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Editorial

Driverless cars are the future, or so we keep being told. It’s no wonder then that manufacturers are racing against each other and Google to become the first to offer one. While the benefits of an autonomous car are clear cut to some, others question whether they would result in fewer accidents and reduced congestion. Debates around the legality have some way to go, too. Technology is one thing, regulations are another but consumer acceptance of such technologies needs to happen too.

In the meantime, a myriad of advanced driver assistance system (ADAS) technologies are already available from the luxury class to small city cars. Such technologies can steer, park and even brake for us. And if you are willing to pay more, you can drive even less. Our first article looks back at when the main ADAS began to appear on the road while our second feature assesses the stage we are now at.

While such technology may sound useful for the driver, how does this affect the windscreen? Manufacturers are designing ever more complex brackets for the windscreen capable of supporting a variety of electronics from rain sensors to lane departures systems to automatic high beam controls. The accent is on placing the camera and sensors behind the mirror instead of the grille. Consequently, this area of the windscreen is becoming jam-packed with electronics on certain models. Such cameras for the most part, need to be recalibrated upon replacing the windscreen.

Our third article therefore highlights some finer developments of forward- and driver-facing cameras.

Although component manufacturers are pushing back the boundaries of camera technologies, there is still quite a lot of work to do before automakers can offer that driverless car. Our final article provides a round-up on the major manufacturers’ activities and innovations in the ADAS arena.
Advanced driver assistance systems: Where have we come from?

Advanced driver assistance systems (ADAS) aim to make the vehicle capable of perceiving its surroundings, interpret them, identify critical situations, and assist the driver in performing driving manoeuvres. The object is, at best, to prevent accidents completely and, at worst, minimise the consequences of an accident for those concerned.

While self-driving cars are not yet available to the public, there are increasing numbers of models offering some form of advanced assistance to the driver. These include adaptive cruise control (ACC), forward collision warning (FCW), autonomous emergency braking (AEB), lane departure warning (LDW) and traffic sign recognition (TSR). Yet a theme running through this issue of Future Trends is that such technologies are just the tip of the iceberg among production cars.

Technology cascading down the segments

While autonomous driving technologies have appeared across the premium segments for some time, they are starting to appear in less expensive cars. For example, the Nissan Note features the automaker’s so-called Safety Shield, a package of technologies that delivers a new level of driver assistance in the small car segment. Such technologies include blind spot warning, lane departure warning and moving object detection as an ‘around view monitor’.

The fact is that multi-function cameras have already penetrated down to mass market C-segment vehicles in Europe, and are expected to migrate further downwards in coming years driven by Euro NCAP and future regulations. While the smaller A and B segment cars are the most price-sensitive, these are most vulnerable in a crash and can benefit the most from accident avoidance technologies. So we could expect to see more automakers using this as a safety differentiator in these segments.

The following explains some of the main driver assistance technologies, on which cars they first started to appear and on which other cars we can see them today.

**Adaptive cruise control**

**What is it?** Although cruise control has been with us for years, drivers must remain vigilant of the speeds of other vehicles. An adaptive cruise control (ACC) system goes a step further by automatically adjusting the speed of a car to match that of the vehicle it is following, typically using radar sensors. The driver sets a desired speed range and if the system senses a reducing distance to the vehicle in front it automatically reduces engine power and/or activates the brakes in order to maintain a safe distance while not exceeding the driver’s pre-set speed.

**When did it first appear?** BMW was one of the first automakers to offer full ACC, which is capable of bringing a vehicle to a complete stop. Mercedes-Benz, VW, GM and a few others have since rolled out their own fully ACC systems. While most OEMs offer it, the technology is usually limited to a handful of models. For example, Ford offers ACC in the Focus, C-Max, Kuga, Mondeo, S-Max and Galaxy only. Meanwhile, VW started offering ACC on the Polo earlier this year. The Polo incorporates a radar sensor in the lower grille for ACC, FCW, AEB functions and side radar sensors for ‘side scan lane change assist’. The fact that the VW Polo now offers ACC represents another milestone in the market. We expect others to follow as there is no reason to consider driver assistance as a luxury status symbol.
Advanced driver assistance systems: Where have we come from?

Beyond ACC is so-called Predictive Power Control, which is now available in the Mercedes-Benz Actros. Because the system is familiar with the topography of the road ahead, it is able to respond in a way that can improve fuel efficiency. As the first GPS-based cruise control system, Mercedes says that Predictive Powertrain Control not only intervenes to control speed and braking, but can now also regulate the transmission.

**When did it first appear?** Way back in 2003, Toyota began fitting its so-called Pre-Collision System in North America on the Lexus LS430. But such technologies are no longer the sole preserve of the luxury car segments. Vauxhall offers a FCW on its Astra, GTC, Ampera, Zafira Tourer, Cascada, Insignia and Mokka. Its system uses the radar sensor positioned behind the radiator grille to detect a vehicle directly ahead within a 150 metre range.

**Autonomous Emergency Braking**

**What is it?** Autonomous Emergency Braking (AEB) systems add to the basic ACC technology to initiate braking where a collision is imminent, regardless of whether the driver is using ACC. AEB typically uses either a radar or lidar camera sensor to sense the road ahead for obstacles. If a crash looks likely then the system warns the driver to brake. If the driver does not react, the system takes over by engaging the brakes to either avoid a collision or reduce the collision impact.

**When did it first appear?** Mercedes-Benz’s Pre-Safe system was launched on the 2003 S-Class. Using electronic stability programme (ESP) sensors to measure steering angle, vehicle yaw and lateral acceleration and brake assist sensors to detect emergency braking, Pre-Safe can tighten the seat belts, adjust seat positions including rear seats, raise folded rear headrests and close the sunroof if it detects a possible collision or rollover. A later version of the Pre-Safe system added the functionality of closing any open windows if necessary.

**Forward collision warning**

**What is it?** A forward collision warning system is an extended function of the ACC system, typically sharing the same camera sensors to provide warning of an impending collision. FCW applications have until recently been nearly exclusive to radar sensors with the occasional lidar-based system for a hint of sensor diversity.
Advanced driver assistance systems: Where have we come from?

Since then, a number of carmakers have begun offering AEB. Indeed, those OEMs hoping to get five star NCAP rating have had to put in an AEB system from this year onwards. While such requirements have accelerated the fitment of AEB in Europe, most OEMs have actually offered it on certain models for a while. For instance, Ford’s so-called ‘Active City Stop’ was first introduced on the Ford Focus in 2011. Since then it has been extended to the Fiesta, B-Max, C-Max, Grand C-Max, Kuga, Transit Connect and Tourneo Connect. For its part, Volvo’s Collision Warning with Auto Brake (CWAB), developed in cooperation with Israel’s Mobileye NV, was introduced on the 2007 S80. Volvo City Safety is an autonomous emergency braking system designed to help a driver avoid a low-speed crash or to reduce its severity.

When did it first appear? For its part, BMW introduced LDW on the 5 and 6 Series back in 2008, using a vibrating steering wheel to warn the driver of unintended departures. In late 2013 BMW updated the system with Traffic Jam Assistant, appearing first on the redesigned X5. A number of OEMs offer LDW today, of course, including Audi, Citroën, Ford, Honda, Kia, Seat and Opel.

As a further advance, Continental has developed a system that recognises and warns the driver if he is entering a highway in the wrong direction or is going the wrong way on a one-way street. A camera recognises the relevant traffic signs and then issues a warning to the driver via the head-up display or the instrument cluster.

Traffic sign recognition

What is it? The main purpose of a traffic sign recognition (TSR) systems is to remind the driver of the current speed limit.

When did it first appear? The first such system was developed in cooperation by Mobileye and Continental AG. They first appeared in late 2008 on the redesigned BMW 7-Series and the following year on the Mercedes-Benz S-Class. Others have rolled out their own systems. For example, TSR was made available on the 2011 VW Passat and since 2012 on a number of Volvo models, including the S80, V70, XC70, XC60, S60, V60 and V40.

Lane departure warning

What is it? As the name suggests, a lane departure warning (LDW) system aims to warn the driver of an unintended lane drift. It uses a camera positioned behind the rearview interior mirror to monitor the road ahead for lane markings.

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**ADAS: Where are we now?**

Today’s driver assistance systems use a combination of warnings and some degree of active intervention to help steer the driver away from trouble. Although the accent is on giving assistance to the driver rather than take control away, motorists are still wary about cars that supposedly drive themselves. While active intervention clearly holds many possibilities, it is also fraught with difficulty. Here we consider the stage we have reached with ADAS and head-up displays (HUDs) in cars along with some highlights from the recent Paris motor show.

As we have seen in the previous article, ADAS technologies are becoming increasingly common in the European mass-market C and D segments. Now that the NHTSA (National Highway Traffic Safety Administration) has made collision warning and lane departure alert part of the New Car Assessment Programme requirements for a five-star safety rating, we can expect the market for such technology in North America to grow, too.

While NHTSA has helped drive this market, there are other market forces playing an important role in their popularity. Insurance companies dotted across Europe offer price reductions for vehicles with these features, and we expect insurance companies in the US to follow suit, although more conservatively.

Meanwhile, consumer awareness of these collision mitigation features is increasing. We are seeing more TV advertising from a number of automakers, and buyers are developing an expectation that such advanced safety features be “built in” to their vehicles as standard.

There are certainly an increasing number of models with such standard features. For example, Ford hopes that its 2015 Edge will be its technology leader with a range of standard and available technologies designed to improve the driving experience and level of occupant comfort. Technologies being offered for the first time include adaptive steering, enhanced active park assist, side parking sensors and a front camera with washer. Ford says the vehicle comes with a comprehensive suite of driving aids including adaptive steering and 180 degree cameras front and rear which will enable people to see what is coming as they pull out of side turnings or reverse out of parking spaces.

Other OEMs are offering an increasing range of ADAS technologies as either standard or optional, include Hyundai, Volvo, Toyota, Honda and Vauxhall. For instance, the 2015 Hyundai Sonata comes with a number of active safety technologies, including forward collision warning, blind spot detection, rear cross traffic alert and a lane departure warning system.

The Volvo XC90, introduced last summer, is the first car in the world with technology that features automatic braking if the driver turns in front of an oncoming car.

Toyota’s Prius+ has received an infotainment and safety upgrade for the 2015 model year with MirrorLink-ready Toyota Touch 2 multimedia system, touchscreen control, Bluetooth and reversing camera as standard.

Certain 2015 Honda Accord high level trim models offer forward collision warning, lane watch (using wing mirror cameras) and lane departure warning. For example, the Honda Accord EX-L offers a FCW system that uses a camera on the windscreen or, in the case of the Touring model, a radar system in the grille. Meanwhile, the Accord’s lane departure warning system uses a windscreen-mounted camera to track lane markings.
ADAS: Where are we now?

Vauxhall used this year’s Paris motor show to launch its new Corsa. The new model introduces a host of driver assistance systems, including a number that are available in the model for the first time, including: side blind spot alert and the Opel Eye front camera with road sign recognition; lane departure warning; and forward collision warning.

For 2015 model year Dodge Charger, Chrysler 200 sedans and the Jeep Cherokee, Fiat-Chrysler has added Full-Speed Forward Collision Warning Plus as optional equipment. Radar and camera technology combine to determine if a frontal impact with another vehicle is imminent. The two must agree, or the system will not activate. Such redundancy is designed to prevent false-positive readings more prevalent with competitive systems that use either radar or camera technology, the automaker said.

Subaru has developed a new generation ‘EyeSight’ advanced driving assist system which it has begun to optionally fit to new models launched in Japan this year. The new system adopts the revamped stereo camera system enhanced with colour recognition technology combined with an approximately 40 percent increase of viewing angle and visibility distance, expanding visible range, improving object recognition accuracy, and allowing it to recognise brake lights and red traffic signals. The changes are an upgrade to all the basic functions of avoiding collisions, reducing collision damage and driver’s workload.

Head-up displays

While once the domain of jet fighter aircraft and luxury cars, head-up displays have become a clip-on accessory for the masses. For example, Pioneer is offering its augmented reality HUD for smartphone navigation apps. It attaches to the driver’s sun visor and projects traffic, navigation and other information through the windshield.

In pushing back the technical boundaries, Infiniti used the Paris motor show to reveal its Q80 concept car featuring two HUDs, one for the driver displaying the usual information and a second for the front seat passenger showing information from a smartphone connected via the car’s infotainment system.

Another car that caught our eye in Paris was the SW1 Special Edition Range Rover Evoque. This model bristles with driver assistance features, including a new laser HUD marking the first of its kind on the market. It projects information such as speed, sat nav instructions and cruise control settings on to the windscreen. This laser technology gives greater contrast for a more vivid display. The XE also has a stereo camera that provides a 3D view of the road ahead. The camera acts as a sensor for safety equipment such as the autonomous emergency braking system.

Finally, Alps Electric’s new driver assist system goes a step further by incorporating sensor technologies that allow a car’s HUD to be controlled with the driver’s eyes and the door locks with just a wag of a finger. This system features an updated version of Alps’ HUD, which shows the speed and route on the windscreen. The display uses a newly developed laser light source for a clearer presentation even in bright settings.

Alps recently began mass-producing the display, and US and European automakers are expected to debut the technology in their new models starting in 2015 and 2016.
ADAS: Where are we heading?

Research has shown that driver error is one of the most common causes of traffic accidents. Driver assistance technologies can therefore provide a helping hand in times of trouble. Here we report on how this form of back seat driving will perform a vital role in tomorrow’s car.

Driverless cars

A recent survey of 1,000 adults in the US found that the majority of consumers are not yet comfortable with the idea of fully autonomous vehicles and that safety is their top priority before adopting the technology. It is certainly true that a sudden malfunction in such a car could leave you frighteningly powerless. Aside from who is to blame if something goes wrong, it will take some time for drivers and pedestrians alike to feel comfortable with and around such technology. While driverless cars are being pushed to the public as desirable, are they really? Many of us like driving cars, most of the time.

Despite the concerns about driverless cars, government laws on both sides of the Atlantic are gradually being introduced that allow for them. In 2011, the state of Nevada was the first to pass a law concerning the operation of autonomous cars. Since then, two more states, Florida and California have passed laws allowing for them. And now the UK government has given the green light for driverless cars to appear on public roads in trials from January 2015.

Predictions as to when the first truly driverless car arrives on the market range from 2016 (Google) to 2020 (Daimler). Even if the more optimistic predictions come true, initial volumes will be small. In the meantime, we can expect to see a continuous step-by-step product launches of ADAS technologies.

For its part, GM will begin offering its Super Cruise (semi-automated driving) technologies from 2017. Super Cruise allows the driver to takes their hands off the wheel and feet off the pedals in certain driving situations.

Nissan says that by the end of 2016 it will offer a traffic jam pilot in which cars will have the capability to drive autonomously and safely on congested roads. In 2018, Nissan says it will introduce multiple lane controls that allow cars to autonomously negotiate lane changes and potential road hazards. In 2019, Nissan will start to offer fully automated parking functions. And by 2020, Nissan will offer a system that autonomously drives cars through an intersection. Construction work is currently underway in Japan to build a dedicated autonomous driving proving ground, incorporating bricks-and-mortar townscape.

Last summer’s opening of the AstaZero proving ground near Gothenburg, Sweden brought Volvo a step closer to its ambitious goal by 2020 of no-one in one of its new cars being killed or seriously injured. AstaZero is a US$72.5m automotive research centre backed by Volvo Car Group, Scania, Autoliv and Test Site Sweden as well as academia and government authorities. It allows OEMs and suppliers to focus on active safety systems. The proving centre features a ‘Harlem’ city environment, replicating a New York suburb, with pedestrian dummies, for example, able to suddenly present themselves in the road and test automatic braking systems to the limit.

Interior cameras

Driver alert systems – aimed at identifying signs of driver fatigue - have been around for a while. We have seen such systems being offered by a number of OEMs using different guises, including Ford (calling it Driver Alert), Mercedes-Benz (Attention Assist), Toyota (Driver Monitoring System), VW (Fatigue Detection System) and Volvo (Driver Alert Control).
ADAS: Where are we heading?

Bosch is among those manufacturers of such systems. The supplier has developed systems that warn drivers when they inadvertently drift out of their lane. Combined with electrically supported steering, the system can automatically steer the vehicle if necessary. “Nodding off while driving, or even just picking up a pair of fallen sunglasses, can often cause the driver to swerve out of his lane,” said Dr Werner Struth, president of Bosch’s chassis systems control division. “If there is oncoming traffic or a vehicle is travelling in the same direction in a parallel lane, the result can quite easily be a collision. Video cameras that are able to register high-contrast information as well as the human eye can easily recognise road markings and help the driver stay in his lane”.

More advanced driver alert systems are under development. For example, Mobile Interior Imaging is a joint project by Ford and Intel intended to prevent theft of vehicles and help prevent accidents. The project, known as Project Mobil uses cameras to recognise the driver through facial recognition technology. The in-car experience is then personalised to display information specific to that driver, such calendar, music and contacts. If the system does not recognise the driver, a photo will be sent to the owner’s Intel smartphone. The system also allows the rightful owner to activate the interior camera to see who is driving or maybe just check to see if they have left something on the back seat.

Are we there yet?

For many years, industrialists, academics and Google have discussed the possibility of ‘accident-free driving’. While we are still some way off from achieving this state, could assistance functions result from the close networking of both active and passive safety systems with predictive driver assistance systems? We believe that accidents will gradually be reduced with the introduction of driver assistance systems. But to realise accident-free driving, improvement in driving manners and traffic environment will also be needed.
ADAS: Round-up of manufacturers’ technologies

While all of these driver assistance systems highlighted in this issue – from collision warning through avoidance – are feasible either now or at some point through this decade, there are significant challenges in developing them, not least in how to make the various systems work together to form a true protection zone around the vehicle and then develop algorithms and other technologies to determine if or when the system should intervene with the driving process. Here is a round-up on the major manufacturers’ activities and innovations in the ADAS arena.

**Autoliv**

Autoliv has developed a Stereo Vision Sensing (SVS) system that it claims will make driving safer and more comfortable. Currently, an increasing number of vehicles have Mono Vision Systems (MVS). These systems have one camera which is used for such functions as speed sign recognition, lane departure warnings, and even autonomous emergency braking. By adding another camera in tandem with the first camera, the system can provide a three dimensional view of the area in front of a vehicle.

**Bosch**

Bosch says its myDriveAssist app is able to read traffic signs as well as record and process other information for new vehicle functions. The data is collected by smartphones on the road, analysed by a central server and made available to the vehicle applications. The free Bosch app uses the camera integrated in the smartphone to read traffic signs.

**Continental**

Continental recently began production of short range radar sensors for advanced driver assistance systems at its plant in Seguin, Texas. Continental plans to produce some 3 million short range radar sensors in Seguin in 2016. The numbers say something about how rapidly demand is rising for short range radar functions like blind spot detection or parking assistant systems.

**Caption: Continental’s stereo camera**

The programme recognises traffic signs as it is ‘driving by’ and identifies speed limits, cancellation signs and no-passing zones. In addition, the myDriveAssist app warns the driver visually and acoustically not to exceed the speed limit.

**Delphi**

Delphi has long been involved in developing driver assistance systems. Its active safety portfolio includes ACC, FCW and LDW systems. This year’s jewel in Delphi’s crown is its RACam (Radar and Camera Sensor Fusion System) which is fitted to the Volvo XC90. The RACam technology is an enabler to the automatic intersection braking feature that is a world first on the Volvo.

**Mobileye**

Mobileye and Imagination Technologies recently extended their partnership focusing on creation of vision processing for Mobileye’s ADAS technology. Mobileye has already shipped over 2.5 million EyeQ2 and EyeQ3 SoCs that are based on Imagination’s MIPS processor architecture. These vision processors, together with Mobileye’s broad range of algorithms for mono-camera driver assistance systems, target vehicle active safety applications such as lane departure warning, vehicle detection, pedestrian detection, intelligent headlight control and traffic sign recognition.

**Caption: Continental’s stereo camera**

recognises pedestrians that for example step onto the road from the side and half covered and is able to initiate an emergency brake.

Delphi
ADAS: Round-up of manufacturers’ technologies

TRW is also working with Mobileye. The supplier's S-Cam3 technology comprises Mobileye's EyeQ3 chip and offers six times the processing power of the current generation to provide a higher level of performance. It has an increased vertical and horizontal field of view and a mega pixel imager. The S-Cam3 is capable of pedestrian and vehicle AEB as well as ACC as a standalone sensor. The latest generation is claimed to offer all the functions of its predecessor (lane departure warning, forward collision warning, headlight control, traffic sign recognition and pedestrian detection), but can also enable pedestrian and vehicle AEB, road profile and other contextual information.

TRW

TRW used the Paris motor show to reveal that its next-generation camera system - the S-Cam4 family - will have an expanded object detection range and field of view that will meet the increasingly stringent regulatory requirements for advanced ADAS technologies. The S-Cam4 family includes a single lens, mono-camera version based on a standard housing and mechanical package designed to help meet test protocols such as pedestrian triggered automatic emergency braking and new potential requirements including a crossing bicycle AEB test. The camera family also includes a premium three lens TriCam4 version to support advanced semi-automated driving functions. It is scheduled to launch in 2018.

Valeo

Speaking at this year's Paris motor show, Valeo CEO Jacques Aschenbroich outlined how the company has shifted from sub-contractor-status to becoming a partner to its OEM customers, while focusing on its hi-tech operations. To illustrate his point, the Valeo chief highlighted increasing discussion surrounding autonomous driving: "With regard to driverless vehicles, we are producing the ears and eyes of the vehicle," he said. "We have the brains of the vehicle to allow the vehicle to interpret all the data and allow [it] to become completely autonomous." Valeo used the Paris show to launch a number of driver assistance technologies, including its laser automotive lighting that can illuminate the road over distances of up to 600 metres. The system can double the distance over which obstacles are visible, giving drivers more time to take the appropriate action.
“This edition of Future Trends has brilliantly explained how rapidly high technology ADAS systems are penetrating new car developments across all vehicle brands – and across all price categories. The fact that NCAP in Europe and NHTSA in the US are now pushing the adoption of ADAS means that in a few short years we’ll be struggling to buy vehicles in these key markets without such systems installed. What is also clear is that cameras mounted behind the windscreen are the ‘design of choice’ due to both the clear forward view presented and the protection a windscreen affords these sensitive high-tech components. With this in mind, ADAS is a fantastic opportunity for Belron to reinforce the technical advantage we have over all competitors. Today we already have by far the best industry knowledge of all Vehicle Manufacturer requirements for recalibration; we also already operate the largest number of cross-brand ADAS recalibration tools in the global automotive industry. These facts alone demonstrate to our Key Account and motorist customers that Belron is the natural choice for windscreen replacement on vehicles with ADAS installed.”

Richard Tyler - Group Customer Director

If you have any comments, feedback, or would like to contribute to the newsletter, please contact Gwen Daniel at futuretrends@belron.com.

Also drop us a mail if you would like a specific area to be monitored or investigated by the Future Trends Team.