Neural Networks can Give Driverless Cars Smarter Maps

Autonomous vehicles rely on GPS data and mapping apps, but when they're wrong, the cars are left in the dark.

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A lot of the focus on the future of self-driving cars is, understandably, on the cars themselves. But what about the roads?

Driverless technology will change how many use transportation, but it will also have a big impact on how streets, highways and surrounding areas are designed. Down the road, autonomous traffic could mean narrower roads, fewer parking lots, safer sidewalks and more flexible use of different forms of transportation, to name a few.

Before we get from here to there, however, driverless cars need to be more reliable in a variety of situations. And one key to making them more reliable starts with the mapping systems they use.

Mapping the Future

Driverless cars run on information, the most basic being how to get to where they are going. And just like human drivers in unfamiliar territory, driverless cars rely on GPS data and mapping applications to help them along. These apps are almost always right, but when they are wrong, they leave an autonomous vehicle in the dark. A human driver can improvise, try alternative streets, even — gasp — ask someone for directions, but a driverless car could be frozen in confusion.

Though rare, mistakes do happen when you're "using your GPS." The government-run GPS.gov is quick to point out, however, that the problem is not with the GPS of satellites.

"The problem is in the mapping software used by the devices/apps" created by private-sector companies, the website says, while offering advice on how to report mapping problems. As GPS.gov, which is run by the multiagency National Coordination Office for Space-Based Positioning, Navigation, and Timing, points out, a GPS signal supplies only a dot on a grid (showing your position). Mapping software puts the streets, buildings and everything else around that dot.

So, more reliable autonomous vehicles need more reliable apps, which is where better artificial intelligence can help. Maps made by Google and other companies often rely on aerial images to get the lay of the land, but turning those images into maps typically involves a lot of manual transcription. Automating the process can help, but at times, aerial imaging doesn't show the whole road because of trees or building blocking the view, or even shadows obscuring part of the picture. To date, machine systems haven't been able to intuit where the road is going if they can't see it.

A team of researchers at MIT's Computer Science and Artificial Intelligence Laboratory have come up with a neural network that takes a more human-like approach to filling in the gaps, improving the accuracy of automated mapping.

You Are Here

The system, called RoadTracer, is 45 percent more accurate than current systems, according to a CSAIL report posted on Science Daily. RoadTracer would be very helpful with rural areas where maps are missing existing roads, but it also is effective in cities, researchers said. Using aerial images of New York City, RoadTracer was able to correctly map 44 percent of road junctions, a rate more than double the 19 percent produced by traditional approaches.

Those traditional approaches involve an method called segmentation, in which pixels in an aerial photo are identified as either roads or something other than roads, and a post-processing step fills in the gaps where the photos are incomplete or vague, the researchers write. But that process isn't always definite, and the misidentification of even one pixel can be amplified into a bigger mistake on a map.

RoadTracer instead uses a neural network to look around the area where the view is blocked or murky, determines the point most likely to be the road, and processes that data one a step at a time.

"Rather than making thousands of different decisions at once about whether various pixels represent parts of a road, RoadTracer focuses on the simpler problem of figuring out which direction to follow when starting from a particular spot that we know is a road," Fayven Bastani, a graduate assistant on the team led by MIT professor Mohammad Alizadeh, said in the report. "This is in many ways actually a lot closer to how we as humans construct mental models of the world around us."

The researchers say RoadTracer has several advantages. The first is the low error rate, which makes it more practical than tracing maps manually. The incremental approach is also highly advanced, making it easier to correct errors or account for changes. RoadTracer is also more cost effective than other alternatives, according to researchers working on the program. And Alizadeh said RoadTracer could be effective for large outfits like Google, as well as smaller organizations trying to curate and correct map errors.

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