

Sensors as the basis for high-performance automotive systems

Automotive sensors detect a very wide variety of physical variables. Radar and video sensors, for example, monitor the area ahead of the vehicle, while lambda sensors record the composition of exhaust emissions. The yaw rate sensor in the ESP® anti-skid system senses the rotation of the vehicle around its vertical axis, while other sensors measure the pressure and temperature in the engine. Without the precise data they deliver, modern injection, safety, and assistance systems would not be possible.

ACC adaptive cruise control

ACC uses a radar sensor to monitor the area in front of the vehicle. ACC uses the signals that are reflected back to calculate what direction vehicles ahead are driving in, how far away they are, and what their relative speed is. If the system detects a vehicle driving more slowly in the same lane ahead, it adjusts speed so that the required distance between the two vehicles is maintained. As the system even works in bumper-to-bumper traffic, ACC relieves drivers of some of the burden of driving and helps them to reach their destination more relaxed and more wide awake.

Night vision enhancement system

Night Vision is an active night vision enhancement system. Two infrared headlights scan the road over a range equivalent to that of high-beam headlights. Oncoming traffic is not dazzled, since infrared light is invisible to the human eye. The details of the road ahead are recorded by a video sensor and displayed in the cockpit as a black and white image. Drivers can see the course of the road, other road users, and any obstacles up to 150 meters ahead. They can register critical situations earlier, and therefore react to them more quickly. This makes driving in the dark safer.

ABS antilock braking system / ESP® electronic stability program

If the road is wet or smooth, the wheels may lock while braking, making it impossible to steer the vehicle. Speed sensors on each of the four wheels allow the ABS antilock braking system to recognize when one or several wheels are about to lock, and to specifically reduce braking pressure. In this way, it ensures that the driver can evade obstacles even during emergency braking, and that the vehicle can be brought to a halt safely and quickly.

The ESP® electronic stability program takes the above function one step further by adding an anti-skid function. On the basis of signals from additional sensors, which measure steering-wheel angle, lateral acceleration, and yaw rate, the system can detect whether the vehicle is about to go into a skid. In these situations, ESP® reduces engine torque and brakes individual wheels. This makes the vehicle easier to control, and in most instances prevents it from skidding.

Occupant-protection sensors / airbags

The amount of time occupant-protection sensors have to react in an accident is as short as the blink of an eye. Within five milliseconds, they have to measure, analyze, and react. With the help of acceleration and pressure sensors, the electronics can identify the type and severity of accident and adapt the restraining effect of the occupant-protection systems: by deploying the right airbags at the optimum time, for example. In this way, occupants receive the best possible protection in the event of an accident.

Electronic Pedestrian Protection

The risk of being killed in a road accident is especially high for pedestrians and cyclists. The EPP electronic pedestrian protection system comprises acceleration sensors for the front end of the car. They detect impact at a very early stage and ensure that appropriate action is taken within fractions of a second – raising the engine bonnet, for example. This helps to better cushion the impact of the body with the car, and significantly reduces the risk of injury. In the future, EPP will also use the signals from sensors monitoring the car's environment, and in this way predict and react even faster to an impending collision.

Sensors in engine management

Today's automotive sensors are not just about safety. In electronic injection systems, sensors are responsible for measuring pressure, air mass, and exhaust-gas composition. The optimum air-fuel mix allows the best possible fuel consumption, a smoothly running engine, and the lowest possible emission of pollutants.

Parking aid

In a vehicle that has been aerodynamically optimized, visibility to the front and rear is sometimes restricted when parking. This is where parking aids come in. With the help of front and rear ultrasound sensors, they warn drivers if they are about to collide with another vehicle. This function has been developed further. Now sensors can measure the size of a parking space as the car drives past it, and inform the driver if there is sufficient space. And with the latest generation of parking aids, the vehicle can be parked automatically, without the driver having to steer at all.

Comfort-enhancing sensors

In heavy rain, drivers have to be especially watchful. If their vision is suddenly impaired, for example by water spray when overtaking, they may not always be able to react properly. The rain sensor, by contrast, reacts in fractions of a second, automatically switches the windshield wipers on at the right speed, and immediately restores clear vision.

A light sensor registers ambient light, as well as light conditions on the road ahead, and automatically adjusts the headlights to the current situation – when dusk falls, for example, or when the vehicle drives into a tunnel.

CAN bus

In a modern car, the many electrical and electronic components are connected with each other via hundreds of meters of cable. But there would be even more cable if it were not for data buses, which can deliver messages from different sources to different addresses along one and the same connecting cable. The “controller area network,” or CAN for short, is just such a data highway. Without CAN, which Bosch launched in 1991, the networking of sensors and electronic control units that is common today would be unthinkable.

Additional information

For more information about sensors and driver assistance systems, visit www.bosch-presse.com and www.innovation-bosch.de.