration activity and as required by the assessment process
2.9	Show awareness of the ADAS Code of Practice
2.10	Ensure all ADAS systems are switched on after calibration has been completed
2.11	Use Personal Protective Equipment (PPE)
2.12	Follow Health and Safety guidelines
2.13	Work within given time constraints

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