NUTONOMY QUARTERLY AV TESTING REPORT

FIRST QUARTER 2017

BACKGROUND

nuTonomy is a start-up spun out of MIT that develops software for self-driving cars, or autonomous vehicles (AVs). We aim to deploy the world's first fully autonomous, mobility-on-demand service. We began testing our AVs in 2014, and we have been testing our AVs on public roads in Singapore since last summer. In January, we started testing on public roads in Boston. This Report summarizes our testing in Boston in the First Quarter of 2017.

Last fall, Governor Baker and Mayor Walsh signed Executive Orders that set the conditions for the testing of AVs in Massachusetts. On November 16, the City of Boston, the Massachusetts Department of Transportation, and nuTonomy executed an MOU authorizing nuTonomy to test AVs on public roads in Boston, subject to state approval. On December 23, MassDOT granted our application to test AVs in the Commonwealth.

The City of Boston and nuTonomy jointly created a Test Plan, which divides our testing into phases. In Phase B1, nuTonomy was asked to complete 100 miles of autonomous driving in the Raymond L. Flynn Marine Park, during daylight hours in good weather. In Phase B2, we were asked to drive an additional 100 miles in the Marine Park, and these miles would include driving in the evening and in inclement weather.

It is important to note at the outset that, before nuTonomy tests new AV software on the public roads, it must pass our internal road release process. First, we test the new code in computerized simulations, based on real-world traffic scenarios, including some we have encountered on the public roads in Singapore. Next, we conduct safety and maneuver tests with our AVs on private roads in a closed course environment. Finally, when the updated code has passed the simulations and the closed course testing, we test it on the public roads. At all times during on-road testing, a safety driver monitors the AV, ready to take over manual control immediately.

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SUMMARY

Miles Driven

nuTonomy has completed over 230 miles of operating in autonomous mode in Boston as of mid-March. We began testing in early January 2017. On January 29, we completed Phase B1's 100-mile target, and on February 14, the City approved our request to move onto the next phase. On March 2, we completed Phase B2's additional 100-mile target. During Phase B2, we drove approximately 70 of the 100 miles in evening hours. We also drove some of the second 100 miles in light rain, though we did not drive in autonomous mode while snow was falling.

Locations Driven

We have been testing our AVs on the public roads of the Raymond L. Flynn Marine Park, particularly Drydock Street, Black Falcon Avenue, and smaller connecting roads.

Crash Reports

We have not produced any crash reports, because our AVs have not been involved in any collisions during our testing in Boston.

Failures with Autonomous Mode/Disruptions While Driving in Autonomous Mode

We did not experience any unanticipated failures with or disruptions while driving in autonomous mode. As we explain below in greater detail, in certain traffic scenarios our safety drivers take over manual control because of known limitations of the current state of AV software.

Takeovers

nuTonomy's safety drivers are instructed to take over manual control in any situation in which they feel uncomfortable. During the First Quarter, our safety drivers have taken over manual control of AVs in these situations:

1. when emergency vehicles were present and active (e.g., a police cruiser, with sirens flashing, pulled over another vehicle on the side of the road);
2. when other vehicles were driving the wrong direction on a one-way street (i.e., the one-way section of Black Falcon Avenue);
3. when unwieldy construction vehicles or equipment (e.g., cranes or forklifts) were obstructing the roadway near our AVs;
4. when vehicle fueling was taking place on the road surface (not uncommon along a stretch of Black Falcon Avenue); and,
5. when other vehicles were exhibiting erratic behavior near our AVs.

A safety driver's decision to take over manual control in a given situation does not necessarily indicate that continued autonomous operation in those situations would be unsafe. Because we instruct our safety drivers to err on the side of caution, we expect that takeovers will occur in many situations in which the AV would have handled the situation without incident. We are continuously improving our AV software, and we are confident that our AVs will be able to handle each of these situations without a takeover after further development.

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LEARNING

What We Have Learned

nuTonomy's testing on the public roads in Singapore prepared our AV software to operate in dense urban environments. Testing in Boston has introduced us to new and interesting technical challenges that AV software will need to overcome before AVs can be deployed in a commercial mobility-on-demand service. What follows are several examples of challenges that we have encountered during the First Quarter:

1. MBTA Silver Line buses: our software has learned to correctly classify Boston's articulated buses;
2. Heavy machinery: the active construction sites and industrial operations in the Seaport have given us a variety of unconventional vehicles and obstacles to identify and maneuver around;
3. Vehicles "blocking the box": at certain hours, traffic on Drydock Street waiting for the stoplight at Summer Street routinely backs up into the adjacent intersection between Drydock Street and Harbor Street, creating complicated interactions for vehicles;
4. Speeding: our AVs are programmed to travel under Boston's default speed limit of 25 miles per hour and we have successfully shared the road with vehicles travelling at much higher speeds; and,
5. Seagulls: our AVs have repeatedly encountered seagulls on the road surface and flying within the range of our sensors—we now identify them correctly.

* * *

nuTonomy has recently requested that the City of Boston approve us for Phase C of our testing, which we anticipate will include an expanded testing area. We look forward to their response. We thank Mayor Walsh and the City of Boston, Governor Baker and MassDOT, Massport, and the Economic Development and Industrial Corporation of Boston for their continued support for AV testing in Massachusetts. We are excited to help build the future of transportation in Boston.

An MBTA Silver Line bus as seen by the camera (inset) and the sensors on the car.

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A seagull as seen by the camera (inset, bottom right) and the sensors on the car.

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