Toyotas woes may not end at floor mats

Keyless ignitions, other features can complicate stopping a runaway car.

Ralph Vartabedian and Ken Bensinger

The 2009 Lexus ES 350 shot through suburban San Diego like a runaway missile, weaving at 120 miles an hour through rush hour freeway traffic as flames flashed from under the car.

At the wheel, veteran California Highway Patrol Officer Mark Saylor desperately tried to control the 272-horsepower engine that was roaring at full throttle as his wife, teenage daughter and brother-in-law were gripped by fear.

“We're in trouble... There's no brakes,” Saylor's brother-in-law Chris Lastrella told a police dispatcher over a cellphone. Moments later, frantic shrieks filled the car as it slammed into another vehicle and then careened into a dirt embankment, killing all four aboard.

The tragedy Aug. 28 was at least the fifth fatal crash in the U.S. over the last two years involving runaway Toyota and Lexus vehicles made by Toyota Motor Corp. It is also among hundreds of incidents of sudden acceleration involving the company's vehicles that have been reported to Toyota or the federal government, according to an examination of public records by The Times.

Toyota has blamed the incidents — apart from those caused by driver error — on its floor mats, asserting that if they are improperly installed they can jam open the accelerator pedal. A month after the Saylor crash, Toyota issued its biggest recall in company history, affecting 3.8 million vehicles in model years as far back as 2004. But auto safety experts believe there may be a bigger problem with Toyota vehicles than simply the floor mats.

The Saylor crash and others like it across the country, they say, point to a troubling possibility: that Toyota’s ignition, transmission and braking systems may make it difficult for drivers to combat sudden or unintended accelerations and safely recover, regardless of their cause.

Toyota is not the only car company to be hit with reports of sudden acceleration, but the San Diego fatality, the massive recall that came in its wake and Toyota's position as the world's largest automaker have focused in-
tense scrutiny on the company by federal safety regulators and others.

"This is Toyota's Firestone," said Sean Kane, president of Safety Research & Strategies, a Rehoboth, Mass., auto safety consulting firm. He was referring to the public relations disaster that hit Bridgestone/Firestone almost 10 years ago over defective tires that caused a series of fatal accidents.

"Right now," Kane said, "when you say sudden acceleration, Toyota is it."

In addition to Saylor and Lastrella, the San Diego crash killed Saylor's wife, Cleofe Lastrella, and their only child, 13-year-old daughter Mahala.

Signaling how seriously the company takes the incident, Toyota President Akio Toyoda made an apology this month while meeting with the Japanese news media.

"Customers bought our cars because they thought they were the safest," he said. "But now we have given them cause for grave concern. I can't begin to express my remorse."

One remedy being considered by Toyota implicitly acknowledges what critics have been saying for almost 10 years: That the company's highly computerized engine control system lacks a fail-safe mechanism that can quickly extinguish sudden acceleration events, whether they are caused by floor mats, driver errors or even unknown defects in the electronic control system, as alleged in some lawsuits.

Reports of sudden acceleration in Toyota vehicles has resulted in nine federal inquiries and investigations since 2000, two of which determined that there were improperly positioned floor mats. Another found a loose part in Sienna minivans, and yet another probe remains open. The rest were dismissed with no findings.

In most Toyota vehicles, the floor mats are held in place by two clips, which can come loose. Toyota offers a standard carpeted floor mat and an optional rubber version. Both mats have a cutout around the accelerator pedal. The vehicle driven by Saylor had a rubber floor mat, but Toyota said it was for a different model of Lexus.

Since the San Diego crash, Toyota has urged all its customers to remove their floor mats as an interim fix. But longer term, Toyota spokesman Brian Lyons said, the company is examining significant design changes.

One possible remedy is to redesign the accelerator pedal to make it harder to get caught by a floor mat, he said. Another potential fix, he said, involves reprogramming the engine's computer to automatically cut power when a driver brakes while the gas pedal is depressed.

Such fail-safes are needed, auto experts say, because sudden acceleration can cause drivers to panic, diminishing their ability to take swift action — such as shutting off the engine or shifting into neutral.

If anybody should have known how to stop an out-of-control car, it was Saylor, who was trained in emergency and high-speed driving as a 19-year CHP veteran. But a close look at the Lexus ES 350 raises questions about whether the car's very design may have compromised Saylor's skills.

One obvious line of defense is to simply shut off the engine, a step that may not be intuitive on the ES 350. The car has a push-button start system, activated by the combination of a wireless electronic fob carried by the driver and a button on the dashboard.

But once the vehicle is moving, the engine will not shut off unless the button is held down for a full three seconds — a period of time in which Saylor's car would have traveled 528
A driver may push the button repeatedly, not knowing it requires a three-second hold.

“When you are dealing with an emergency, you can’t wait three seconds for the car to respond at 120 miles an hour,” said Clarence Ditlow, executive director of the nonprofit Center for Auto Safety.

The ES 350 Saylor was driving that day was loaner provided to him by Bob Baker Lexus when he took his family’s Lexus in for servicing. It’s unclear whether Saylor’s own car had the same feature or whether he was aware of the shutdown procedure. Bob Baker Lexus did not return calls.

That procedure is explained deep in the owners manual. In a text box labeled “Caution,” Toyota tells owners, “Do not touch the ‘power’ switch while driving.” Under the warning it adds, “If you have to make an emergency stop, press and hold the ‘power’ switch for more than three seconds.”

Lyons, the Toyota spokesman, said: “I think the text is valid. What I’d prefer to say is to explain that you’ll lose power assist [for] brakes and steering if you do so.”

The shutdown procedure reflects a larger problem: As car manufacturers adopt increasingly complex electronic features, it becomes more difficult to explain how they work, said Paul Green, a human factors expert at the University of Michigan’s Transportation Research Institute. A study by the institute found that in some cases, owners manuals would have to run up to 1,000 pages to fully disclose everything.

“In the past, systems were pretty simple,” Green said. “You put a key in the lock and turn it. Now we have a job with functionality.”

The other common defense tactic advised by experts is to simply shift a runaway vehicle into neutral. But the ES 350 is equipped with an automatic transmission that can mimic manual shifting, and its shift lever for the console has a sensor of gears and detents that allow a driver to select any of at least four forward gears.

The arrangement of those gear selections could make it difficult to shift from a forward gear directly into neutral in a panic situation, Toyota spokesman Lyons acknowledged.

“I think it’s possible to get the shifter confused, but I can’t be sure that’s what happened” in San Diego, Lyons said. “You’d be surprised how many people around here [Toyota] don’t know what the neutral position is for.”

The most obvious impulse for any driver experiencing sudden acceleration is to apply the brakes. But when an engine goes to full throttle and is speeding at 120 mph, the brake might not stop the car.

The ES 350 and most other modern vehicles are equipped with power-assisted brakes, which operate by drawing vacuum power from the engine. But when an engine opens to full throttle, the vacuum drops, and after one or two pumps of the brake pedal the power assist feature disappears.

As a result, a driver would have to apply enormous pressure to the brake pedal to stop the car, and if the throttle was wide open might not be able to stop it at all, safety experts say.

“I don’t think you can stop a car going 120 mph and an engine at full throttle without power assist,” said Ditlow, the safety center director.

Indeed, a 2007 study by federal highway safety officials showed that braking distances and forces of a Lexus ES 350 increased fivefold when the throttle was wide open. And evidence introduced in sudden acceleration trials suggests that it can take up to 225 pounds of pressure on a brake pedal to arrest a runaway vehicle, far more than most drivers can muster from a seated position, said Edgar “Hike” Heiskell, a Charleston, W.Va., attorney who is suing Toyota over a fatal acceleration accident in Flint, Mich.

Lyons acknowledged that the vacuum can be depleted when an engine throttle is wide open, leaving the drivers without power-assisted brakes.

“There’s a federal standard where you have to be able to stop the car without power-assisted brakes, but obviously I don’t think it includes situations where the throttle is wide open,” he added.

Drivers in other crashes also found it difficult to rein in a runaway Toyota. Guadalupe Gomez of Redwood City said he was held hostage for 20 miles on a Bay Area freeway by a 2007 Camry traveling more than 100 mph.

Gomez was unable to turn off the engine or shift into neutral and then burned out his brakes before slamming into another car and killing that driver, said attorney Louis Friend, who represented that victim’s family.

The San Diego crash is still under investigation by the San Diego County Sheriff’s Department and the CHP; until the probe is complete, neither agency is commenting.

The National Highway Traffic Safety Administration, meanwhile, says it has an open investigation into sudden acceleration events involving Toyota vehicles.

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Times staff writer Tony Perry in San Diego contributed to this report.
RUNAWAY TOYOTA CASES IGNORED

Safety investigators dismissed numerous reports of sudden acceleration, then said data were lacking.

RALPH VARTABEDIAN AND KEN BENSONGER

More than 1,000 Toyota and Lexus owners have reported since 2001 that their vehicles suddenly accelerated on their own, in many cases slamming into trees, parked cars and brick walls, among other obstacles, a Times review of federal records has found.

The crashes resulted in at least 19 deaths and scores of injuries over the last decade, records show. Federal regulators say that is far more than any other automaker has experienced.

Owner complaints helped trigger at least eight investigations into sudden acceleration in Toyota and Lexus vehicles by the National Highway Traffic Safety Administration in the last seven years. Toyota Motor Corp. recalled fewer than 85,000 vehicles in response to two of those probes, and the federal agency closed six other cases without finding a defect.

But those investigations systematically excluded or dismissed the majority of complaints by owners that their Toyota and Lexus vehicles had suddenly accelerated, which sharply narrowed the scope of the probes, the Times investigation revealed.

Federal officials eliminated broad categories of sudden-acceleration complaints, including cases in which drivers said they were unable to stop runaway cars using their brakes; incidents of unintended acceleration lasting more than a few seconds; and reports in which owners did not identify the possible causes of the problem.

NHTSA officials used the exclusions as part of their rationale to close at least five of the investigations without finding any defect, because — with fewer incidents to consider — the agency concluded there were not enough reported problems to warrant further inquiry. In a 2003 Lexus probe, for example, the agency threw out all but one of 37 customer complaints cited in a defect petition. It then halted further investigation, saying it "found no data indicating the existence of a defect trend."

Meanwhile, fatal crashes involving Toyota vehicles continued to mount.

In a written statement, the NHTSA said its records show that a total of 15 people died in crashes related to possible sudden acceleration in Toyota vehicles from the 2002 model year and newer, compared with 11 such deaths in vehicles made by all other automakers.

The Times located federal and other records of 19 fatalities involving Toyota and Lexus vehicles from the same model years in which sudden or unintended acceleration may have been a factor, as well as more than 1,000 reports by owners that their vehicles had suddenly accelerated. Independent safety expert Sean Kane, president of Safety Research and Strategies, said he has identified nearly 2,000 sudden-acceleration cases for Toyota vehicles built since 2001.

Other experts say the numbers may be far higher, pointing to a 2007 NHTSA survey of 600 Lexus owners that found 10% complained they had experienced sudden acceleration.

Most sudden accelerations did not result in a crash, but there were notable exceptions. Bulent Ezal, a retired engineer, plunged 70 feet off a Pismo Beach cliff into the Pacific Ocean surf. He was hospitalized with minor injuries, but his wife of 46 years was killed.

"By the time they pulled me out, the tide was about to cover the car," Ezal said.

He said his 2005 Camry had suddenly accelerated in a parking lot.

In its research, The Times examined thousands of federal defect investigation records, complaints filed with NHTSA by Toyota and Lexus owners, lawsuits against the company, and reports by independent safety experts and local police agencies.

Toyota has been under a spotlight since Aug. 28, when off-duty California Highway Patrolman Mark Saylor and three members of his family died in a Lexus ES 350 that accelerated to more than 100 mph and crashed in San Diego County.

Toyota has blamed the Saylor crash on an incorrectly installed floor mat that jammed the accelerator pedal. The company announced a recall of 3.8 million vehicles in September and is designing a fix aimed at preventing sudden acceleration caused by floor mats.

The recall affects the following Toyota models: the 2007-2010 Camry, the 2004-2009 Prius, the 2005-2010 Avalon, the 2006-2010 Tacoma and the 2007-2010 Tundra, as well as the 2007-2010 Lexus ES 350 and the
FATAL: Bulent Ezal said his Camry suddenly accelerated before it plunged off a Pismo Beach cliff in 2007, killing his wife.

2006-2010 Lexus IS 250 and IS 350.

Last week, the NHTSA called the issue a “very dangerous problem” and said the remedy remains to be determined.

The agency declined a request for interviews, but issued a statement defending its past actions, saying its officials have continuously monitored Toyota vehicles for potential defects and that many of the reports of sudden acceleration involved only momentary surges of engine power that did not result in any loss of vehicle control.

“NHTSA takes every allegation of safety problems seriously and that is why we read every consumer complaint within one business day of its receipt,” the agency said. “In the case of complaints about sudden acceleration in Toyota vehicles NHTSA moved very quickly to respond to them.”

Toyota Motor Corp. defended its Toyota and Lexus vehicles and the validity of prior investigations.

“Over the past six years, NHTSA has undertaken several exhaustive reviews of allegations of unintended acceleration on Toyota and Lexus vehicles. In each case, the agency found that any electronic engine control system malfunction could not be the cause of unintended acceleration,” the company said in a statement.

Whatever the cause, Toyota and Lexus owners have grappled with the dangerous consequences.

Jean Bookout awoke in an Oklahoma hospital a month after a crash in her 2005 Camry.

She said the car sped out of control on a freeway, then smashed into an embankment after she swerved it onto an exit ramp, leaving behind long skid marks from attempts to stop the vehicle with her brakes and emergency brake.

Bookout sustained permanent memory loss, and her best friend died.

“I did everything I could to stop the car,” she said Tuesday.

Nancy Bernstein, a vice president for a Long Beach community garden and former science teacher, said she was taken on an 8-mile high-speed ride by her 2007 Prius while she was following her husband in a group bicycle tour in Wisconsin. She said her Prius accelerated from 45 mph to 75 mph on a winding, two-lane highway crowded with 100 cyclists.

“I was sure I was going to kill someone on a bicycle or myself,” she recalled. “I stood on the brakes with both feet. All of sudden, I see fire. I thought, are my brakes on fire. I thought about maybe trying to sideswipe a tree to slow down.”

Eventually she was able to stop at the bottom of a hill, using her brakes and emergency brake. A local resident rushed out with a fire extinguisher.

Dr. David W. Smith, an emergency room physician from San Dimas, has yet to receive a satisfactory answer from Toyota about his Lexus GS 300. Smith said he was driving with his cruise control in Central California on Highway 99 last year, not touching the accelerator, when suddenly the vehicle accelerated to 100 mph.

The brakes did not release the cruise control or slow down the vehicle, Smith recalled. Finally, he shifted into neutral and shut off the engine. “I am sure it is the cruise control,” he said. “I haven’t used it since.”

In reviewing consumer complaints during its investigations, the NHTSA relied on established “positions” that defined how the agency viewed the causes of sudden acceleration. Cases in which consumers alleged that the brakes did not stop the car were discarded, for example, because the agency’s official position was that a braking system would always overcome an engine and stop a car. The decision was laid out in a March 2004 memorandum.

When asked to submit its own complaint data to the NHTSA, Toyota eliminated reports claiming that sudden acceleration occurred for “a long duration,” or more than a few seconds. Elsewhere, the company said a fail-safe in its throttle system makes such an event impossible.

NHTSA officials acknowledged in a statement that the exclusions were made, but defended the practice.

“While some vehicles may be excluded from the scope of an investigation into a specific defect allegation, all are continuously reviewed, along with other relevant information, in order to identify other emerging issues of concern,” the statement said.

A reduced pool of reports created the appearance that the problem was much smaller than the total number of complaints suggested, making a broader vehicle recall seem less necessary, critics say.

“NHTSA has ways of pigeonholing reports, categorizing them as brake failure rather than sudden acceleration,” said attorney Edgar Heiskell of Charleston, W.Va., who is suing Toyota over a fatal crash in Flint, Mich. “By excluding these braking and long-duration events, they have taken 80% of the cases off the table.”

In 2004, the NHTSA began a probe into a defect petition filed by Carol J. Mathews, a registered nurse who was then director of health services for the Montgomery County, Md., school system. Mathews reported that she had her foot on the brake of a 2002 Lexus ES when it took off and hit a tree.

In its subsequent investigation, the NHTSA and Toyota both winnowed down other reports of sudden acceleration involving 2002 and 2003 Lexus ES and Camry models.

When the agency asked Toyota to dig deeper all of the reports it knew about, the company eliminated an unknown number in five broad categories, including cases in which drivers said they were unable to control a runaway engine by applying the brakes.

In closing the probe, federal
investigators said only 20 cases were considered relevant.

But The Times' examination of consumer complaints and a sampling of reports from Toyota dealers found more than 400 reports of sudden acceleration involving those models. And federal records show that the NHTSA knew about 260 of those cases and another 114 cases identified by Toyota.

As for its position that brakes can always overcome a vehicle's engine, the safety agency and Toyota now acknowledge that a braking system cannot always counter a wide-open throttle, as is the case in sudden acceleration.

The NHTSA began investigating the problem of sudden acceleration in the mid-1980s, after a flood of complaints about the Audi 5000. One outgrowth of the subsequent investigation was the NHTSA view that acceleration events at high speed are a different issue than events at low speed.

In 2005, for example, Jordan Ziprin of Phoenix, who had experienced a minor accident he blamed on sudden acceleration, filed a defect petition with the NHTSA that included nearly 1,200 owner complaints about Toyota vehicles. The automaker argued that the majority should be eliminated because they dealt "with two completely different issues."

When owners said the "vehicle unintentionally or suddenly accelerated," Toyota claimed that represented a different issue than when they said "the vehicle surged" or "lurched." The NHTSA ultimately went a step further, eliminating every "

"Nothing to see here, folks"

In multiple investigations into sudden-acceleration allegations, both federal regulators and Toyota decided not to consider a wide range of consumer complaints and driving conditions.

"'Sudden acceleration' does not describe unintended events that begin after vehicles have reached intended roadway speeds."


"Toyota did not include consumer complaints alleging one of the following that clearly do not relate to the alleged defect . . .

(1) an incident alleging uncontrollable acceleration that occurred for a long duration
(2) an incident in which the customer alleged that they could not control a vehicle by applying the brake
(3) an incident alleging unintended acceleration occurred when moving the shift lever to the reverse or the drive position
(4) incidents involving dissatisfaction with drivability, such as shift shock or engine response
(5) no explanation of circumstances (customer complained about unintended acceleration, but did not actually experience subject defect, or just stated their concern)"

—Toyota to NHTSA, which had requested all complaints related to sudden acceleration. June 1, 2004

Sources: National Highway Traffic Safety Administration, Times research

Doug Stevens Los Angeles Times
single complaint except Ziprin's, finding them to have "ambiguous significance."

The agency also has thrown out evidence for other reasons. In 2008, the NHTSA opened a probe of the Toyota Tacoma after a consumer found that the truck had accumulated 32 times as many sudden-acceleration complaints as any other pickup. But Toyota at the time said the complaints stemmed from "media and Internet exposure." The NHTSA closed the case without a finding after it whittled down a list of more than 450 complaints to just 82.

"To this day I still can't find evidence online of a flood of media exposure," said William Kronholm, the Helena, Mont., man who said he requested the investigation after he experienced two acceleration events in his 2006 Tacoma. "They never dealt with the question I presented in any real way."

The NHTSA has declined to reconsider previous investigations, even in the face of new evidence.

In March, Jeffrey Pepsi of Plymouth, Minn., formally requested that the NHTSA reopen two closed investigations into Toyota and Lexus vehicles for the acceleration problem, arguing in part that 10 other motorists had experienced sudden acceleration that could not be explained by floor mats.

The NHTSA looked at the 10 cases and tossed them out. The agency's way of looking at them sharply contrasted with the drivers' original accounts.

In one case, the driver of a 2007 Lexus ES 350 reported that the sedan accelerated into a building, bounced backward, struck another vehicle and ended up on top of a snowbank. But federal officials described the same case as a "single incident of alleged engine surge while parking vehicle. No trouble found by dealer."

The NHTSA denied Pepsi's petition last week, arguing that further study was "not warranted."

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Times researcher Scott J. Wilson and Times staff writer Melissa Rohlin contributed to this report.
Data point to Toyota’s throttles

The automaker cites floor mats, but reports of acceleration trouble shot up after the move to electronic control.

KEN BENSINGER
ANDRALPH VARTABEDIAN

Eric Weiss was stopped at a busy Long Beach intersection last month when he said his 2006 Toyota Tacoma pickup unexpectedly started accelerating, forcing him to stand on the brakes to keep the bucking truck from plowing into oncoming cars.

Toyota Motor Corp. says the gas pedal design in Weiss’ truck and more than 4 million other Toyota and Lexus vehicles makes them vulnerable to being trapped open by floor mats, and on Wednesday, it announced a costly recall to fix the problem.

But Weiss is convinced his incident wasn’t caused by a floor mat. He said he removed the mats in his truck months earlier on the advice of his Toyota dealer after his truck suddenly accelerated and rear-ended a BMW.

“The brakes squealed and the engine roared,” the 83-year-old cabinet maker said of the most recent episode. “I don’t want to drive the truck anymore, but I don’t want anyone else to, either.”

Amid widening concern over unintended acceleration events, including an Aug. 28 crash near San Diego that killed a California Highway Patrol officer and his family, Toyota has repeatedly pointed to “floor mat entrapment” as the problem.

But accounts from motorists such as Weiss, interviews with auto safety experts and a Times review of thousands of federal traffic safety incident reports all point to another potential cause: the electronic throttles that have replaced mechanical systems in recent years.

The Times found that complaints of sudden acceleration in many Toyota and Lexus vehicles shot up almost immediately after the automaker adopted the so-called drive-by-wire system over the last decade. That system uses sensors, microprocessors and electric motors — rather than a traditional link such as a steel cable — to connect the driver’s foot to the engine.

For some Toyota models, reports of unintended acceleration increased more than fivefold after drive-by-wire systems were adopted, according to the review of thousands of consumer complaints filed with the National Highway Traffic Safety Administration.

Toyota first installed electronic throttles in 2002 model year Lexus ES and Camry sedans. Total complaints of sudden acceleration for the Lexus and Camry in the 2002-04 model years averaged 132 a year. That’s up from an average of 26 annually for the 1999-2001 models, the Times review found.

The average number of sudden-acceleration complaints involving the Tacoma jumped more than 20 times, on average, in the three years after Toyota’s introduction of drive-by-wire in these trucks in 2005. Increases were also found on the hybrid Prius, among other models.

Toyota spokesman Brian Lyons said the automaker could not explain the trend.

Recalled models

Toyota said it is recalling more than 4 million vehicles to address the risk of floor mats trapping open the gas pedal. Here are the vehicles and model years affected:

- Toyota Camry: 2007-10
- Toyota Prius: 2004-09
- Toyota Avalon: 2005-10
- Toyota Tacoma: 2005-10
- Toyota Tundra: 2007-10
- Lexus ES 350: 2007-10
- Lexus IS 250 and IS 350: 2006-10

But Toyota has consistently held that electronic control systems, including drive-by-wire, are not to blame.

“Six times in the past six years NHTSA has undertaken an exhaustive review of allegations of unintended acceleration on Toyota and Lexus vehicles,” Toyota said in a statement this month. “Six times the agency closed the investigation without finding any electronic engine control system malfunction to be the cause of unintended acceleration.”

NHTSA officials have consistently said they have not found any electronic defects. “In the high-speed incidents, which are the type of crashes in which death or serious injury is most likely, the only pattern NHTSA has found to explain at least some of them is pedal entrapment by floor mats,” a spokeswoman said in a written statement.

Toyota has been under a spotlight since the San Diego crash, in which the driver’s des-
perate efforts to stop the car were recorded on a 911 emergency call made by a passenger.

After that incident, The Times reported that sudden-acceleration events involving Toyota vehicles have resulted in at least 19 deaths since the introduction of the 2002 model year. By comparison, NHTSA says all other automakers combined had 41 fatalities related to sudden acceleration in the same period.

Independent electronics and engineering experts say that the drive-by-wire systems differ from automaker to automaker and that the potential for electronic throttle control systems to malfunction may have been dismissed too quickly by both Toyota and federal safety officials.

Unlike mechanical systems, electronic throttles — which have the look and feel of traditional gas pedals — are vulnerable to software glitches, manufacturing defects and electronic interference that could cause sudden acceleration, they say.

Ask the computer

"With the electronic throttle, the driver is not really in control of the engine," said Anthony Anderson, a Britain-based electrical engineering consultant who investigates electrical failures and has testified in sudden-acceleration lawsuits. "You are telling the computer, will you please move the throttle to certain level, and the computer decides if it will obey you."

**Comparing acceleration systems**

Toyota and Lexus began switching their throttle controls from mechanical to electronic in 2002. Here's how the two systems work:

**The old mechanical way**

When the driver presses down on the accelerator pedal, it pulls a cable that physically opens the throttle valve, thereby regulating the intake of air and gasoline to the engine.

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**The new electronic way**

An electronic sensor detects the position of the accelerator pedal and sends a signal to the vehicle's computer, or electronic control module (ECM). The module then signals the throttle to regulate air intake.

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Sources: Toyota, Times research. Graphics reporting by Wil Ramirez

Note: Items are representational and not to scale

Matt Moody Los Angeles Times
A surge in reports
Complaints of sudden acceleration for Toyota and Lexus models increased significantly after the adoption of electronic throttles, in 2002 for Camry and Lexus ES, and 2005 for Tacoma.

<table>
<thead>
<tr>
<th>Model</th>
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<th>Complaints</th>
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<tr>
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<td>38</td>
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<td>Tacoma</td>
<td>2005</td>
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Sources: National Highway Traffic Safety Administration, Times research

With the electronic throttle, the driver is not really in control of the engine. You are telling the computer, will you please move the throttle to a certain level, and the computer decides if it will obey you.

—ANTONY ANDERSON, electrical engineering consultant

Advanced systems
The electronic throttle was first introduced by BMW in 1988. Like a conventional throttle system, it controls the flow of air into the engine. Today, every new Toyota vehicle sold in the U.S. uses drive-by-wire. The systems cost less to install on the assembly line and increase the efficiency of the vehicle.

To run these advanced throttle systems, each automaker develops its own electronic control modules and proprietary software that has unique control logic. The operations of the systems are opaque to consumers, as are potential failures.

In a worst-case scenario, consultant Anderson says, stray electrical voltages, electromagnetic signals or bad sensor readings could cause an undetectable error within the car’s network of up to 70 microprocessors, setting off an unpredictable chain of reactions. One of those, he said, could be a command to completely open the throttle.

The auto industry has battled allegations of electronic defects in sudden-acceleration lawsuits for more than two decades, arguing that they are not caused by any vehicle defect.

Richard Schmidt, a former UCLA psychology professor and now an auto industry consultant specializing in human motor skills, said the problem almost always lies with drivers who step on the wrong pedal.

“When the driver says they have their foot on the brake, they are just plain wrong,” Schmidt said. “The human motor system is not perfect, and it doesn’t always do what it is told.”

To be sure, the complaints by Toyota and Lexus owners about sudden acceleration involve a tiny share of the company’s vehicles on the road.

But runaway acceleration represents a high proportion of the complaints filed by consumers about Toyota in federal databases. For the 2007 Lexus ES sedan, for example, 74 of 132 complaints filed with NHTSA alleged sudden acceleration.

And independent experts say the number of complaints actually filed is only a tiny fraction of all potential problems, because most people don’t bother filing a report.

Critics say NHTSA hasn’t kept pace with technological changes.

The auto industry has undergone a technological revolution in the last decade, and today about 25% of a vehicle’s price reflects its electronics content. Nonetheless, NHTSA has adopted few, if any, standards for designing or testing vehicle electronics, according to industry officials. Indeed, the agency’s two-page safety standard for accelerators was adopted in 1971.

Dale Kardos, who runs a consulting firm that helps automakers with regulatory issues, said manufacturers had repeatedly tried to get that standard updated because they feared they could no longer comply. “The industry would...
like to see standards written to reflect modern technology," Kardos said.

Instead, independent organizations and the industry itself are setting standards and developing safety policies. The International Organization for Standardization, a non-government group that sets industrial standards, recently introduced a new standard for automakers to protect vehicle electronics.

Supplier TRW Automotive Holdings Corp., which makes computerized controls for brakes and air bags, said its systems have multiple layers of redundancy to make sure electronic faults are detected and isolated.

"Manufacturers' standards are far above the regulatory standards," said Ian Harvey, TRW's executive lead for electromechanical compatibility. "You wouldn't want somebody to make a cellphone call and the air bag goes off. That potentially could happen if you didn't take the proper precautions."

Test drives

Despite the huge increase in complexity, when NHTSA investigators conduct field tests of alleged malfunctions of Toyota throttle systems, they rarely do more than drive suspect vehicles for a few miles, test the brakes and plug a diagnostic tool into their onboard computers to look for error codes, investigation records show.

Michael Pecht, a professor of mechanical engineering at the University of Maryland who has studied sudden acceleration for 10 years, said it's nearly impossible to replicate an electronic control system fault simply by driving a short distance.

"These are not things that occur every day. If it occurred a lot, you could track it down. If it occurs once in 10,000 trips, then it is difficult to find," he said.

What's more, said Huei Peng, a mechanical engineering professor at the University of Michigan and a specialist in vehicle control systems, many of the kinds of electronic errors that a modern car is susceptible to are not detectable by the car's fault detection system.

"When there's no error code, it doesn't mean there's no error," Peng said.

Despite the potential risks associated with electronic systems, NHTSA's own reports indicate it often does not test them while investigating unintended acceleration.

In a 2005 probe of Lexus ES vehicles, NHTSA reported that its investigator reviewed two vehicles that had allegedly surged out of control, but that "no interrogation or communication with the electronic systems was performed" before giving them a clean bill of health.

Texas resident Thomas Ritter, who has a mechanical engineering degree and spent 15 years as an engineer at General Motors, Chrysler and other auto and truck makers as well as 25 years designing oil exploration equipment, believes Toyota's acceleration problem lies in the electronics.

Last July, his wife was driving her 2006 Lexus ES 330 with four grandchildren near Houston when it accelerated out of control. To avoid a wreck, she crossed four lanes of traffic before crashing into a masonry sign, totaling the car and deploying the air bags. No one was seriously injured.

"When you think about a machine operated by computers, almost anything can go wrong," Ritter said.

A 'smart pedal'

Toyota announced Wednesday that it had developed a series of fixes to prevent floor mats from causing sudden acceleration.

In 4.26 million vehicles in the U.S. and Canada, Toyota said it would cut off a segment of the accelerator pedal and then later install a newly designed pedal. It also will add a so-called smart pedal, software that cuts engine power anytime both the accelerator pedal and brake pedal are depressed at the same time.

Such software has already been adopted as a safety feature by a number of automakers, including Volkswagen, Audi, Porsche, BMW, Nissan and Chrysler, the companies said.

Independent auto safety experts said that though all of Toyota's fixes would help reduce the problem, it has not gotten to the root cause.

"These incidents are coming in left and right where you can't blame the floor mats," said Sean Kane, president of the consulting firm Safety Research and Strategies. "So they are chipping away at a problem that is widespread and complicated without having to unravel a root cause that could be very expensive."

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