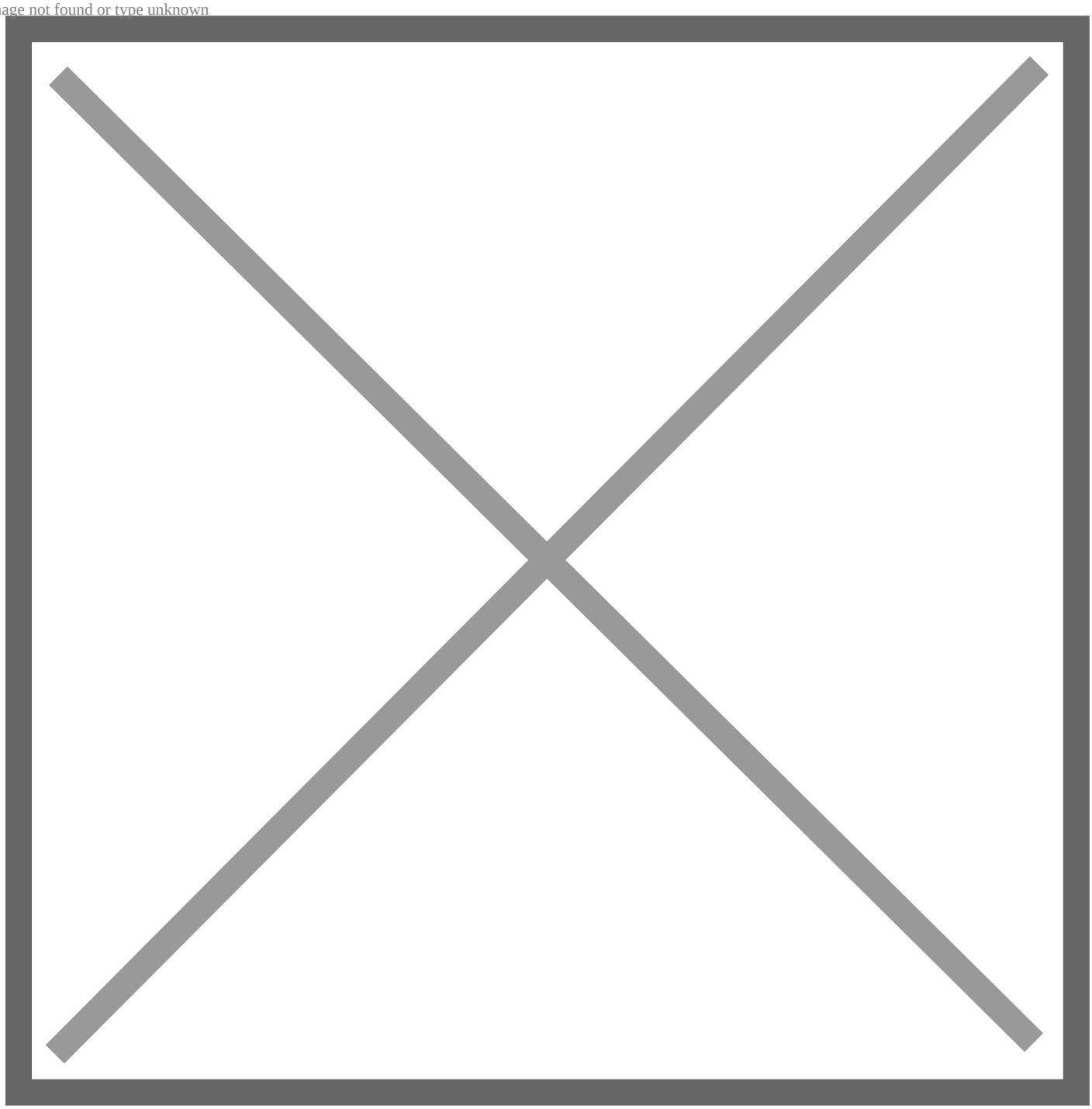
CSRC’s Pedestrian Research Becomes More Predictive

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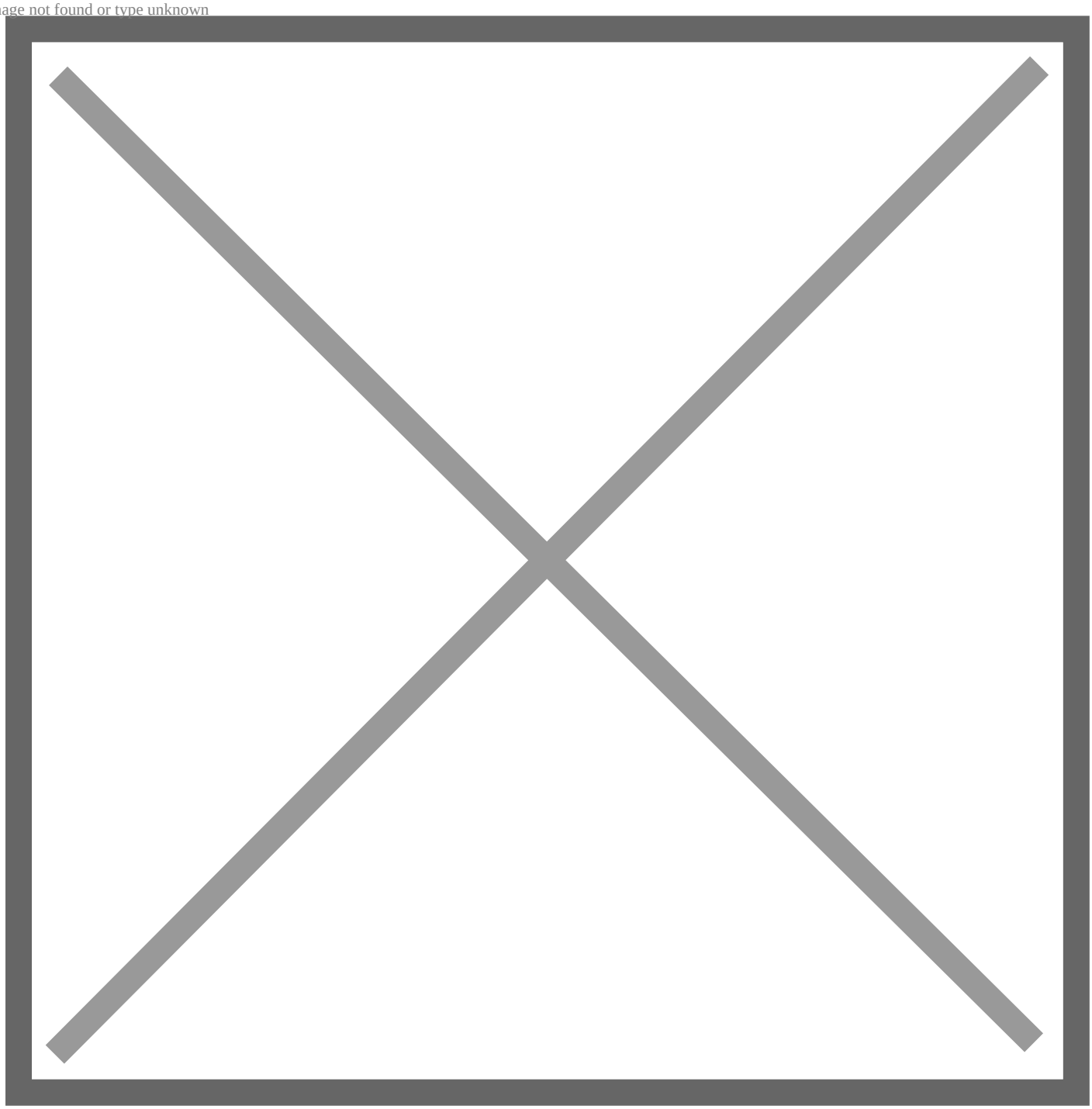
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Since its founding in 2011, Toyota's Collaborative Safety Research Center (CSRC) has been interested in understanding how to mitigate crashes among pedestrians and cars. The interest has grown over the years as technology such as Toyota Safety Sense has developed to aid drivers in being more alert and responsive to their surroundings.

Early CSRC projects tried to gain a better understanding of how drivers and people on the street communicate with each other. The working assumption at the time – more than a decade ago – was that there would be some eye contact or some other non-verbal cues between them. That turned out to be rare. But the studies gained a more nuanced understanding of how pedestrians and drivers do make decisions about each other.

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That led to a focus on “gray areas,” or situations where some pedestrians choose to cross a road while others play it safe. CSRC researchers found that pedestrians were, for the most part, very good at determining whether it was safe to cross by observing the speed of oncoming vehicles and estimating the time it will take them to get close.

“Humans are really good at observing biomechanical motions and making judgments about them,” said Josh Domeyer, principal scientist at CSRC. “It was hard at first to turn that into rules for machines to follow. We started to ask what about human perception helps us judge the behavior of pedestrians and vehicles.”

There were other insights. A look at infrastructure showed that drivers and pedestrians don't communicate as much as when there are things like stop signs and traffic signals. The signage or warning lights can communicate for people walking, and drivers know to be more alert. All of the communications insights informed the development of an international safety standard for pedestrian communication, known as ISO 23735.

In another key set of studies, researchers at the Massachusetts Institute of Technology AgeLab helped CSRC create a dataset of car-pedestrian interactions that is open to other researchers and companies in the industry. Like all of CSRC's research, Toyota publishes the findings to outside groups because the goal is to improve safety as widely as possible.

Over the past decade, the research has started to focus on making cars less reactive and more proactive, said Bryan Reimer, a research scientist at MIT's Center for Transportation and Logistics and co-founder of the university's Advanced Vehicle Technology (AVT) consortium. The Toyota datasets have been used to develop models, which are the key to program systems to be able to be more predictive, he said.

Traditional technology senses that a pedestrian is in the path of the car, and so it applies the brakes. That's a reactive system, Reimer said. A proactive system, by contrast, is monitoring the surroundings around the vehicle to detect the movement of pedestrians as well as other road users, he said. That means the most current advanced safety systems can predict the likely trajectory of your car and everything around it to anticipate what's about to happen. This is one of the keys to self-driving cars.

"Automated vehicles require proactive decisions," Reimer said. "Consumer vehicles, to date, have largely been built with reactive systems. As computational capabilities and sensing capacities increase, we're going to be seeing more and more deployments of proactive systems in the future."

In June, CSRC invited the media to a demonstration at the American Center for Mobility test track in Ypsilanti, Mich. Reporters saw the specialized pedestrian dummy used to test the effectiveness of automatic braking systems. Toyota-sponsored research helped the industry understand how radar reflects off of human skin, how to read limb motions and gait, typical body proportions. It all was used to develop a family of prototype dummies – an adult, child and bicyclist, said Jason Hallman, senior manager at CSRC in Ann Arbor, Michigan. This kind of dummy is now used in testing programs such as at the Insurance Institute for Highway Safety, the National Highway Traffic Safety Administration, and EuroNCAP.

"Before CSRC, these Automatic Emergency Braking systems were rare, and there was no accepted way to measure how well they could avoid pedestrians in the real world," Hallman said. 'CSRC's work helped lay the foundation for these specialized mannequins and test methods, which are now used for ratings in the U.S. and across the world."

CSRC has learned a lot about pedestrian-car interactions, but there is more work to be done. The next steps in CSRC's pedestrian research program involve a study being conducted with Purdue and Ohio State looking at more advanced ways to detect pedestrian limb motions.

Another project is under way at the University of Virginia to find ways to enhance the front-end structures of trucks to reduce injuries in pedestrian-vehicle crashes.