Safer overtaking in sight

David Crawford investigates a new driver assistance system being developed by BMW which will warn drivers of sections of road that are unsafe for overtaking. Dynamic Pass Prediction (DPP) was prototype-tested last year on rural roads in Southern Bavaria and showed that it can make it easier for the driver to choose precisely those sections of the road that are suitable for overtaking.

German automotive BMW is developing a new driver assistance system to warn drivers of sections of road that are unsafe for overtaking. Combining digital map data with locational, speed and acceleration information from both the car’s internal management system and satellite-derived positioning, it will extend the driver’s natural visual horizon to an electronic one with greater forward range.

Statistics indicate that some 43% of serious traffic accidents in Europe take place on rural roads, where overtaking is responsible for around 10% of the total. The new system forms an integral part of BMW’s ConnectedDrive programme, which aims at the intelligent integration of the driver, vehicle and driving environment.

Current limitations on sensor capabilities restrict the amount of information that is available through existing driver assistance aids. A digital electronic horizon can serve as an extra sensor, and BMW’s dynamic pass prediction (DPP) route information system uses the concept to indicate to drivers when it is unsafe to overtake.

Prototype-tested over the last year on rural roads in Southern Bavaria, Germany, DPP took as its starting point commercially-available digital maps common to widely-used in-car navigation systems. To check if an upcoming road section was safe to overtake, DPP checked these for characteristics including road type, numbers of lanes and speed restrictions.

The tests ran in BMW 5 Series and 6 Series sedans, with a navigation system and head-up display (HUD), both designed to show overtaking information relevant to the driver. Standard maps, however, do not currently carry road curvature information.

For the BMW project, therefore, mapping provider Navteq has pre-calculated the curvatures at shape points on the basis of the existing street geometry. The tests demonstrated that the necessary calculations could normally be carried out within the vehicle (although better results will demand more sophisticated calculations that cannot practically be carried out in real time onboard).

The adapted digital map database stores the calculated curvatures for road shape points, with hyperbolic interpolation simulating continuous curvature function over a whole section. The road tests indicated that the resulting data was of good quality, although the full functioning of the prediction system needed improved mapping.

Again, legal restrictions on overtaking do not...
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The DPP head-up display HUD from inside the car. Road segments that the DPP algorithm finds unsuitable for overtaking are marked in orange. The MPP is part of the electronic horizon, and MPP event signs symbolise the reason for the ‘unsuitable’ classification. If there are multiple reasons, the event sign shown represents the first reason. The vehicle symbol on the display is orange if the system indicates the undesirability of starting an overtaking manoeuvre; otherwise it is white. Below right: DPP orange sections indicate ‘not safe to overtake’.

The system generates an extract from the digital map as an electronic horizon (EH), covering stretches of road that the car is going to reach within a relatively short distance – up to 10 km if the driver so decides. (To keep the amount of data to be processed as small as possible, it selects, on the basis of probabilistic algorithms, the most likely path (MPP) for the driver to analyse for hazardous situations).

Should the system determine that, for example, a road junction or speed limit is coming up ahead, it will register the relevant section of the road as a function of the car’s speed and acceleration, based on dynamic vehicle information. It will then present the result on the map display and the HUD (if the driver opts for one) as indicating the need for heightened awareness. It will react in the same way when the clear stretch of road coming up ahead is simply not long enough safely to overtake another vehicle.

The system does not, however, monitor oncoming traffic. It will, therefore, not give any indication or recommendation that overtaking is safe - leaving the decision on, and undertaking of, the manoeuvre as the responsibility of the driver (who is, of course, required in any case to observe normal traffic rules).

The test have shown that DPP can make it much easier for drivers to choose precisely those sections of the road that are suitable for overtaking a slower vehicle at minimum risk. They can therefore be more relaxed at the wheel, and avoid the stress of unclear or ill-judged attempts to overtake, resulting in both increased safety and greater fuel economy.

Driver assistance products using map databases as an additional source of information will most likely be introduced in phases. The DPP is based on available GPS technologies and common map databases designed for driver assistance systems. Even with the quality of navigation data available today, it can be enhanced by dynamics that adapt to the situation.

The DPP trial used an ADASRP (Advanced Driver Assistance System Research Platform) 2006 plug-in. ADASRP 2006 is a Windows-based framework application developed by Navteq for hosting ADAS solutions.

Manufacturers

The GPS receiver module used for the DPP prototype is the RCB-4H1 manufactured by Swiss company u-Blox and based on the Antaris 4 chipset from US-based Atmel. Navteq supplied the digital maps. The sensor data necessary to calculate vehicle position comes from a BMW proprietary acquisition unit equipped with two Atmel microprocessors. This combines data from the vehicle (signals from gyroscope, speed pulses, reverse driving information) with the GPS position acquired by the GPS receiver module. The DPP trial used an ADASRP (Advanced Driver Assistance System Research Platform) 2006 plug-in. ADASRP 2006 is a Windows-based framework application developed by Navteq for hosting ADAS solutions.

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appear among map providers’ standard digital attributes. For DPP, therefore, Navteq gathered and integrated key road-based factors that are critical for making overtaking decisions, eg the location of traffic signals, pedestrian crossings and street markers.

The system generates an extract from the digital map as an electronic horizon (EH), covering stretches of road that the car is going to reach within a relatively short distance – up to 10 km if the driver so decides. (To keep the amount of data to be processed as small as possible, it selects, on the basis of probabilistic algorithms, the most likely path (MPP) for the driver to analyse for hazardous situations).

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