Self-driving car trajectory tracking gets closer to human-driver ideal

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Have you taken an Uber ride and disagreed with the "fastest" route that the GPS app suggested because you—or the driver—know a "better" way?

For society to truly embrace self-driving cars, the experience of passengers must feel just as comfortable as any trip with a human driver—including choosing the "best," or more comfortable, way to get there.

It turns out that this is an extremely difficult computational challenge, but researchers are getting us a little bit closer to that ideal comfy ride.

They have devised a new optimization method for tracking the trajectory of self-driving cars that reduces errors, all the while keeping computation demands low. They published their results in *IEEE/CAA Journal of Automatica Sinica*.

While operating a vehicle, a human driver can be thinking about and responding to multiple phenomena from moment to moment: how fast to go, what to expect on the street, safety considerations, all the while also making decisions on—and constantly re-assessing—a trajectory that is above all comfortable for themselves and their passengers. This ability to prioritize comfort, and the attempt to replicate it in robots, has been the focus of a great deal of recent research.

An important aspect of this is the trajectory tracking problem—ensuring a vehicle follows a desired route as closely as possible in a given amount of time. It sounds simple because we humans do it all the time without paying much attention, but mathematically it really isn't simple at all. Popular ways of dealing with the problem have the major drawback of excessive computational requirements.

"With an autonomous vehicle, all this has to be performed in what we'd call the 'brain' of the autonomous vehicle," says paper author and engineer Kayvan Majd of Arizona State University. "We set ourselves a challenge that is simple to state but hard to achieve with respect to trajectory planning: A passenger in a self-driving car has to feel as if it were driven by a human."

A couple of attempts in recent years have been made to reduce this computational "overhead," but in doing so, they re-introduce large errors with respect to the trajectory.

What makes the new method such a leap forward is that it ticks all the boxes of stable trajectory tracking with minimal errors with respect to position, velocity and acceleration, while keeping computational overhead down.

The next step for these specialists is making their method more widely applicable, by taking into account additional and even more realistic

variables such as taking into account tire forces and side slipping. This will allow the cars to operate at high speed and under harsh road conditions more accurately.

More information: Keyvan Majd et al, A stable analytical solution method for car-like robot trajectory tracking and optimization, *IEEE/CAA Journal of Automatica Sinica* (2020). DOI: 10.1109/JAS.2019.1911816

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