



December 21, 2018

Miguel Acosta
Chief, Autonomous Vehicles Branch
California Department of Motor Vehicles
2415 First Avenue
Sacramento, CA 95818

Dear Mr. Acosta,

Apple is testing automated driving systems (ADS) on public roads in the San Francisco Bay Area with a fleet of modified Lexus RX 450h vehicles. This is Apple's first disengagement report since we received our AV Testing Permit and covers the period from April 14, 2017 to November 30, 2018, as required by 13 CCR § 227.50, *Reporting Disengagement of Autonomous Mode*.

Our Approach to ADS Safety

Safety is our highest priority. Apple's approach to disengagements is conservative, because our system is not yet designed to operate in all conditions and situations. To support this approach, our public road testing policies require drivers to proactively take manual control of the vehicle any time the system encounters a scenario beyond our currently proven abilities. In addition, our software self-monitors and returns control back to the driver when it encounters any errors or issues during operation. This allows for us to prioritize the safe operation of our vehicles above all else at all times.

More information about Apple's approach to ADS safety will be detailed in our upcoming Voluntary Safety Self-Assessment.

Disengagement Types and Definitions

Apple's approach to assessing disengagements has evolved over the reporting period. Initially, as we gained valuable insight from all disengagements, our disengagements were categorized into two primary classes: Manual Takeovers and Software Disengagements.

Manual Takeovers occur when the drivers or operators decide to take back control from the vehicle software. These takeovers primarily result from the conservative operational constraints we adhere to during our testing. Examples of these operational constraints include disengagements at the earliest indication of emergency vehicles, construction zones, or unexpected objects in and around the roadway. Drivers and operators are also instructed to manually takeover any time they deem necessary.

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Software Disengagements occur when monitoring systems detect an issue with the input, output, or decision-making ability of the ADS. This class of disengagement is further categorized as:

- *Perception*: The sensing system could not sufficiently localize, detect/classify an object, or track the objects in the surrounding environment.
- *Motion Planning*: The path planning system could not generate a motion plan to provide to the control system.
- *Controls*: The vehicle or actuator systems did not respond appropriately or as expected within the specified design of the system.
- *Communications*: An ADS communication error, such as a timing issue or dropped messages between processes.

Beginning in July 2018, we began to categorize our disengagements in greater detail. In particular, we began to flag certain disengagements as Important Disengagements. *Important Disengagements* occur in situations that might have resulted in a safety-related event or a violation of the rules of the road.

Reporting Disengagements

The attached report applies the two methodologies described above for identifying reportable disengagements during two distinct time periods. For the period since we received our AV Testing Permit through June 2018, this report documents all disengagements we experienced on public roads in California. For the period beginning in July 2018 through the remainder of the specified reporting period, this report documents Important Disengagements. Accordingly, this report is over-inclusive when disclosing disengagements prior to July 2018. Between April 2017 and June 2018, our vehicles drove 24,604 miles autonomously and experienced 40,198 Manual Takeovers and 36,359 Software Disengagements. Since July 2018, our vehicles have driven 56,135 miles autonomously and have experienced 28 Important Disengagements, two of which occurred in connection with collisions where 3rd party motorists struck Apple test vehicles.

Protecting the safety of all road users will always remain our primary focus. As we continue to improve our capabilities and tools, we expect our future reporting will focus on Important Disengagements.

Please contact me if you have any questions regarding the report.

Sincerely,

A handwritten signature in cursive script that reads "Jaime Waydo".

Jaime Waydo
Senior Director, Autonomous Systems Engineering
Apple