

Google Self-Driving Car Project

Monthly Report

July 2015

This month, we took a couple of our Lexus self-driving cars to Austin to begin testing in a few square miles of town north and northeast of downtown. We want to get more experience testing our cars in new locations that have different driving environments, traffic patterns and road conditions, and in Austin, we'll have to be ready for anything from pedicabs to pickup trucks! It's also important that we learn how different communities perceive and interact with self-driving vehicles, and we know we can count on Austinites for some great feedback.

Activity Summary (all metrics are as of July 31, 2015)

Vehicles

- 23 Lexus RX450h SUVs – currently self-driving on public streets in Mountain View, CA, and Austin, TX
- 25 prototypes – 5 are currently self-driving on public streets, mainly Mountain View, CA

Miles driven since start of project in 2009

“Autonomous mode” means the software is driving the vehicle, and safety drivers are not touching the manual controls. “Manual mode” means the safety drivers are driving the car.

- Autonomous mode: 1,101,171 miles
 - Manual mode: 842,101 miles
 - We're currently averaging ~10,000 autonomous miles per week on public streets
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Distracted Driving

Earlier this month, project director Chris Urmson posted a [blog](#) with an important observation – that we seem to be getting hit by a lot of drivers who are distracted and not paying attention to the road. Although the AAA Foundation for Traffic Safety says that summer is the “[100 Deadliest Days](#)” for teenage drivers, what we're seeing goes well beyond an age group or specific time of year.

Driving is actually really complex – a driver driving at 30 mph sees an average of [1320 pieces of information every minute](#). Yet most of us think it's pretty mundane and that we're above average drivers, giving us the confidence to multitask and take our eyes off the road. Cell phones are the most common distractors, with [~660,000 drivers](#) using cell phones or other devices while driving at any given daylight moment across America. These folks are unfortunately [23 times more likely](#) to be involved in a crash or near crash event – see for yourself with [AT&T's texting while driving simulator](#).

Check out Chris's [blog](#) for more on why this is motivating us to work toward building a fully self-driving car.



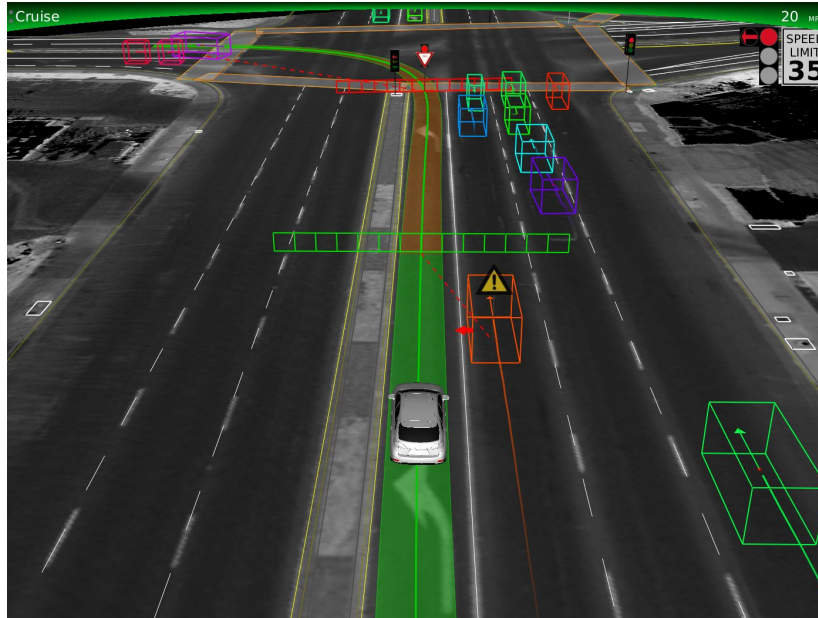
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Scenes from the Street - *each month we'll give examples of everyday situations we encounter*

Understanding other vehicles' intentions. Our vehicles understand the intentions of other vehicles on the road – such as when they want to enter our lane – and can respond accordingly. It's not just about detecting a turn signal – our sensors can detect subtle shifts in other vehicles' movement and consider where our car is relative to others, as well many other factors, to help it understand what's happening in a given situation.



In this situation, we detect that the car to the right of us (the red box) wants to come into our lane – as indicated by the caution sign with a red left turn arrow – and slow down to allow them to enter.

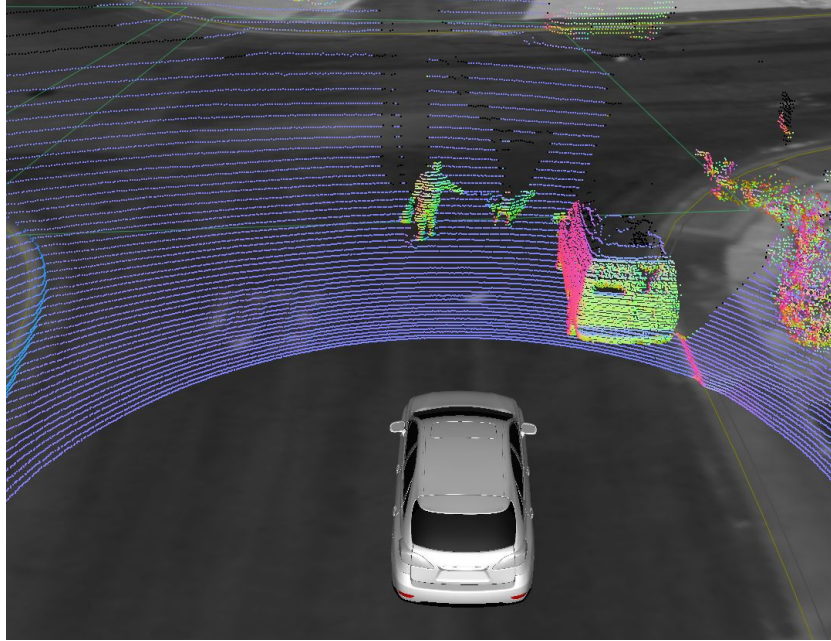


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Responding to things we've never seen before. Teaching a self-driving car to handle every possible situation it could encounter on the road is not feasible, as there's an infinite number of possibilities. Instead, our technology gives it fundamental capabilities to respond correctly to unexpected situations as they happen, like when we encounter a dog-powered skateboard.



In this case, we didn't have to explicitly program a "dog-powered skateboard" algorithm; instead, our vehicle was able to understand there was a person here, and how they were moving, and then was able to slow down and give them space.



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Traffic Accidents Reported to CA DMV

Given the time we're spending on busy streets, we'll inevitably be involved in collisions; sometimes it's impossible to overcome the realities of speed and distance. Thousands of minor accidents happen every day on typical American streets, 94% of them involving human error, and [as many as 55% of them go unreported](#). (And we think this number is low; for more, see [here](#).) In the six years of our project, we've been involved in 15 minor accidents during more than 1.9 million miles of autonomous and manual driving combined. Not once was the self-driving car the cause of the accident.

(CA regulations require us to submit CA DMV form OL316 Report of Traffic Accident Involving an Autonomous Vehicle for all collisions involving our cars. The following summary is what we submitted in the "Accident Details" section of that form.)

July 1, 2015: A Google Lexus model autonomous vehicle ("Google AV") was traveling northbound on Grant Rd. in Mountain View approaching the intersection of Phyllis Ave. and Martens Ave. in autonomous mode. The two vehicles in front of the Google AV, the Google AV, and the vehicle behind the Google AV were all traveling at a steady speed of ~15 mph. While approaching a green light intersection with stopped traffic on the other side of the intersection, the first vehicle decelerated and came to a stop, keeping clear of the intersection. The vehicle directly in front of the Google AV and the Google AV also decelerated and came to a stop with adequate and similar stopping distances. About 1 second later, the vehicle approaching from the rear struck the Google AV at ~17 mph and did not appear to decelerate prior to the collision. At the time of the incident, the driver, co-driver and rear passenger of the Google AV reported some whiplash. They were driven by other team members to a local hospital, where they were evaluated by medical staff and cleared to return to work. The driver of the other vehicle reported minor neck and back pain. The Google AV sustained minor damage to its rear bumper. The other vehicle sustained significant damage to its front end.

(This incident was the impetus for our [blog post](#) last month.)

What we've been reading

- Reid Hoffman on LinkedIn, "[Driving in the Networked Age](#)", July 2015
- NPR, "[The Big Red Button](#)", July 2015
- Autoblog, "[Another Google self-driving car crash? Ho-hum](#)", July 2015
- Austin American-Statesman, "[Google expands self-driving car project to Austin](#)", July 2015
- AP, "[2 visions emerge for getting self-driving cars on road](#)", July 2015
- Wired, "[Inside the fake town built just for self-driving cars](#)", July 2015

