Using a car’s surround viewing cameras for automated emergency braking

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Can the same information used to autonomously park a car also be used for automatic emergency braking in low speed? This Master’s Thesis which was performed at Volvo Cars attempts to answer that question by developing a proof-of-concept which does just that.

In recent years, technology has made it a lot easier to park your car. First, the ultrasonic sensor was introduced. This helped by sensing where the car ends and/or begins and signalling this to the driver using sound warnings. Then came the parking camera which gave the driver the ability see what is in the blind spot behind the car, providing even more security.

A third innovation has been the surround viewing camera system. By using 4 fisheye cameras and stitching their individual videos together, it provided the driver with a bird-eye perspective of the car, allowing full vision of the car’s surroundings. Another more recent innovation, is the ability to provide emergency braking in the cases where someone, either in a car or on a bicycle, is approaching from the side just as you are about to back out of a parking slot.

Some of the more recent high-end models even have the ability to park themselves! All of these innovations have made life easier and made people feel safer when it comes to parking.

The question posed in this master’s thesis is; if a car can gather enough information about its surroundings to park itself, then could it also use the same information to make sure the driver never hits anything when driving him- or herself? Could it provide you with a safety net so that when you make a mistake, it can help you brake in time or even steer away from a collision?

To answer this question, a car which has the capability to park itself was used to make a proof-of-concept for a collision avoidance function. The function would be limited to function in low speeds due to the limited range of the parking sensors, which in this case consist of a 360-degree camera system like the one mentioned earlier. The cameras use imaging techniques to detect obstacles around the car. These obstacles are used to detect where the car can and cannot drive while autonomously parking.

The work in this thesis consisted of calculating if and when the driver of the car is about to drive into something which has been detected by the cameras as an obstacle and if that is the case, slam the brakes just in time to avoid a collision.

So did it work?

Sure, in some cases, but challenges were discovered in the process. Some problems stem from the way these cameras see the world. The imaging technique they use can be compared to the way we humans see the world. In order to get a sense of depth we need two eyes which see objects from a slightly different angle. The car only has one camera looking at each direction and because of this the car needs to move in order to see objects from different angles.

Another issue with the cameras can be imagined by picturing a puzzle. When laying out the pieces and figuring out which piece goes where, you need some reference feature which can be related to the whole picture. If all you have is one colour, you would probably give up. Similarly, the cameras need to find reference features in each image whose positions can be compared between images. To summarise this problem, the cameras have a hard time detecting obstacles when they cannot detect features in the images.

These problems one should be able to solve by improving the existing imaging technique and combining it with other ones, but also combining the cameras with different sensors, like ultrasonic for example.

There also needs to be improvement in the way the car predicts where it will be in the future and makes decisions on how to avoid collision. But one day in the not too distant future you might not ever need to worry scratching your car in a parking lot again.