

A person in a brown suit is captured mid-air, jumping over a black metal railing. The background is a bright teal wall. In the distance, other people are visible, including a child in a blue shirt and shorts. The overall scene suggests a public event or a safety demonstration.

STATUS REPORT

INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

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BIG STRIDES

in crash protection have been made for people riding in passenger vehicles, but the same can't be said for pedestrians. People, after all, don't come with airbags. Now engineers are trying to make vehicles safer for people outside them, too, by adding technology to help drivers avoid hitting pedestrians and design features to soften impacts.

Technology has the potential to avert many of these crashes altogether. Automakers are developing systems to spot pedestrians entering a vehicle's path and to automatically brake if the driver fails to react. One such system already is on the US market (see p. 4), and more are in the works. A new Institute study on pedestrian crashes shows what kind of

situations such technology should be equipped to handle. Researchers found the most common scenario involves a person crossing a roadway and a vehicle traveling straight. In most cases, nothing blocks the driver's view of the pedestrian, and no braking is reported. Such crashes usually happen during the day, although most of the fatal ones occur at night.

"The best way to protect pedestrians is to separate them as much as possible from vehicle traffic," says David Zubry, the Institute's chief research officer. "But the paths of walkers and drivers inevitably are going to intersect at some point, and new warning systems, as well as vehicle design changes required in Europe, have the potential to make those meetings less deadly."

Overall highway deaths have fallen to their lowest levels since 1950, and much of the decline in recent years is due to safer vehicles. Pedestrian fatalities have fallen, too, but that may simply be a result of people walking less. Still the death toll remains high: In 2009, 4,092 pedestrians were killed, accounting for 12 percent of all crash fatalities in the United States.

Tried and true methods for reducing pedestrian crashes generally involve roadway design changes. Pedestrians and vehicles can be separated with sidewalks, overpasses, and refuge islands

Forward collision warning is offered on 19 vehicle makes in 2011 and is one of several crash avoidance features that have been gaining ground. (Others are lane departure warning, side view assist, and adaptive headlights.) The Institute has estimated that as many as 1.2 million crashes, including 879 fatal crashes, could be prevented or mitigated each year if all vehicles were equipped with forward collision warning (see *Status Report*, May 20, 2010; on the web at iihs.org). Pedestrian detection systems could prevent an additional 39,000 crashes, including 2,932 fatal ones, researchers estimate.

As automakers continue to work on this technology, the Institute conducted its latest study to help guide their designs.

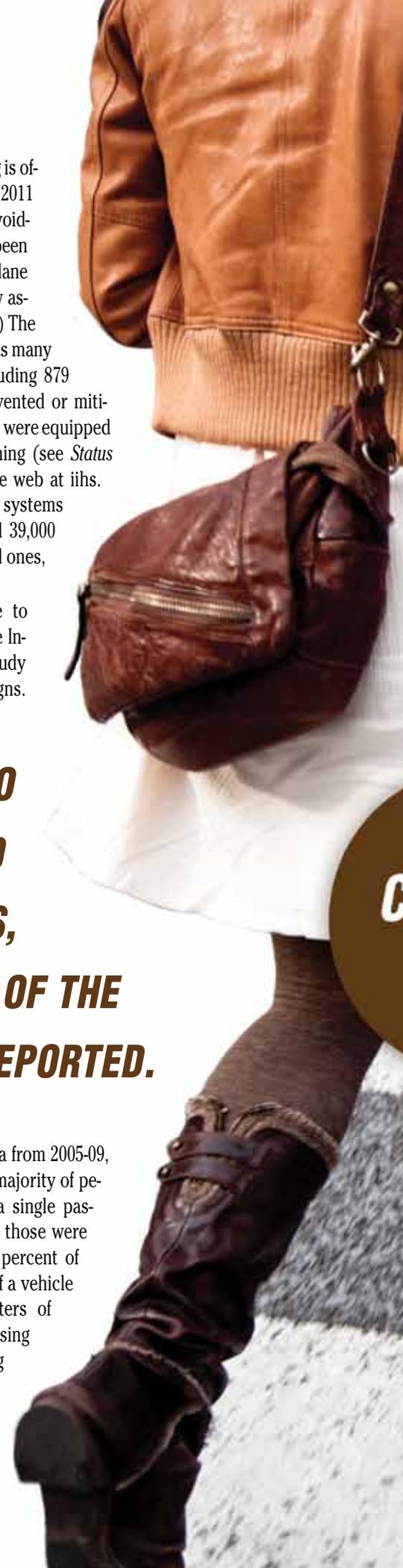
THE MOST COMMON CRASH SCENARIO INVOLVES A PERSON CROSSING A ROAD AND A VEHICLE GOING STRAIGHT. IN MOST CASES, NOTHING BLOCKS THE DRIVER'S VIEW OF THE PEDESTRIAN, AND NO BRAKING IS REPORTED.

in the middle of busy two-way streets. Better lighting and pedestrian countdown signals can help, as can reducing vehicle speeds and banning right turns on red. But such solutions haven't always been implemented consistently and can't address every risky scenario, which is why technology could play a key role.

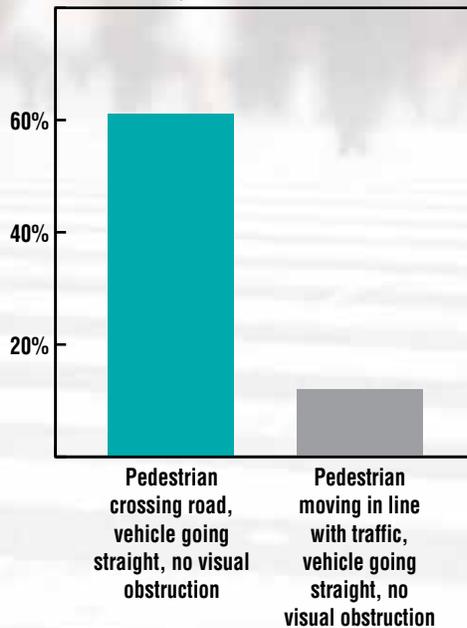
Crash avoidance technology: Systems aimed at preventing or lessening the severity of pedestrian crashes are an offshoot of a more common type of crash avoidance feature known as forward collision warning. Such systems alert the driver if the vehicle is about to crash with a vehicle ahead of it and, in some cases, apply the brakes automatically if the driver fails to respond. A pedestrian detection system is a forward collision warning system that has been enhanced to recognize not just vehicles, but people too.

Looking at federal crash data from 2005-09, researchers found the vast majority of pedestrian crashes involved a single passenger vehicle, and most of those were frontal crashes. Ninety-five percent of people struck by the front of a vehicle and more than three-quarters of those who died were crossing traffic as opposed to walking along the road.

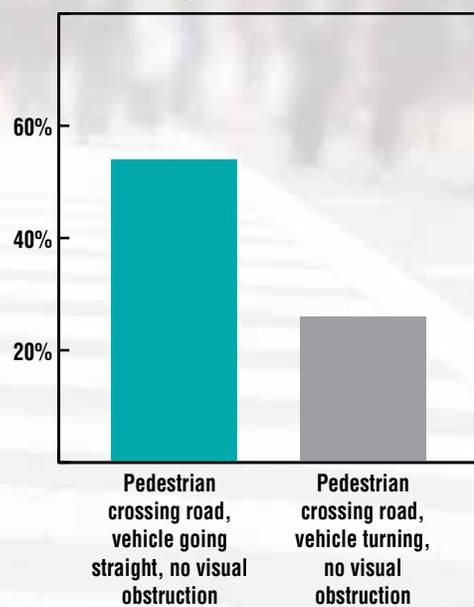
Eight of 10 pedestrians who were killed while crossing traffic,



FATAL FRONTAL CRASHES
INVOLVING PASSENGER VEHICLES AND
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ALL FRONTAL CRASHES
INVOLVING PASSENGER VEHICLES AND
PEDESTRIANS, 2 MOST COMMON SCENARIOS



CRASHES
2005-09

224,000
PEDESTRIANS HIT

Frontal crashes with
single passenger
vehicles

13,193

PEDESTRIANS KILLED

95%

Pedestrians
crossing
traffic

77%

63%

Vehicle
traveling
straight

72%

54%

Driver
view not
obstructed

61%

as well as a majority of those who were struck but didn't die, were hit by drivers who were going straight with no visual obstruction. That scenario accounted for a majority of all frontal collisions between passenger vehicles and pedestrians and 61 percent of the fatalities.

Other kinds of crashes were far less common. The second most common one, involv-

ing a turning vehicle with no visual obstruction and a person crossing the road, accounted for about a quarter of pedestrians struck by the front of a vehicle and 4 percent of those who died. The second most common type of fatal crash, involving a vehicle going straight with no view obstruction and hitting a person walking in line with traffic, was responsible for 12 percent of pedestrian deaths.

So-called dart-outs, in which a person appears suddenly in the roadway from behind a parked vehicle or other obstruction, were even less common.

Of the cases involving vehicles going straight without view obstruction, drivers hit the brakes in only 13 percent of both fatal and nonfatal impacts. In other words, most drivers who hit pedestrians crossing the roadway apparently never react to what's in front of them. That means pedestrian detection systems have a lot of potential to avert crashes by acting as an extra set of eyes and an extra foot above the brake pedal.

Of course, a system that recognizes an impending collision only after the pedestrian is directly in front of (*continues on p. 6*)

CARS CAN BRAKE FOR PEDESTRIANS IF DRIVERS DON'T

The developers of the first pedestrian collision mitigation system available in the United States drove about half a million miles in cities around the globe to gather the necessary information about pedestrians — and about things a computer might mistake for them.

“The most difficult part is actually to make sure that the car does not brake when it’s not supposed to,” says Thomas Broberg, senior technical adviser for safety at Volvo. “You would never accept a car that brakes every time you pass a mailbox.”

Introduced last year on the S60 sedan, Volvo’s system, dubbed Pedestrian Detection, is now an option on several Volvo models sold in the United States. The system uses radar combined with a camera to identify potential collisions with both pedestrians and the rear-ends of other vehicles and motorcycles. It first warns a driver of an impending crash and then brakes automatically if the driver doesn’t respond.

Subaru has developed a similar system, but so far it’s only available in Japan. Other automakers are close behind. Audi, for example, is working on a system that, unlike Volvo’s, promises to work in the dark. That’s important because most fatal pedestrian crashes take place at night.

Automatic braking: In Volvo’s system, if the driver isn’t taking action, a warning sounds and a red light meant to resemble another vehicle’s brake lights appears in the windshield. If the driver still doesn’t respond, the car stops itself. The Swedish automaker says the system can avoid a crash completely at speeds up to 22 mph. Beyond that, it’s about reducing the speed of the impact and, therefore, the consequences of the crash. The feature can function at speeds as fast as 50 mph.

Volvo estimates the feature could reduce by 24 percent pedestrian deaths caused by frontal crashes if it were adopted universally.



In addition to being dependent on light, the Volvo system has a few other limitations. It won't spot a person shorter than 31.5 inches or in a wheelchair, nor is it programmed to react to cyclists or animals. If a driver's view of a pedestrian is blocked, the camera won't be able to see the person either. However, it should work in what the Institute has identified as the most common

scenario — a driver going straight with a clear view and a pedestrian crossing traffic.

Volvo suffered a few well-publicized failures during demonstrations for journalists. Video footage shows an S60 crashing into a dummy instead of stopping. Broberg says in the vast majority of demonstrations the system has worked as advertised, and the mishaps that did occur were a result of the



Broberg says Volvo decided to do something about pedestrians because they account for such a large share of fatalities — 12 percent in the United States and an even larger share in Europe. Volvo and other automakers, spurred on by European regulators, have modified the fronts of vehicles to make them “softer” if they contact a pedestrian. It’s not clear yet how much such changes will help. Broberg, for his part, is skeptical.

“Unfortunately, the laws of physics are against us there. ... Two tons of steel versus 80 kilograms of flesh,” he says. “So our belief has been that we need to try to help the drivers avoid these types of collisions.”

What other manufacturers are doing:

Subaru’s EyeSight system, which is available in Japan, is similar to Volvo’s, but the latest version relies on two cameras to produce stereo vision, instead of radar and a single camera. The company says that helps keep down the cost.

Subaru says its system can recognize both pedestrians and cyclists. As with Volvo’s technology, EyeSight also is activated if the car gets too close to the vehicle in front of it and can brake automatically if the driver doesn’t respond to warnings.

Audi, meanwhile, is working on a pedestrian avoidance system that it says will work in all light conditions. It uses a relatively new technology known as a PMD sensor, or photonic mixer device, to detect obstacles in the road. The system is designed to automatically brake if a crash with a pedestrian or large animal is unavoidable. It also avoids some collisions with other vehicles. The system is expected to reach consumers within the next three years.

Audi already has a separate system that alerts drivers to the presence of pedestrians at night. The night vision assistant uses a thermal imaging camera to highlight people on a dashboard display.

Both Mercedes and BMW have similar night vision features. BMW is developing a camera-based pedestrian detection system with automatic braking, and Mercedes is enhancing existing crash avoidance systems to react to pedestrians as well as other vehicles.

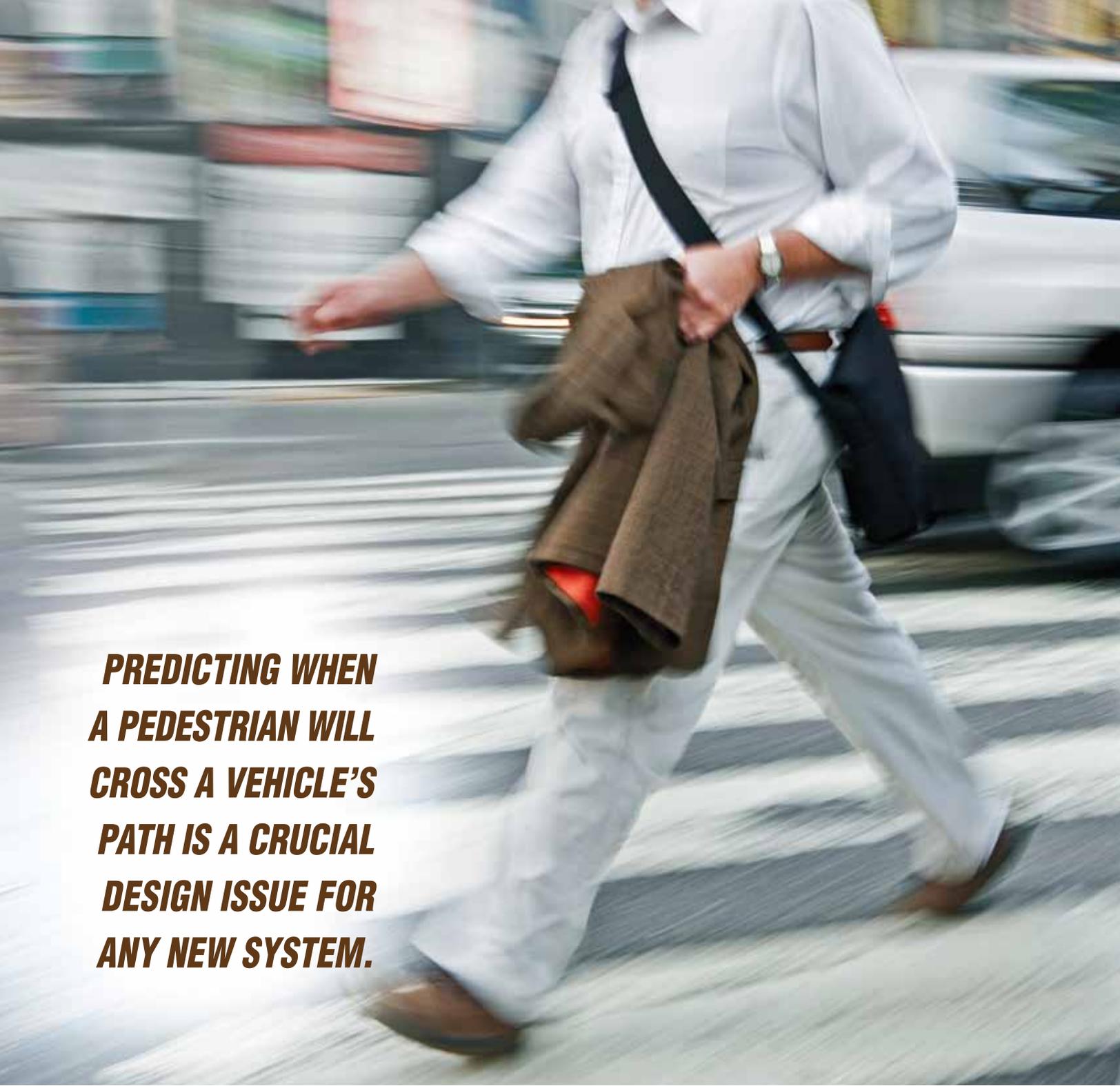


Volvo’s Pedestrian Detection uses radar and a camera to identify people who might end up in the car’s path (above and left). If the system determines a collision is imminent, it first alerts the driver with an audible warning and a red light in the windshield (far left). If the driver doesn’t respond, the vehicle brakes itself. The system also reacts to the rear-ends of other vehicles and motorcycles.

technology’s sophistication. The system, he says, is “hard to trick” because it’s programmed to recognize only a flesh-and-blood person.

Pedestrian Detection is distinct from Volvo’s City Safety, which uses a less expensive laser sensor and is aimed at avoiding rear-end crashes with other vehicles at low speeds only. Pedestrian Detection is an op-

tional feature, raising the question of whether people are prepared to pay more to protect others. But the system also appeals to people’s self-interest because it prevents rear-end crashes with other vehicles and because it’s part of a bigger technology package that includes things like adaptive cruise control. The company estimates it will have a take rate of 20-25 percent globally.



***PREDICTING WHEN
A PEDESTRIAN WILL
CROSS A VEHICLE'S
PATH IS A CRUCIAL
DESIGN ISSUE FOR
ANY NEW SYSTEM.***

(continued from p. 3) the vehicle would hold limited value. The trick is developing technology that can accurately predict when someone is going to step into the path of a vehicle.

“Pedestrians can change course quickly, so just as it can be hard for a driver to know what a person at the curb is going to do, it also can be tricky for a computer,” Zuby says. “It’s important to get that right be-

cause too many false alarms could turn a warning system into an annoyance and make drivers reluctant to accept the new technology.”

Another finding relevant to developers of pedestrian detection systems is that three-quarters of people struck were on roads with speed limits of less than 40 mph. Fatalities, however, were more evenly distributed. Roads with speed limits of 30-39 mph, 40-49

mph, and over 49 mph each accounted for more than a quarter of them.

The biggest hurdle for the new technology is how to prevent crashes that occur at night. The systems on the market now rely on light-dependent cameras. Most frontal collisions with pedestrians occur during the day, so these systems could be expected to take a bite out of the overall pedestrian crash problem. But with more than two-

thirds of fatalities occurring after dark, significantly cutting pedestrian deaths will require technology that can perform reliably with limited or no light.

Europe's approach: Crash avoidance technology is just one aspect of the effort to improve passenger vehicles to protect pedestrians. Another strategy is to modify the fronts of vehicles to lessen the harm they can cause to a person who is struck. New regulations in the European Union are taking this route.

As of September 2010, all passenger vehicles must pass crash tests that assess the risk of injury to an adult's head, a child's head, and adult's knee and lower leg. By September 2015, automakers must comply with a second phase that has stricter standards for the head and leg and also tests the impact that the hood's edge would have on a person's hip.

To meet the new requirements, automakers are putting more room between the hood and engine, designing hoods that automatically raise up a few inches from the engine upon impact, installing hood airbags, hiding hard elements like windshield wipers, and designing softer bumpers for their vehicles sold in Europe. It's too soon to tell whether these changes are reducing pedestrian injuries.

In the United States, the National Highway Traffic Safety Administration conducted research from the 1970s through the early 1990s that could have led to similar requirements, but that effort was scuttled (see *Status Report*, March 13, 1999). The agency never made clear its reasons for abandoning the idea, but the motivation for it likely faded as pedestrian fatalities continued to drop on their own.

Nevertheless, some version of the European tests may come to the US in the future as part of an effort to standardize such regulations across the globe.

For a copy of "Primary pedestrian crash scenarios: factors relevant to the design of pedestrian detection systems" by J.S. Jermakian and D. Zuby, write: Publications, Insurance Institute for Highway Safety, 1005 N. Glebe Rd., Arlington, Va. 22201, or email publications@iihs.org.

SILENCE ISN'T GOLDEN WHEN IT COMES TO HYBRIDS, ELECTRICS

The National Highway Traffic Safety Administration has three years to come up with a requirement for equipping quiet hybrid and electric vehicles with sounds so that pedestrians can hear them coming. President Barack Obama signed the bill setting the deadline in January.

With the proliferation of hybrids, advocates for the blind have raised concerns that the vehicles don't produce enough noise to warn pedestrians, particularly at low speeds when they are likely to be operating solely on electricity. Quiet vehicles are a concern not only for the blind, but for anybody traveling on foot or bicycle. A 2009 government study found hybrids are more likely to crash with pedestrians and bicyclists than vehicles with internal combustion engines (see *Status Report*, Dec. 22, 2009; on the web at iihs.org).

US Secretary of Transportation Ray LaHood said in a recent blog post that government researchers have begun testing synthetic sounds in advance of the new law. "We're trying to find the right balance between quiet roadways and pedestrian safety," he wrote. Automakers also are trying to get in front of the issue. The electric Nissan Leaf produces an airplane-like whooshing sound at low speeds, as does the M35 hybrid from Nissan's Infiniti brand. The

Chevrolet Volt can emit a chirping sound along with flashing lights, but drivers have to activate the alert system. Another example is the Hyundai Sonata hybrid, which makes a sound similar to a gently accelerating gasoline engine.



OESCH RETIRES FROM INSTITUTE

Stephen L. Oesch has retired after 29 years with the Institute. He began his Institute career as a communications researcher tracking down background information for *Status Report* articles and retired as secretary-treasurer and senior vice president for insurer and government relations in December 2010.

Oesch worked on a variety of highway loss reduction programs. These included Institute efforts to improve federal safety standards for motor vehicles and implement effective traffic laws and enforcement programs to reduce alcohol-impaired driving and increase child restraint and safety belt use.

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