

Fatal Telsa crash shows limits of self-driving technology

July 1 2016, by Dee-Ann Durbin



In this Sept. 15, 2015 file photo, a Tesla Model S is on display on the first press day of the Frankfurt Auto Show IAA in Frankfurt, Germany. Federal officials say the driver of a Tesla S sports car using the vehicle's "autopilot" automated driving system has been killed in a collision with a truck, the first U.S. self-driving car fatality. The National Highway Traffic Safety Administration said preliminary reports indicate the crash occurred when a tractor-trailer made a left turn in front of the Tesla at a highway intersection. NHTSA said the Tesla driver died due to injuries sustained in the crash, which took place on May 7, 2016 in Williston, Fla. (AP Photo/Michael Probst, File)

The U.S. government is investigating the first reported death of a driver whose car was in self-driving mode when he crashed. Joshua D. Brown, 40, died May 7 when his Tesla Model S, which was operating on "autopilot," failed to activate its brakes and hit a truck in Florida.

The crash raises questions about autonomous and semi-autonomous cars, their capabilities and their limits. Here are answers to some of those questions:

Q: ARE THERE SELF-DRIVING CARS ON U.S. STREETS RIGHT NOW?

A: Yes, but in limited numbers. Various companies, including Google, Ford and Uber, have test fleets of autonomous cars running in specific areas, including Mountain View, California, and Austin, Texas. Right now, those vehicles always have a steering wheel, brakes and a driver ready to take over in case of a problem, but prototype cars without steering wheels are also being developed.

Q: HOW DO THEY WORK?

A: A network of cameras, radars and lasers feeds information to the car's computers, helping to fill in the gaps in the GPS system, which knows how to get the car from point to point. Cameras let the car see what's around it, while radar senses things in the dark or in inclement weather. Lasers constantly scan the road and give a three-dimensional picture of what's going on.

Q: ARE THERE LAWS ALLOWING SELF-DRIVING CARS?

A: Right now, it's a patchwork. Eight states—including Nevada, Michigan, Florida and Tennessee—and Washington D.C. have laws allowing autonomous vehicles. Other states have legislation in the works. Later this summer, the federal government is expected to release guidelines for the safe deployment of autonomous vehicles.

Q: WHAT ARE THE BENEFITS OF SELF-DRIVING CARS?

A: Self-driving cars have the potential to save lives by anticipating accidents before they happen. Intel CEO Brian Krzanich said Friday that 90 percent of car accidents are caused by human error, and distracted or drowsy driving accounts for some 13 percent of those crashes. The accidents cost about \$870 billion a year globally.

Q: CAN I BUY A SELF-DRIVING CAR?

A: No. A few automakers offer cars and SUVs with semi-autonomous modes that can perform some functions without help from the driver, including maintaining a set speed, braking, changing lanes and even parallel parking. Semi-autonomous features can be found on high-end vehicles from Tesla, Mercedes-Benz, Infiniti and Volvo. Some lower-priced models have them, too. Toyota, for example, plans to make automatic emergency braking standard on its vehicles by 2017, ahead of a self-imposed deadline of 2022 that most automakers have agreed to.

Q: WHEN WILL COMPLETELY SELF-DRIVING CARS BE AVAILABLE TO CONSUMERS?

A: That's not yet clear. Volvo plans a large-scale test of driverless cars in Sweden next year. Google wants to make cars available to the public around the end of 2019. BMW, Intel and Israel's Mobileye have teamed up to roll out the cars by 2021.

IHS Automotive, a consulting firm, predicts that the U.S. will see the earliest deployment of autonomous vehicles, with several thousand on the road by 2020. That number will rise to 4.5 million vehicles by 2035, IHS says. But even if the vehicles are on the road, they might not be in your garage. The earliest [self-driving cars](#) might be on-demand taxis, employee shuttles or other shared vehicles.

Q: WHAT ARE THE TECHNICAL CHALLENGES TO GETTING AUTONOMOUS CARS ON THE ROAD?

A: Driverless cars need detailed maps to follow, and companies are still mapping roads. They also can have trouble staying within lanes in heavy rain or snow. And, as the Tesla crash showed, there will always be scenarios that driverless cars can't foresee or navigate correctly. Brown's car didn't see an oncoming tractor-trailer because it was white against a brightly lit sky. Tesla CEO Elon Musk said the [car's](#) radar is also designed to tune out what looks like overhead signs to prevent false braking.

Q: HOW COULD THE TESLA AUTOPILOT NOT SEE SOMETHING AS LARGE AS A TRACTOR-TRAILER?

A: Raj Rajkumar, a computer engineering professor at Carnegie Mellon University who leads its autonomous vehicle research, said computers can't be programmed to handle every situation. But Tesla may need to adjust its radar, he said.

Tesla would not comment directly on the radar and computer programs, but the company issued a statement saying that it continually advances its software by analyzing hundreds of millions of miles of driving data. The National Highway Traffic Safety Administration is looking at the design and performance of Tesla's system as part of its investigation.

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Citation: Fatal Telsa crash shows limits of self-driving technology (2016, July 1) retrieved 2 May 2024 from <https://phys.org/news/2016-07-fatal-telsa-limits-self-driving-technology.html>

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