When the Rubber Meets the Road

By Gregory J. Quan

Unintended acceleration claims against automakers often gain traction despite scientific findings in favor of the manufacturers.

Ford, GM, Audi, Toyota—over the past 30 years or so, unintended acceleration has killed dozens of people, according to the National Highway Transportation Safety Administration (NHTSA). If you believe victims' lawyers, the number shoots well above 100.

Lawsuits filed against the carmakers are based on one premise: Companies have liability for the defect in their products. Plaintiffs—even those who haven't suffered an "injury in fact"—have sued for millions. Personal auto insurers are suing, too, seeking reimbursement for claims they already paid to victims of the acceleration problem. Massive research efforts have been undertaken by the accused manufacturers to determine culpability. Toyota is the most recent manufacturer to come under pressure.

Ever since the fiery crash of a Lexus ES350 that killed a Southern California family in late 2009, the vehicle's manufacturer, Toyota Motor Corporation, has been subjected to intense scrutiny by its newer-vehicle owners, the federal government, and consumer groups. The publicized recording of a pre-disaster 911 call from the panicked Lexus driver provoked angry outbursts toward a company that allegedly had ignored several years of unintended acceleration complaints registered with the NHTSA.

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Once Toyota completed the examination of the sudden acceleration complaints, it initiated a series of vehicle recalls to address vulnerabilities identified in the affected models. The first effort focused on floor mats that could jam the accelerator pedal and targeted more than 4 million vehicles. The next one recalled upward of 2 million vehicles with accelerator pedals that could become harder to depress, slow to return to idle, or mechanically stuck in a partially depressed position. All told, Toyota has recalled over 8 million cars and paid $48.8 million dollars in fines to the federal government. However, regulators, consumer groups, and class-action attorneys pointed to a third culprit: namely, the electronic throttle control system that could mysteriously command a vehicle to accelerate without driver input.

Tread marks scarring highway asphalt reveal the story of a dramatic crash event.

Electronic throttle control systems . . . prompt concern that vehicles will behave contrary to driver intentions.

The Toyota hoopla points to a very real concern for insurers—how do carriers investigate accident claims where unintended acceleration is a suspected factor? Ghost hunting through complex electronic systems is not a standard accident reconstruction effort and, as such, requires the input of automotive engineers with deep understanding of the microprocessors installed in today's vehicle models.

Many newer cars and trucks, including all of the vehicles involved in the Toyota recalls, use an electronically controlled throttle rather than a traditional throttle cable mechanism. A sensor in the accelerator pedal of these vehicles sends a signal to an electronic control unit (ECU) which then operates an electric motor that opens the throttle. Under normal operating conditions a wide-open throttle accelerates a vehicle to its maximum speed.

Electronic throttle control systems allow easy integration of features, such as cruise control, traction control, and stability assistance, since the throttle can be manipulated by the ECU independently of the accelerator pedal. (NHTSA requires some of these driver-assist systems for all new vehicle models because they significantly enhance driving safety.) However, it is this exact feature that prompts concern that vehicles will behave contrary to driver intentions—fears that a faulty electronic signal or an errant fragment of software code could cause the car to accelerate without driver input. Since electronic errors do not always manifest themselves physically and are often difficult to reproduce, it is challenging to verify or refute unintended acceleration claims with certainty. Thus a thorough investigation of the electronic throttle control system is the optimal way to reveal the likelihood of a defect.

A mangled accelerator pedal in a crashed vehicle.

The driver stated that she depressed the brake pedal repeatedly to stop the car, but the damage to the accelerator contradicts her statement.

How Electronic Defects Are Investigated

The engineers begin their investigation by determining the normal operation of the electronic throttle control system in the affected vehicle(s). Every auto manufacturer uses redundant sensors to detect the accelerator pedal position and corresponding throttle position. These sensors communicate with an electronic control unit (ECU) which processes the signals and directs a small motor to open the throttle plate a specific amount.

The signal voltages used for the accelerator pedal and throttle sensors vary from vehicle to vehicle—on some, a five-volt reading on one sensor may correspond to full throttle, whereas a different voltage may be used on other vehicles. Similarly, the backup sensor(s) may use another voltage scale than the primary position sensor, but this scale may also vary among vehicles. Investigating engineers can determine how the sensors behave normally by tapping into the signal wires and observing their voltage outputs while the accelerator pedal is depressed and released.

The investigators then need to determine how the system behaves when it detects abnormal behavior. If the accelerator pedal position sensors and/or throttle position sensors do not agree with each other, the ECU is designed to switch to a condition known as "limp mode," which limits the amount that the throttle can be opened. In addition, the ECU illuminates the check engine light and stores a fault code. Engineers can intercept the position sensor signals and introduce controlled faulty ones in order to determine if the system functions as designed.

The next step in the investigation is to test the sensitivity of the throttle control system when electronic noise or other aberrations are introduced. By intercepting and controlling the position sensor signal inputs, they can measure the degree of variation the signal can tolerate before a fault occurs. If the ECU is too sensitive to variation, it could trigger the limp mode status and seriously hamper the driver's ability to operate the vehicle. In contrast, if the ECU is not sufficiently sensitive it will not detect faults that could cause unwanted vehicle behavior such as jerky throttle response or unintended acceleration.

Once the internal workings are understood, the investigators will then test the robustness of the throttle control system design by comparing it to the systems deployed by other vehicle manufacturers. Such an effort entails evaluating the type and number of position sensors used in the competing systems plus the range of sensor voltages; sensor placement and likelihood of failure; and system behavior under inputs like depressing the accelerator and brake pedals simultaneously or jamming open the throttle with a foreign object. As in the original testing process, the engineers would study the fault criteria and behavior of these other throttle control systems and test their fault sensitivity as well. If the system being examined differs significantly from those of the other vehicles tested in the protocol, then the investigation could reveal how these differences might result in divergent throttle behavior in the subject vehicle(s).

The Status

In a February 22, 2010, ABC News story, Dave Gilbert of Southern Illinois University modified an electronic throttle in order to make a Toyota accelerate without driver input and without recording an error code. In response, Toyota hired independent automotive engineers who demonstrated that the modifications he made to produce that sequence of events would be highly unlikely to occur spontaneously in a real-world scenario. Those engineers also demonstrated that vehicles from other manufacturers could be similarly modified to cause unintended acceleration.

On February 8, 2011, engineers from NASA's Engineering and Safety Center (NESC) exonerated the automaker's electronic throttle control systems. No electronic flaws were revealed in the 10 months of examination and testing by the NESC engineers. Following the NASA announcement, Transportation Department Secretary Ray LaHood identified entrapment of the gas pedal by some Toyota floor mats and "sticky pedals" in some of the automaker's models that released too slowly as probable causes of the unintended acceleration events. Event data recorder downloads from affected Toyota models implicated faulty driver decision-making as well.

Toyota remains embroiled in a complicated and contentious cleanup effort, not the least of which is a class action lawsuit over diminished market value of the plaintiffs' cars. U.S. District Judge James Selna has allowed that master consolidated complaint to continue, despite the space agency's findings. The suit is docketed for the first quarter of 2013. Before then, in late 2011, the National Academy of Sciences plans to release its analysis of all automotive electronic control systems.

In the meantime, subrogation suits from at least eight insurers are underway. The first was filed by Allstate in October 2010, with seven more following in Los Angeles Superior Court in December.

Ultimately, the bottom line for all unintended acceleration claims—no matter the automaker—is that they are very difficult product liability actions to pursue. Electronic faults are elusive to pinpoint and require expert input by skilled automotive engineers to test and verify, and they often result in a duel of competing experts. Manufacturers will deploy the biggest guns in their arsenals in self-defense, and the battle waged will be costly for all parties. That certainly does not mean the effort is doomed to failure; rather, the science supporting the claim must be beyond reproach.

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