



Q4
2018

AUTONOMOUS VEHICLE TESTING **PROGRESS REPORT**

Quarterly update for the City of Boston on Optimus Ride's autonomous vehicle testing program.



Optimus Ride Inc. is a self-driving vehicle technology company. Emerging from Boston's vibrant robotics ecosystem, we carefully bring together the promise of self-driving technologies with real-world considerations. We design our software to enable efficient, sustainable, and equitable mobility systems and solutions.

Introduction

By the end of December 2018, Optimus Ride has driven over 3,700 miles autonomously in the State of Massachusetts. Nearly half of the driven miles were completed around the Raymond L Flynn Marine Industrial Park Zone, continuing the interaction with the typical urban environment of the City of Boston. We also continue development for our growing commercial AV service in South Weymouth, which has grown steadily since launching in May of 2018.

In light of launching our commercial service we've also begun tracking key customer satisfaction and usage metrics, including but not limited to "Net Promoter Score", "Product-Market Fit", and other high-level ridership patterns. This is crucial for us to continuously refine our service quality and availability.

Lastly, in October, our participation in the 2018 edition of the HubWeek Robot Block Party continued to garner excitement for Optimus Ride as we invited visitors to participate in our raffle for a ride in our self-driving vehicles. Lucky winners can expect to catch a ride in the first half of 2019.

Research Achievements

Safety is our key priority. We are continually improving the tools and processes used for testing the system. This includes testing in simulation, vehicle testing on closed-courses, and vehicle testing on public roads. We analyze the results from our real world testing to update test procedures and processes. This data is also used to inform improvements to our simulation.

Driving on public roads allows us to encounter a multitude of scenarios organically, including edge-case scenarios. Some of these scenarios have led us to investigate how these can be addressed to improve our system and ride comfort. Examples of such scenarios include intersection handling with vehicles that do not come to a full stop or respect right of way, handling large vehicles that make wide turns or cut across our lane during turns, and double-parked cars that obscure the field of view for oncoming traffic. Additionally, changing urban infrastructure impacts our driving protocols. Such instances include a changing built landscape due to construction in the booming Seaport district and police manually directing traffic movement. These real and complex events we encounter on the road allows us to test our system with scenarios which provide another perspective on the robustness of our system.

Daily testing also allows Optimus Ride to acquaint our systems with the particularities of the Seaport district such that we can ensure safe driving specific to the Marine Flynn Industrial Park Zone:

- Heavier traffic during rush hours related to commuters
- Potential use cases ranging from commuter's main destination (i.e. first and last mile mobility solutions) to short distance trips during lunchtime

During this quarter we completed testing with incremental advances to our technology in obstacle detection and recognition. For example, we assessed several sensors to determine if it has suitable performance for our operating requirements. The sensors are evaluated in real world conditions where several factors like performance in inclement weather, obstacle detection, and computational load can be analyzed. We have also improved our ability to detect obstacles and made progress in improving the classification of objects, such as distinguishing between cars, trucks, and buses.

The solid performance of our vehicles ensures each of our vehicles meet our safety and operational standards.

Takeovers

The driver takeover methods used in the Optimus Ride vehicles have been designed to be inlined with best practices in order to ensure the Human Machine Interface (HMI) is clear, consistent, gives context, and provides the necessary feedback about the system.

The system is designed to disengage autonomous control and enable manual control by the safety driver when a takeover is initiated. The safety driver can safely and quickly take control using the brakes, throttle or steering wheel.

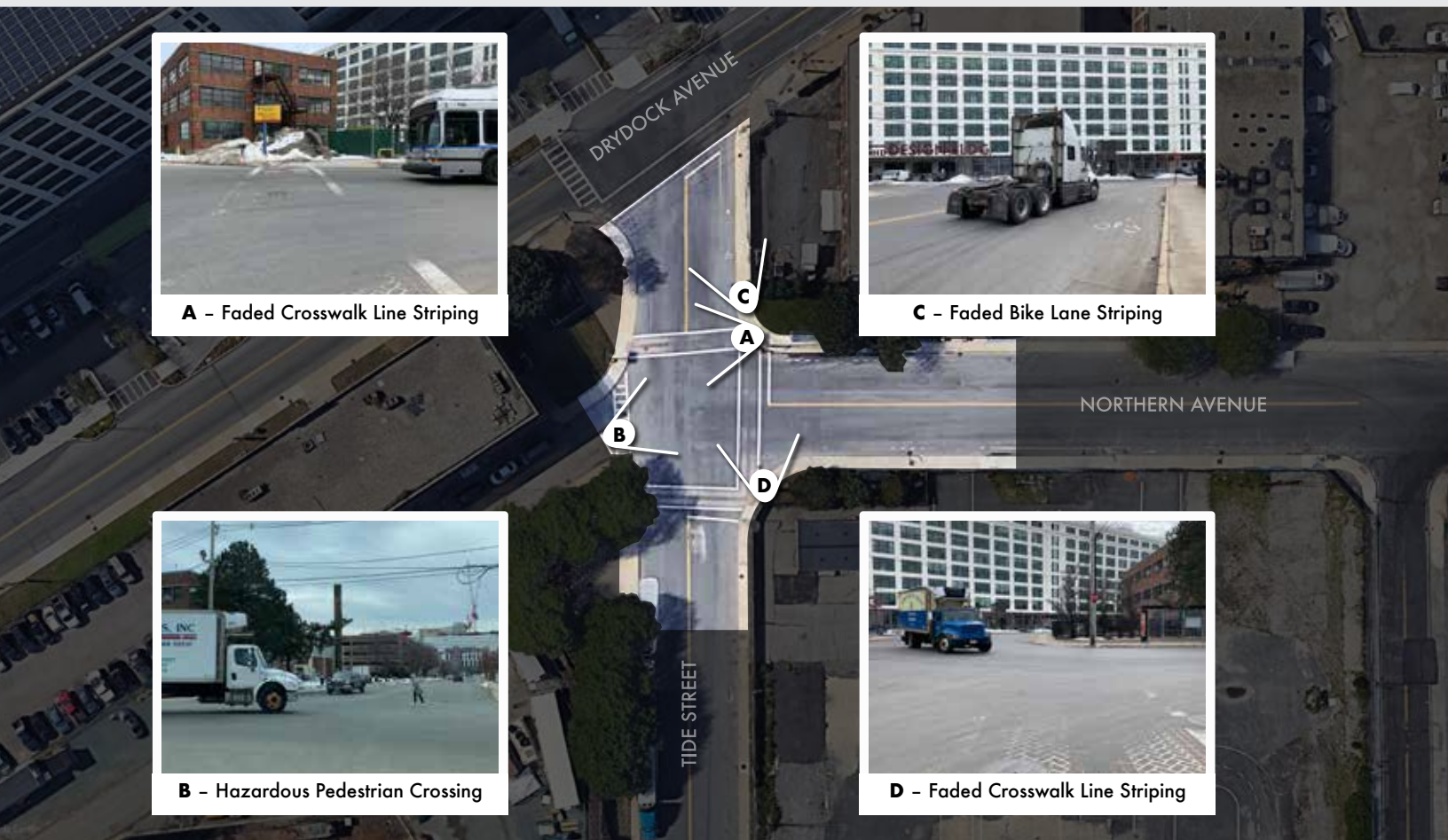
Examples of takeovers include driving conditions where the common speed is over the speed limit. As we are looking to be responsive to other users of the road, this would be a circumstance where our safety drivers would take over to drive in pace with the common speed. While our vehicles may be focused on Vision Zero and keeping to the 20 MPH speed limit, it is the case that other drivers in the zone may not be abiding the speed limit. Unsafe behavior by others, including rolling stops, not stopping at all, and inappropriate maneuvers such as illegal U-turns also prompt takeovers from our safety drivers. These are ongoing road behaviors that compromise the safe operation of autonomous vehicles and are industry-recognized challenges. We believe these challenges underscore the importance of utilizing safety drivers while operating autonomously.

Potential Improvements

The two primary areas of improvement continue to be:

- **Re-stripping of roads (see graphic below)** – On wide roads like Northern Avenue and Tide Street the lack of striping on wide streets continues to create confusing road conditions for pedestrians, bikers, and manual drivers alike. The lane striping is significantly faded on the sidewalks of the Northern Ave and Tide St. intersection, making the pedestrian crosswalk imperceptible at a four-way intersection that is not governed by either a traffic light or walk signal. While our vehicles have pedestrian crossings and other lane configurations built into our operational domain, poor lane markings can result in other drivers around us not understanding why we are slowing down or stopping, and potentially leading to those drivers getting frustrated and/or unexpectedly passing our vehicles. Lastly, this intersection is also dimly lit at nighttime, further compromising safe driving and pedestrian crossings.
- **Max speed enforcement** – Optimus Ride has observed maximum vehicle speeds are constantly violated along certain streets (e.g., Drydock Avenue, Massport Haul Road), thereby creating potential hazardous condition for merging traffic and pedestrians.

Additionally, the increase of construction vehicles and passenger buses parked along Tide St and Northern Ave continues to be a challenge for all vehicles, due to the increase of construction and tourism during the fall season.



Safety Record

Optimus Ride continues to foster a Safety Culture by maintaining and continuously improving the safety of our daily activities and overall operations record. We maintain an excellent safety record and have no accidents, failures, or disruptions of our vehicles to report.



Optimus Ride safety driver and software operator at our South Weymouth deployment site.

Thank you

We are thankful to the State of Massachusetts and the City of Boston for supporting the development of the autonomous vehicle industry. As the only Boston-based startup in the autonomous vehicle technology industry, we are excited to grow our operations in the state and continue pursuing efficient, sustainable, and equitable mobility systems and solutions.