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Mercedes-Benz previews next-generation intelligent safety and driver assistance systems; "sensor fusion"

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Mercedes-Benz "Intelligent Drive" systems. Click to enlarge.

Mercedes-Benz has augmented its driver assistance systems with new functions which are now able to support the driver in a broader range of situations. Using advanced sensor technology, they are able to monitor the area around the vehicle, providing the driver with warnings and support, and reducing driver workload. Mercedes-Benz calls the combination of sensors and systems to support these systems "Intelligent Drive".

Mercedes-Benz recently previewed its next-generation intelligent safety and driver assistance systems for the next S-Class, which will make its own debut next year, at an "Intelligent Drive" TecDay in Stuttgart.

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Mercedes-Benz S-Class radar, Stereo Multi-Purpose Camera (SMPC, stereo camera for short) and ultrasonic sensors. Click to enlarge.

Prof. Dr. Thomas Weber, Member of the Daimler Board of Management responsible for Group Research and Head of Mercedes-Benz Cars Development, noted that the intelligent assistance systems of the future will be able to analyze complex situations and recognize potential dangers out on the road with the aid of improved environment sensor systems even more accurately than today. "*Figuratively speaking*," he said, "*the next S-Class won't just have eyes at the front; it will have 360-degree all-round vision.*" Of crucial importance in this respect is the networking of all systems, or "sensor fusion".

The new systems hold tremendous potential for either preventing accidents or mitigating their consequences, according to Prof. Weber.

> *Take, for instance, the new BAS PLUS assistance system with Cross-Traffic Assist. The results of our accident research based on the data from the GIDAS (German In-Depth Accident Study) indicate that it could either prevent or lessen the severity of 27% of all accidents at road junctions resulting in personal injury. That equates to some 20,000 accidents a year in Germany alone.*
>
> —Thomas Weber

The new assistance systems—and those with notably enhanced functionality—include:

- DISTRONIC PLUS with Steering Assist helps the driver to guide the vehicle in its lane and can follow the vehicle in front in slow-moving traffic automatically.
- For the first time, the Brake Assist system BAS PLUS with Cross-Traffic Assist is able to detect cross traffic and also pedestrians, and if necessary boost the braking power applied by the driver accordingly.
- PRE-SAFE Brake can detect pedestrians and initiate autonomous braking to avoid a collision at speeds up to 50 km/h (31 mph).
- PRE-SAFE PLUS can recognize an imminent rear-end collision, prompting the PRE-SAFE system to trigger occupant protection measures. It can also firmly apply the stationary vehicle's brakes in the event of a rear-end collision to prevent secondary accidents.

- With PRE-SAFE Impulse, the driver and front passenger are pulled away from the direction of impact by their seat belts at an early phase of the crash before the resulting occupant deceleration starts to increase. This can substantially reduce the risk and severity of injuries in a frontal collision

- Active Lane Keeping Assist can detect oncoming traffic and when the adjacent lane is not clear, and prevent the vehicle from leaving its lane unintentionally by applying the brakes on one side.

- Adaptive Highbeam Assist PLUS allows the main-beam headlamps to be kept on permanently without dazzling traffic by masking out other vehicles in the beams' cone of light.

- Night View Assist PLUS can alert the driver to the potential danger posed by pedestrians or animals in unlit areas in front of the vehicle by automatically switching from the speedometer display to a crystal-sharp night view image and highlighting the source of danger. A spotlight function is furthermore able to flash at pedestrians detected ahead.

- ATTENTION ASSIST can warn of inattentiveness and drowsiness in an extended speed range and notify the driver of their current state of fatigue and the driving time since the last break, as well as offering an adjustable sensitivity setting.

Sensors and cameras. DISTRONIC PLUS with Steering Assist, BAS PLUS and PRE-SAFE Brake all employ sensor fusion using the same stereo camera and multistage radar sensors.

Mercedes-Benz says it is taking a major step forward with the introduction of the Stereo Multi-Purpose Camera (SMPC) (stereo camera). Like the Multi-Purpose Camera (MPC) fitted previously, it is positioned behind the windshield in the vicinity of the rear-view mirror. It has an opening angle of 45° and is capable of three-dimensional detection of crossing objects and pedestrians, and calculating their path.

The camera's two "eyes" provide it with a three-dimensional view of the area up to around 50 meters (55 yards) in front of the vehicle, and it is able to monitor the overall situation ahead for a range of up to 500 meters (547 yards). In this way, the new camera is able to provide data for processing by various systems.

Intelligent algorithms evaluate this information in order to detect and carry out spatial classification of both vehicles that are driving ahead, oncoming or crossing, as well as pedestrians and a variety of traffic signs within a large field of vision.

The radar sensors provide additional data. The system of radar sensors comprises two short-range radar sensors in the front bumper with a range of 30 meters (33 yards), opening angle 80°, which are complemented by a long-range radar sensor (range 200 meters (219 yards), opening angle 18°) including mid-range scan (60 meters (66 yards), 60°). The data from the camera and radars is amalgamated in a control unit in order to provide the system-specific data for the various functions.

The full list of external sensors and cameras includes:

- 2 short-range radar sensors at the front (30 m, 80°)
- 1 long-range radar sensor at the front (200 m, 18°) with mid-range detection (60 m, 60°)
- 2 short-range radar sensors on the sides at the rear (30 m, 80°)
- 1 multi-mode radar sensor at the rear (30 m, 80° and 80 m, 16°)
- Stereo camera (Stereo Multi-Purpose Camera, SMPC) located behind the windshield in the vicinity of the rear-view mirror (range 500 m, incl. 3D capability for approx. 50 m, 45°)
- 12 ultrasonic sensors (4 each at the front / rear + 2 each on the left / right in the front and rear bumpers)
- 4 cameras as 360° camera system (1 each at the front in the radiator grille / at the rear in the trunk handle recess / on the bottom of the exterior mirror housings, vertical approx. 130°, horizontal > 180°, resolution 1 megapixel (1280 - 800 px)

An system of additional internal sensors is able to keep an eye on the current driving state and the driver's reactions. If the sensors detect a hazardous situation, they are able to feed the algorithms for all manner of assistance systems with data in order to provide just the right support for the specific situation.

DISTRONIC PLUS with Steering Assist. The DISTRONIC PLUS adaptive control system is a driver aid designed to keep the vehicle at the desired distance from another vehicle in front that is travelling slower than the selected cruising speed. This radar-based function has now been enhanced by the addition of Steering Assist, which helps drivers to stay centered in their lane by generating the appropriate steering torque when travelling on a straight road and even in gentle curves.

The stereo camera recognizes lane markings as well as vehicles driving ahead together with their three-dimensional positioning, and relays this information to the electric steering assistance system. When driving at slow speeds—e.g. in congested traffic—Steering Assist can use the vehicle ahead as a means of orientation, enabling semi-autonomous following even when there are no clear lane markings visible. As a result, the system is able to further enhance driving comfort and substantially ease the driver's workload in many traffic situations.

The new Steering Assist function integrated into the DISTRONIC PLUS system is predominantly based on the new stereo camera. At the same time, the area in front of the vehicle continues to be monitored by two short-range radar sensors and a long-range radar sensor with medium-range detection. The system fuses the data gleaned from both technologies, calculates any reactions required, and then regulates the vehXeed as requirements dictate by controlling engine power, transmission and brakes, as well as actuating the electric steering for lateral vehicle guidance.

The new DISTRONIC PLUS with Steering Assist can be activated as before with a lever on the steering column in a speed range from 0–200 km/h (0–124 mph). Any speed between 30 km/h (19 mph) and 200 km/h can be selected as the desired cruising speed. A green steering wheel symbol appears in the instrument cluster to indicate when Steering Assist is operating while DISTRONIC PLUS is activated. Meanwhile, longitudinal information (cruise control function) is still visualized in the speed display by means of circular segments and the speedometer needle.

Drivers must keep their hands on the steering wheel at all times even when Steering Assist is activated, as the function only works in curves above a certain, speed-dependent radius. Legal considerations also mean there are no plans to introduce hands-free driving. The system’s sensors can detect whether the driver’s hands are actually on the steering wheel. If they are not, a visual warning is issued first. Should the driver fail to react to this prompt, a warning signal sounds and lateral lane guidance is deactivated. This does not affect the cruise control function, however, which continues to be operative.

The driver is able to override the Steering Assist at any time. If the driver signals to change lane, for instance, the lateral guidance function will switch into passive mode for the duration of the lane change.

The longitudinal performance capabilities of DISTRONIC PLUS have been further refined. Now, the system is able to brake at a rate of up to 5 m/s^2 without any intervention from the driver. If the “S” drive mode button is pressed, the rate of acceleration increases, too. Vehicle acceleration is also more dynamic if the driver signals a wish to overtake by switching on the indicators, assuming the road is clear.

By combining radar and camera data, DISTRONIC PLUS is also able to detect both vehicles cutting in and vehicles ahead in adjacent lanes and take necessary action promptly. This can prevent illegal undertaking on highways and multi-lane highways, for example, by adapting the speed to that of vehicles in the outside lanes.

BAS PLUS with Cross-Traffic Assist. The new Brake Assist BAS PLUS is capable of more than just helping the driver to avoid collisions with vehicles ahead or lessen their consequences in a purely longitudinal direction—the new Cross-Traffic Assist function can also come to the driver’s aid when there is a risk of a collision with cross traffic at junctions.

If this anticipatory system detects a hazardous situation of this type, it prompts the driver to start emergency braking by activating visual and acoustic warnings. If the driver presses the brake pedal too tentatively, BAS PLUS will step in by automatically boosting brake pressure for effective emergency braking, even applying the brakes at full power if necessary. Applying just the right amount of braking power for the situation at hand maximizes the available braking distance for traffic behind.

The Cross-Traffic Assist function is operative at speeds up to approx. 72 km/h (45 mph), while BAS PLUS is able to aid the driver in longitudinal situations at any speed.

Active Lane Keeping Assist. The new version of Active Lane Keeping Assist is now also able to intervene should the driver inadvertently cross a broken line when the neighboring lane is not clear and changing lane could cause a collision as a result. The system can determine if this is the case using the information from the stereo camera and the radar system. The latter has been supplemented by a sensor at the rear, which works in unison with the other sensors in the front and rear bumpers.

Active Lane Keeping Assist is not only capable of recognizing critical situations such as overtaking vehicles, vehicles to be overtaken and parallel traffic, but it can also respond effectively to oncoming traffic. If the system detects the vehicle crossing the lane markings when the adjacent lane is not clear, not only does it cause the steering wheel to vibrate in pulses as a haptic warning for the driver, it guides the vehicle back into lane by single-sided braking via the ESP. It thereby forms a complement to the Active Blind Spot Assist, and also makes it possible for the first time to prevent collisions with oncoming traffic together with their often serious consequences.

Active Lane Keeping Assist is active at speeds between 60 (37 mph) and 200 km/h. If driver activity in the form of, for example, active steering, braking or acceleration is detected or when the indicators are switched on, both the warning and the corrective brake actuation are suppressed.

Traffic Sign Assist. The new Traffic Sign Assist system builds on the capabilities of the previous Speed Limit Assist. The system is now also able to recognize no-passing zones and to alert drivers to access restrictions.

The camera on the inside of the windshield continues to pick up speed limit signs, including those on overhead gantries and in roadworks, for example. The camera's data is cross-referenced against the information in the navigation system and can be displayed in both the instrument cluster and the map view. If the camera fails to spot any road signs showing a speed limit or a speed limit is lifted, the legal speed limits based on the navigation data are shown instead, such as a maximum speed of 100 km/h on country roads in Germany or 50 km/h in built-up areas.

No-overtaking zones and the signs signaling their end are also registered and displayed, while in the case of signs imposing access restrictions, an acoustic warning is additionally emitted together with a visual warning in the instrument cluster.

ATTENTION ASSIST. A quarter of all motorway accidents in Germany are put down to drowsiness, making it one of the most frequent causes of accidents, most of which are of a serious nature. In 2009, Mercedes-Benz presented ATTENTION ASSIST, which is able to detect tell-tale signs of inattentiveness and increasing drowsiness based on changes in steering behavior and a number of other factors.

The system has been subject to ongoing development, and the latest version has the ability to detect drowsiness and inattentiveness across a far greater speed range from 60 - 200 km/h. The system's sensitivity can furthermore be adjusted, e.g. for drivers who already feel tired when they get behind the wheel. A new menu in the instrument cluster display also makes the system more tangible and transparent for the driver by visualizing the current ATTENTION ASSIST level and the driving time since the last break. It is also possible to see whether the system is active in the current driving situation. If the ATTENTION ASSIST warning recommending the driver to take a break is emitted, nearby service areas can be indicated in the navigation system.

The system can be deactivated by making the appropriate selection in the instrument cluster menu. However, it will always be automatically reactivated with the sensitivity setting last selected the next time the vehicle is started.

Active Parking Assist. The Active Parking Assist is designed for automated parking with active steering and brake control in both parallel and perpendicular spaces. It is an advanced version of the PARKTRONIC system with Parking Guidance offered previously. The system is now also able to maneuver out of parallel parking spaces again all by itself with automatic steering and brake control, assuming the vehicle was parked there automatically previously.

When travelling at speeds below 30 km/h, ultrasonic sensors with an extended range in the bumpers' side sections survey the nearside of the road for suitable parallel and perpendicular parking spaces. The same procedure is carried out for the far side of the road if the driver indicates accordingly. A symbol in the instrument cluster shows that the system is in the process of measuring. If a suitable parking spot is identified, an arrow appears alongside the symbol indicating that the system

is ready for automatic parking. All the driver now has to do to activate the system is engage reverse gear and confirm by pressing the OK button on the steering wheel.

Active Parking Assist steers and brakes the vehicle automatically as well as indicating the various driver actions required in the display, such as the transmission position to be selected. The driver moves the vehicle by lightly pressing the accelerator or releasing the brake.

November 22, 2012 in Autonomous driving, Connected vehicles, Driver Assistance Systems, Safety | Permalink | Comments (4) | TrackBack (0)

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Comments

"Over 100 vehicles collided on Interstate 10 near Beaumont, Tex., on Thursday, as many were headed to visit family for Thanksgiving. Two were killed and 51 were injured, eight critically, as first responders pulled survivors out of wreckage that went for miles."

http://video.today.msnbc.msn.com/today/49938271/#49938271

Posted by: Bob Wallace | November 23, 2012 at 09:12 AM

This happens periodically on Highway 5 between Stockton and Sacramento in California due to fog. Front radar and computers could avoid this.

Posted by: SJC | November 23, 2012 at 11:06 AM

"Speed Limit Assist" does it actually limit the speed of the car to the posted limit? If it does, people will turn it off, and therefore make all the cameras, radars, and sensors a big waste of money.

Posted by: Zhukova | November 23, 2012 at 07:58 PM

> *"PRE-SAFE Brake can detect pedestrians and initiate autonomous braking to avoid a collision at speeds up to 50 km/h (31 mph)."*

That 50 km/h limit is weird, since in most countries the general speed limit in urban areas is 50 km/h. So if you go the exact speed limit, you don't know whether it is on or off? Why not stretch it to 65 or 70 km/h to definitely include that 50 km/h.

And include 53 or 55, it is tempting and therefore commonplace to drive a few km above the speed limit.

Posted by: Anne | November 26, 2012 at 12:37 AM

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