![University of Michigan Mcity logo]

March 11, 2021

The Honorable Pete Buttigieg
Secretary of the U.S. Department of Transportation
1200 New Jersey Avenue, S.E.
Washington, DC 20554

Dear Secretary Buttigieg:

On behalf of the University of Michigan's Mcity research center, I am writing in response to
Docket No. NHTSA-2020-0106, in which the National Highway Traffic Safety Administration
seeks comments about potentially developing a framework for automated driving system (ADS)
safety.

Lower-level automated vehicles are penetrating the market quickly, and vehicles at higher
automated levels (Levels 3-5, as defined by SAE) are being developed by many manufacturers.
We applaud the Department of Transportation for the timeliness and foresight of this ANPRM.

Mcity has sponsored several research projects to study the testing and simulation of ADS. We
are also actively working with organizations such as the SAE's International Alliance for
Mobility Testing and Standardization (IAMTS) consortium, which focuses on defining best
practices and a standard process for developing scenario-based testing concepts that are crucial
to ADS verification and validation (V&V).

This letter consists of two parts:
  ● An overview of Mcity activities in ADS V&V
  ● Our thoughts on a possible ADS safety framework

<u>Overview of Mcity activities in ADS V&V</u>
Mcity is a public-private partnership among industry, government and academia, led by the
University of Michigan (U-M). U-M researchers have collected millions of miles of naturalistic
driving data, developed naturalistic driver models, defined a scenario library, and designed an
ADS testing process called the Mcity ABC Test.

Mcity proposes the ABC Test concept serve as a blueprint as NHTSA considers developing an
ADS safety framework. The ABC Test protocol, including a possible scoring system, is detailed
in two white papers published by Mcity:
  • "Mcity ABC Test: A Concept to Test the Safety Performance of Highly Automated
    Vehicles"
  • "Conducting the Mcity ABC Test: A Testing Method for Highly Automated Vehicles"

We have demonstrated the ABC Test concept in both real vehicle testing and in simulations. As of today, digital twins of the Mcity Test Facility are available from eight commercial software companies and two from open source software. The virtual Mcity has been used by many researchers for ADS development.

Our comments in the next section are based on prior Mcity research and testing. They reflect the views of Mcity researchers, and not necessarily those of Mcity industry members.

Mcity comments on the ADS safety framework

Questions Nos. 6-7:
We do not believe an ADS safety framework should go into the sub-systems related to "sensing," "perception," "planning," and "control." Instead, NHTSA should focus on setting expectations for overall vehicle performance.

This is because ADS systems may consist of elements of end-to-end solutions, or have multiple modules following a voting scheme in forming the final control decision. In other words, an ADS may not have a clear single stream of sensing, perception, planning, and control functions. As such, the relationship between sub-system performance and final vehicle performance is unclear.

Questions Nos. 1-5:
We do not believe public road testing can be used as a reliable metric to measure the safety performance of an ADS as part of a NHTSA safety framework, due to the large variation of traffic, road and climate conditions nationally. Closed-track scenario-based testing, however, is extremely suitable as a core element of an ADS safety V&V process. A library of scenarios can be defined, and multiple test cases for each scenario can be conducted to verify the behavior competence of the ADS. The scenario-based approach is easier for government oversight because the process is well defined, and independent sampling and verification by a third party is possible.

We believe the main goal of the NHTSA safety framework should not be to "prove" an ADS is safe (which is not possible). Instead, it should be to ensure an ADS exhibits "behavior competence" within the operational design domain (ODD) of the ADS.
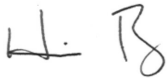
The ODD specifically defines the conditions under which the ADS is designed to properly operate, including when and where not to drive, which is as important as being intelligent when an ADS is driving. A clearly defined ODD also makes ADS V&V testing well-defined and easier to conduct.

We have a question related to the scope of the contemplated ADS safety framework. There are emerging ADSs that were designed explicitly for the purpose of goods delivery, and some of them are very small, lightweight, and operate at very low speeds. It would be helpful to make it clear whether they will fall under the same safety framework.

Finally, we have designed an Mcity ABC Test demonstration using three Mcity-developed ADS research platforms. This demonstration includes seven scenarios and shows the key elements in conducting an ADS V&V process. We are ready to share what we've learned, if that is of interest.

Thank you for the opportunity to comment on NHTSA's plan to possibly develop an ADS safety framework. Please do not hesitate to contact us if you have any questions, or if you would like to learn more about the Mcity ABC Test.

Sincerely,

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