by Michael Wofsey

Will Collision-Avoidance Systems Work?

Until now, automobile safety involved air bags, automatic seatbelts, and crumple zones—devices that protect occupants during a crash. The next advances in safety may lead to cars that are smart enough to avoid collisions altogether.

Collision-avoidance systems would benefit all drivers and, hopefully, reduce the annual number of U.S. traffic deaths, which is currently about 40,000. But new technologies also face risk, because a new product may never attract a large following. John Pierowicz, a physicist with Calspan SRL Corp. (Buffalo, NY) calls collision avoidance "a promising area. It's a high-risk, high-reward field. If you can develop systems that avoid crashes, you're going to have big rewards by reducing the severity or preventing the crash."

Although collision-avoidance systems have been used for years in aircraft, adapting them to automobiles will not be easy. Collision-avoidance systems in cars must contend with greater variability in drivers and in conditions than occur in the air.

The U.S. Department of Transportation is developing guidelines for a collision-avoidance system. Many of the crucial points will come from research under way at Carnegie Mellon University (Pittsburgh, PA) and Calspan. The research centers on two areas where most accidents happen: The Carnegie Mellon project hopes to stop cars from running off the road, and the Calspan project intends to prevent intersection crashes.

Carnegie Mellon is using an experimental station wagon outfitted with a video camera, which is pointed straight ahead at the roadway. The camera records the view and downloads the data to a computer, which determines the car's position. The driver will then be alerted if it looks as though the car is headed off the road or into an obstacle.

Calspan's project uses vehicle-mounted radar that "looks" both sideways and in front of the car—scanning for any other vehicles that are moving fast enough to pose a threat. Steering sensors and accelerometers feed data into the computer to give it a hint of what the driver is intending to do, and the computer examines the logic of the system.

In theory, collision-avoidance systems seem straightforward: Combine sensors—optical or radar—with a computer powerful enough to perform some artificial intelligence and warn a driver of any hazard. However, getting that to work in real life is extremely complicated—especially when it must be inexpensive enough to install in every family car. Engineers may need to start their systems slowly.

Some automobile-instrumentation manufacturers, including Delco Electronics Corp.

(Kokomo, IN), expect to start with simple systems and gradually add capabilities over the years. For instance, a back-bumper-mounted radar system might warn a driver of obstacles while backing up. Although this may not sound like an advanced collision-avoidance system, it might keep you from backing over your child's bicycle. Such a system would scan in the 77-GHz frequency—considerably higher than conventional radar—in order to provide a narrow radar beam that would not be overly sensitive. Such a system might also be extended to warn of tailgaters on the road. In addition, investigators at the Oak Ridge National Laboratory (Oak Ridge, TN) are experimenting with a low-cost version of the night-vision cameras that were used by the U.S. military in Operation Desert Storm, and they think these could help drivers see farther and more clearly at night.

At the next stage, wide-area radar in the 24-GHz range could be used to monitor a car's sides, warning the driver if another vehicle is in the blind spots. With time, the range could be extended to warn of potential side collisions. Eventually, such a system might warn of any collision—providing true collision avoidance for normal driving.

The first systems will undoubtedly face problems. For example, if every vehicle on the road employs radar, the receivers may react to the wrong signal. Likewise, the computer algorithms behind current video camera systems can be fooled in some situations. For instance, a system might lock on snow tracks of a previous car that slid off the road. The worst problem, however, will be eliminating false alarms.

None of the these systems can work at all without thoroughly understanding the habits of drivers. This is the most difficult task because every driver is different: Some weave slightly, some oversteer, and some constantly touch the brakes. Developing artificial intelligence that can adapt to the driver will probably be the most difficult problem for researchers to overcome.

"There are lots of human factor issues," said Jeff Everson of Battelle Memorial Research Institute (Cambridge, MA), a research organization working on both Carnegie Mellon's and Calspan's projects. "For example, how much information can you supply to the driver without overloading him or her? It's one thing to have an in-vehicle computer working to generate all of this information but then what do you do with it and how much do you supply to the driver? Do you make things better or worse?"

It took years to perfect the current on-board jetliner collision-avoidance system, called the Ground Proximity Warning System (GPWS). "Early in the system there were false alarms, and some pilots did get angry with it and turn the systems off," says Ron Iori of Allied Signal Corp. (Morristown, NJ), the manufacturer of GPWS. "But over the years—and it's been literally 20 years—our systems have gotten much better and the pilots are not apt to do that anymore." Will we say that about car systems in 2020?