Would you trust brakes that think for you?

Kasey Panetta, Associate Editor

 In keeping with the vehicle-safety theme I've self-cultivated with Signal [1] and the inflatable seatbelt [2], let's take a look at the world of brakes, specifically Automatic Emergency Braking Systems (AEBS).

The idea behind AEBS is that in the event that you, the driver, are unable or incapable of braking in order to avoid a collision with a car, pedestrian, object, your garage door, etc. the car will take (complete or partial) control and activate the braking system or otherwise alert you to an imminent crash.

In an independent report [3] done for the European Commission, DG Enterprises, researchers have explored the various available and planned versions of AEBS and found that in general AEBS "is highly likely to be a very effective safety measure in terms of both casualty reduction" and also beneficial with regards to cost ratio "provided further technical development and cost reduction take place."

Before we get into the debate about what happens when this system glitches and you stop dead on a highway, it's important to talk about what AEBS actually are and how they are designed to work.

First, as the study [3]points out, when referring to AEBS there are generally three separate types:

1. Collision avoidance: The first version is what is typically thought of as AEBS. In this version, the car takes over completely, utilizing full-stop breaking and taking control of steering, if necessary, independent of the driver. Obviously, this has the most benefit as it completely removes human error from the equation. In theory, it would know before the driver that an accident could occur and stop the car, eliminating the risks of physical and monetary damages to cars and passengers. However, it's high-risk in the event of a glitch or system malfunction, as it could go into brake mode for the wrong reason or for no reason. Because of that potential, this system hasn't really been implemented.

2. Collision mitigation braking systems (CMBS): This system would only deploy if a

crash was imminent and the driver could do nothing to avoid it. At that point, the car applies emergency breaks. In this situation, as the name implies, the accident isn't avoided altogether, but the immediate reduction in speed would lessen the damage. Because this system only activates when it is likely to be the *most* accurate—as in perilously close to another vehicle or object—it is considered less risky, but because you're probably –definitely—going to get into an accident, it's not as beneficial as the collision avoidance.

3. Forward collision warning: In this system, the car—sensing a collision—finds some way to warn the driver, whether it's a quick tug of the seatbelt or another indicator. The control remains in the hands of the driver, but the car serves as a warning that something is about to go terribly wrong.

Now that we know the basic layout, we can look at some specific examples and various interpretations in the car world.

Mitigating the disaster

When it comes to the Collision Mitigation version of the brakes, a few companies have implemented a carrying version in their cars. Basically, since you're already going to hit whatever you're going to hit, the Toyota Harrier has a system where the car, sensing impact just a split second before it happens, automatically reduces speed and tightens seatbelts, hopefully limiting the damage. The Honda system featured in the 2006 Honda Legend Saloon and 2007 CR-V 4x4 relies on an alert and visual BRAKE signal on the dash. If those are ignored, the car applies a slight braking and a seatbelt tug; if those don't work, the car tightens seat belts and prepares for a crash. Honda does list some limitations: It can't see pedestrians, small vehicles/bikes on the side of the road might not be detected, accuracy depends on speed, and it's not so great in bad weather. Many car manufacturers including Chrysler, Lexus, Mercedez-Benz, Volvo, and Ford have their own versions of this system.

Collision Warning System

Bosch has designed a Forward Collision Warning system, which is two-fold. First the car, sensing a collision, "prepares the breaking system for an emergency stop by pre-filling the circuit with fluid so the lining are just in contact with the discs." Basically, if the driver decides to hit the brakes, they'll be completely ready to be used to their full capacity. Bosch claims it will shave 30ms off the time it takes to fully activate the breaks, citing studies that most people are too hesitant when braking. The second part of the system is what I call the "hey, hi, hello, pay attention" part—officially it's called the Predictive Collision Warning—which consists of a quick tug on the seatbelt, warning sounds, and visual displays. It should help eliminate a lot of accidents where the person doesn't even brake because they aren't paying attention. Nissan has a similar system in place to judge when the

brakes might be needed at full force.

The future

Because allowing the car to fully take control could be a pretty risky move, no cars are currently in production with the Collision Avoidance system. The researchers [3] noted this is a sticky legal situation because of the 1968 Vienna Convention on Road Traffic, which basically requires that each driver always be in control of their car so they are able to make any decisions regarding safety. The committee decided that because current systems don't really rely solely on the driver, the AEBS system is acceptable.

For the future, some manufactures are looking at a "fusion" between a high-performance laser scanner for range and speed measurements and a far-infrared camera to measure the angles to the outline of the target and for figuring out what the obstruction is. The combination of the two technologies is used to calculate the distance to nearby objects and how much braking would be necessary to avoid a collision. If the object is far enough that driver intervention is possible, the system remains largely inactive. When the steering/braking combo reaches a point where it's no longer possible to avoid the object, the braking system takes over.

Most of the collision avoidance systems being designed today are a combination of the other two systems with visual/physical/auditory warnings combined with brake preparation. The added aspects of these advanced braking system is that the car *will* take control, using its own calculations to determine the best route and options.

The controversy

The problems here are pretty easy to spot. Partially because they are obvious, like what happens when the brake system activates itself for no reason, and partially because they're already been visited during discussions about cars which drive themselves like the Google car. I'm all for warning systems and visual/auditory systems to get your attention back on the road. There are a lot of distractions in today's world, so that can only improve driving—unless the seatbelt tug malfunctions, which would be annoying.

I think the collision avoidance systems need a lot of work before I would trust one in my car. Accidents are mostly caused by human error and a computer-calculated algorithm would probably help correct that, but sometimes a computer can't fully comprehend a situation because it can only factor in what it knows. Computers have no instincts or experience, which are helpful in avoiding some accidents. Perhaps the solution is some sort of manual override for the just in case this doesn't work situations. Perhaps it's just learning to trust the vehicle computer. Either way, the AEBS are definitely a peek into the future of driving and it's a wild, wild world.

Links:
[1] http://www.ecnmag.com/blogs/2012/08/helmet-attachment-could-save-lives
[2] http://www.ecnmag.com/blogs/2012/07/designing-better-seatbelt
[3] http://ec.europa.eu/enterprise/sectors/automotive/files/projects/report_aebs_en.pdf