AUTONOMOUS VEHICLES

UPDATE ON VALIDATION OF THE SAFETY OF AUTONOMOUS VEHICLES

by Richard A. Wilhelm

A challenge confronting the acceptance and deployment of autonomous vehicles (AVs) is validating the safety of a vehicle operated not by a human, but rather by an automated driving system (ADS). Currently, auto manufacturers certify that their traditional vehicles comply with Federal Motor Vehicle Safety Standards and their certifications can be confirmed through uniform, objective and repeatable testing. However, autonomous vehicles driven solely by an ADS will not comply with some of those standards as written, i.e., those predicated on human operation. Also, standards and testing procedures relating to safe vehicle operation by an ADS don't yet exist (only safety "guidance" has been offered).

While the National Highway Traffic Safety Administration (NHTSA) has not yet proposed ADS-related safety standards, it is currently undertaking two efforts relating to validation of the safety of AVs in the context of existing safety standards. Those efforts are,

1. The evaluation of GM's Petition for Temporary Exemption from certain safety standards so that GM can operate a fleet of "pure" self-driving vehicles (AVs without any manual controls for driving) based on the Chevrolet Bolt EV in a rideshare program.

2. The determination of how it can validate a pure self-driving vehicle for compliance with performance and other requirements of existing safety standards that were written for vehicles having human drivers.

In the first effort, NHTSA has to evaluate GM's claim that if the exemptions are granted, its pure self-driving vehicle will either provide a safety level at least equal to the safety level of the standards from which it is exempted or it will not unreasonably lower the safety level of that vehicle.[1] In the second effort, it has to determine how to test pure self-driving vehicles to ensure they comply with safety standards revised so as not to be predicated on the vehicle having a human driver. Presently, NHTSA has sought and obtained comments on GM's Petition. It is soliciting comments through its Advance Notice of Proposed Rulemaking (ANPRM) on the "feasibility and permissibility of a number of approaches to addressing the challenges in certifying or verifying compliance to certain crash avoidance (100 series) [safety standards] for ADS-DVs [Automated Driving System-Dedicated Vehicles] without manual controls." These efforts raise the question of whether NHTSA can make the determination that pure self-driving vehicles that are exempted from the standards will nonetheless be safe without yet having a full understanding of how it will evaluate the performance of the technology in those vehicles under those standards.

GM's Petition for Exemption

GM filed its Petition for Exemption on January 11, 2018. NHTSA did not publish the Petition for Notice and Comment until March 19, 2019. The delay in publication resulted from a NHTSA rule blocking publication of a petition if the submission is deemed incomplete. On December 26, 2018, NHTSA unilaterally changed that rule to allow the publication of GM's incomplete Petition. The comment period closed on May 20, 2019.

The safety standards for which exemptions are being sought by GM fall into four general categories.

1. Safety standards that require certain controls, displays or warnings for the safe operation of the vehicle by a human driver. GM states that the ADS doesn't need controls and will directly monitor and react to the information that would have been displayed or that would have prompted a warning.

2. Safety Standards with test procedures premised on a human driver for demonstrating compliance with performance requirements in the standard. GM states that the vehicle will fully comply with standard 135 (Light Vehicle Brake Systems) and will "meet the functional requirements and purposes of other standards…" (i.e., The ADS will take the place of the driver and perform the driving related tasks required of the human driver.)

3. Safety Standards that assume the vehicle has a "driver's seat" – which the GM vehicle does not technically have. GM states that there is no need to protect a driver from the steering wheel during a crash when there is no steering wheel.

4. Safety Standards that address a driver's ability to see to the side and rear of the vehicle. GM says the ADS's sensors do not use or need mirrors. The sensors will perform the task required of the human driver.

GM's Petition asserts that

> Each proposed exemption from an FMVSS should first be analyzed to determine whether the subject system or equipment achieves the safety purpose and intent of the Standard at issue. If the subject system or equipment achieves the safety purpose and intent of the Standard (thus proving safety equal to that of a vehicle that directly complies with the Standard), then NHTSA should find that deployment of the equipment is consistent with the Safety Act.

GM also asserts that the Agency should consider the safety level of the vehicle in the context of the vehicle's operational design domain (ODD) – low speed urban driving. That is, the vehicle simply will not be exposed to many of the risks or the magnitude of the risks the standards are designed to protect against.

GM supports its claim that its pure self-driving vehicle achieves the safety purpose and intent of the relevant standards largely by describing and illustrating how the ADS will perform the tasks of a human driver, how it will monitor and react to inputs about vehicle operation, and how it will see to the side and rear of the car. In certain other cases, GM states that it **will run** tests, including crash tests and simulations. The described testing was not submitted with the Petition or by the time

NHTSA published the incomplete petition 14 months later. NHTSA has not indicated that the test data has been received under a request for confidential treatment.

NHTSA's ANPRM

Eight days after the comment period on GM's Petition closed, NHTSA filed an ANPRM seeking comments on various approaches for revising certain FMVSS compliance procedures for vehicles that lack "traditional manual controls necessary for human drivers to maneuver the vehicle and other features intended to facilitate operation of the vehicle by a human driver." The agency noted that it could simply remove references to traditional manual controls and drivers from those standards, but the focus in the ANPRM is on how NHTSA would then test such vehicles to ensure they comply with the revised standards.

Specifically the agency is seeking comment on six different approaches for testing pure self-driving vehicles. The first is testing the pure self-driving vehicle "as is." The existing ADS would control the vehicle during compliance testing. However, the test procedure may be outside of the ODD of the vehicle, rendering the vehicle incapable of being tested. The second is requiring the manufacturer to preprogram a library of compliance test procedures into the ADS that would be accessible by test engineers. Implementation of the library is of concern to NHTSA. The third is developing an external controller ("interface, translator and/or communication protocol") that allows the test engineer to direct the ADS through the test procedure. However, no such controller has yet been developed. The fourth would use test simulations to "determine how a modelled computer system will respond to a given set of inputs." Here, NHTSA saw an issue with repeatability, a requirement for statutorily mandated objective test procedures. The fifth would rely on technical documentation supplied by the manufacturer. An issue is how to verify that vehicles on the road match the documentation. The sixth and last would require the use of surrogate vehicles with traditional human controls along with evidence that the relevant aspects of the surrogate and pure self-driving vehicle are identical. Establishing equivalence was noted as a possible issue.

Discussion

NHTSA has never before evaluated a petition for exemption involving autonomous vehicles. In its notice, NHTSA observed "… this is the first petition whose analysis by NHTSA will involve a comparison of (1) a vehicle in which all driving decisions…would be made by an ADS to (2) a vehicle in which almost all of those decisions are made and implemented by a human driver." 84 FR 10182, 10183.

So what standard and what data will NHTSA use to evaluate whether granting GM the requested exemptions from multiple standards will either not unreasonably lower the safety level or be as safe as a fully compliant non-AV version of the Bolt EV? Does NHTSA need to evaluate whether the vehicle will perform as well as a compliant vehicle? If the answer is yes, can NHTSA make that determination without understanding how it will evaluate the performance of the technology in those vehicles under the particular standards? The ANPRM suggests that NHTSA may currently lack all the knowledge and tools necessary to do that.

Or, is such a standard too high, essentially foreclosing the possibility of any exemption being granted? That is, a manufacturer should not have to show compliance in order to get the exemption. If a lesser standard is appropriate, should it evaluate whether the pure self-driving vehicle "achiev[es] the safety purpose and intent of the standard" as GM asserts? And, is it sufficient for GM to explain without data how its ADS technology will perform as the standards require to establish safety equivalence? After all, this approach is the core of the Safety Self-Assessments encouraged by NHTSA AV Guidance 2.0 and 3.0 (i.e., explain to states and consumers how the auto company took into account certain safety elements in the design of the autonomous vehicles being tested in the US). For some standards that do not have performance and testing requirements, this approach may be sufficient. For standards with performance and test requirements, likely not.

In reviewing GM's Petition, NHTSA has to decide whether describing how a system works is sufficient to demonstrate that it will work. NHTSA's ANPRM may be suggesting that a more rigorous evaluation based on real information and data is needed. None of the approaches it outlines in the ANPRM include descriptions and explanations. Also, NHTSA's labelling of GM's Petition as incomplete suggests that a more data-driven evaluation will be required. However, given NHTSA's hands-off approach so far, what will be required is not certain. Hopefully, NHTSA will be guided by knowledge it gains through comments on its ANPRM.

[1]The standard required depends on whether GM seeks the exemption to (1) make easier the development or field evaluation of a new safety feature or (2) make easier the development field evaluation of a low-emission vehicle. 49 USC 30113(b)(3)(ii)-(iii). GM is seeking the exemption under both prongs but places more emphasis on the second prong.

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