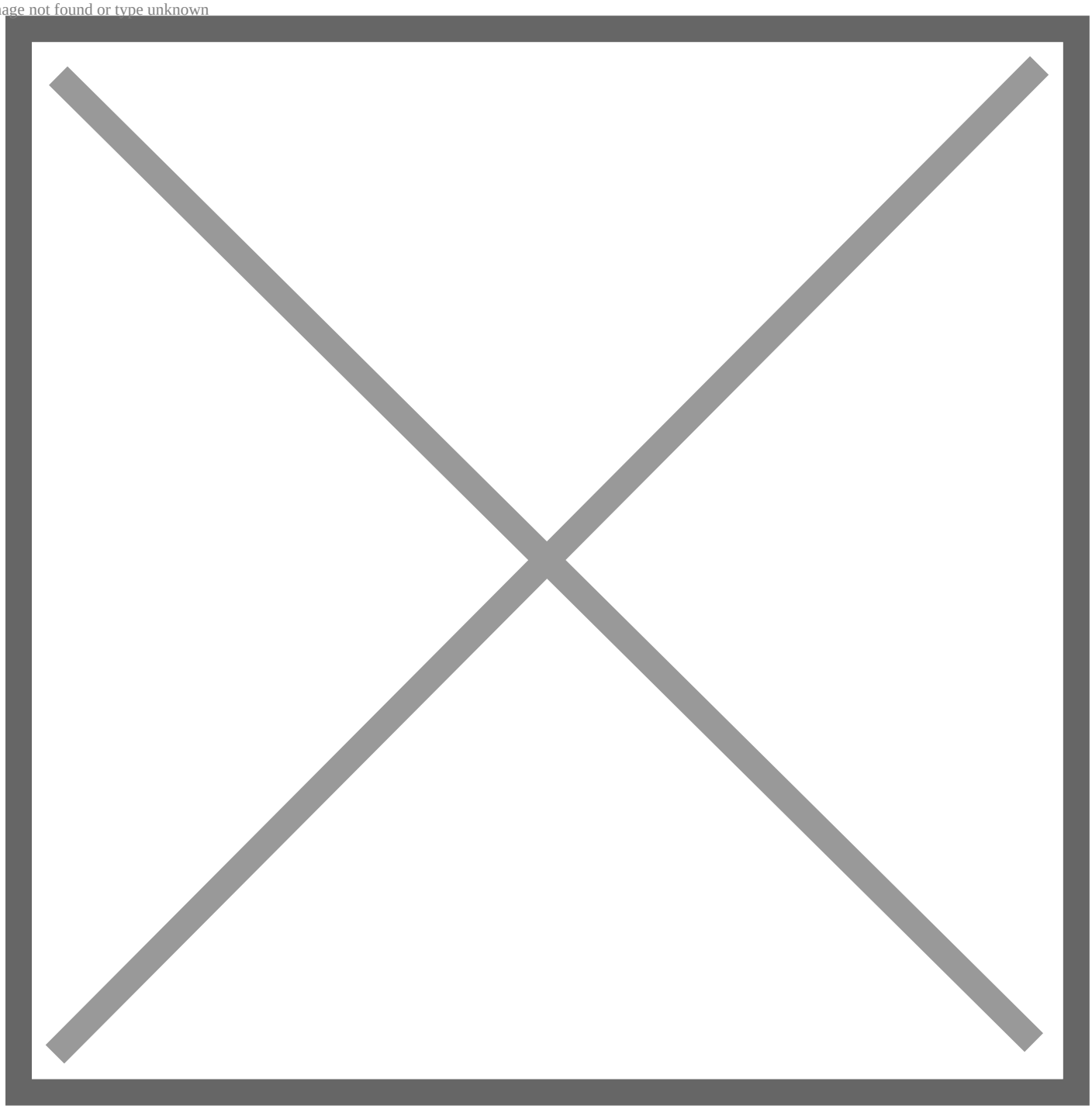
Robot Cars That Play Well With Others

March 24, 2022

Image not found or type unknown



What if autonomous vehicles are so safe they frustrate human drivers and produce road rage?

That was a hypothetical question until a few years ago when the first autonomous vehicles started appearing on the road. Some humans thought the very cautious test cars were a hazard because they clogged up traffic. The cars were safe, but were they generating ill will?

Tech developers began rethinking the parameters of autonomous vehicle driving. This has led to a call for "roadmanship," or the concept that vehicles need to display a range of normal behavior to be accepted by other road users. It's like the slow car in the fast lane of the expressway – something that seems safe to the driver but can actually create a danger as antsy faster-moving cars stack up behind or human drivers try to cut into the large open gap this has created.

Toyota's Collaborative Safety Research Center (CSRC) recently partnered with experts at the University of Michigan's Mcity on two projects that began the effort to establish parameters of road courtesy. They both took common driving situations and looked at a large section of human-driven cars to establish what "normal" looks like.

"As we start to implement vehicle automation, we're evolving our thinking around safety to consider human behavior," said John Lenneman, senior principal research scientist at CSRC. "It's also how well they interact with road users. We want vehicles that play well with others, not creating new potential safety hazards. How to measure that and compare to human driving remains an open question."

CSRC's first roadmanship study looked at vehicles turning left against oncoming traffic. The researchers wanted to know how much of a gap human-driven vehicles would require before making the turn. The point was to establish norms. Turns that are too cautious frustrate drivers waiting behind. Turns that cut it too close seem dangerous and rattle oncoming traffic.

One challenge was finding the right intersection to study. The team settled on a corner in Jackson Hole, Wyoming that is recorded 24 hours a day by video cameras. After amassing hours of footage and converting images into a bird's-eye-view orientation, researchers used machine learning to measure how drivers reacted to oncoming traffic. More than 5,000 driving situations were documented, with different gaps deemed acceptable and unacceptable. The situations included cases in normal weather, in rain and in snow.

One of the most interesting findings was that people use distance as the main factor when deciding it is safe to turn at the right-turn intersection. This suggests they're making a judgment based on what they're seeing rather than mentally calculating the speed of oncoming traffic or the time it takes to make the turn, Lenneman said.

The research team used a similar approach to study how drivers interacted on a five-point roundabout. For drivers entering these circles of moving traffic, the angle of approaching cars and trucks mattered even more than distance, Lenneman said. The drivers appeared to be making a geometric assessment of the trajectory of oncoming vehicles to determine if it was safe to proceed, he said. Because these results differed from the right-turn intersection, it showed that what is considered good roadmanship may depend on the situation.

Mcity expects to build on these studies with other research to determine how human-driven vehicles can safely coexist with self-driving cars, said Greg McGuire, managing director of the Ann Arbor, Michigan-based research center.

"The challenges don't end with other vehicles," McGuire said. "Human drivers must also respond to and exert far more caution around other people riding bikes, motorcycles, and walking. AVs will need to do the same."

The roadmanship studies can help engineers quantify driving specifications as self-driving cars are tested and eventually produced, CSRC's Lenneman said. Much more research is needed, but over time, developers will be able to map more normal human road behavior into steering, braking, acceleration and other driving actions. The

long-term goal is for autonomous vehicle developers to take these roadmanship issues into account while still mitigating potential accident risks due to unsafe maneuvers by human drivers. The end result will be a more harmonious relationship between human drivers and their autonomous counterparts.