NHSTA so far has no regulation of the ADS vehicles. It only has “Voluntary Guidance” which is just echoing back to industry what some of the leading providers in the industry were already doing. This is quite an affront to public safety with ADS vehicles from several providers running wild without any federal government mandates being complied before deployment on public roads within their ODD and therefore creating unknown and potentially unreasonable risk to the public. NHSTA should not be waiting for fatalities to happen before getting serious about regulation.

We do not let planes take off unless they have met many regulatory standards, we do not let drug companies just start selling whatever they claim as the next breakthrough drug without having them go through a rigorous FDA approval process, so why are we letting thousands of pounds of vehicles driven by machines go on the roads without any real mandatory regulation?

L3:

As a matter or urgent priority, the L3 category should be banned in the US or there should be no steering control by the car in normal driving conditions (i.e. not emergency type situations). L3 cars can take full control of steering (besides brakes and accelerator) for multiple number of seconds (basically behave like L4 during this time even though they are not) and then annoy the driver with some indication and bring the car to a stop if the driver does not show engagement and this is enforced through some monitoring means (e.g. sensing if person is applying torque to steering wheel or using a camera to see face to find distraction etc.). This is obviously flawed because it is almost impossible for ordinary humans to remain engaged in the driving task when the car drives fine on its own on mundane highway conditions for example, easily creating a false sense of trust and allowing to easily distract with scenery, cell phone texting, etc. The logic is fundamentally flawed in that the AV is claiming that it can drive very reliably (better than most competent human driver, being able to perceive every situation) for few seconds and then it cannot, this makes no sense. Does the system oscillate between high and low levels of performance between driver disengagement and reengagement (this is a rhetorical question)? And what about the lag in driver reengagement when the driver is distracted for multiple seconds? Not to mention the distraction is being exaggerated by flashy displays that the electronics companies are eager to load up the dashboard with (e.g see latest announcements/videos in CES 2021 – Mercedes Benz for example). Using fancier algorithms to monitor user engagement (e.g by using a camera facing the driver) is not a cure for the problem (it has safety value though when the computer does not take away steering control) that should not exist in the first place.

A glaring case of above-mentioned dangerous deployment is Tesla cars. They have been openly jeopardizing safety of their drivers and more importantly of the non-consenting public on road alongside Tesla cars. Besides several crashes with fatalities due to faulty behavior in earlier versions of their AV offerings, NHSTA has been very much in bed with them. We also see horrifying videos on the internet of people sleeping while driving Tesla cars on highways (by easily circumventing the poorly designed driver monitoring), with a disaster waiting to happen when Tesla car sees a scenario on the highway that it cannot understand and requires immediate driver reengagement, or the car simply fails to correctly perceive some novel situation on the highway. Not to mention their misleading marketing “Autopilot” and “FSD (Full Self Driving)” which violates the voluntary guidance by NHSTA. The truth is that Tesla users are paying thousands of dollars more for the comfort of hands-free and eyes-off driving more than safety and they help Tesla test their cars in an uncontrolled manner on public roads i.e the road users are being forced to participate in dangerous real-world car testing of “beta” level software. The car is being looked at like a consumer entertainment type device (“early adopters”) overlooking the safety priority. This activity has particularly increased with their release of so called FSD (which is a veiled claim

to L5 basically) Beta where Tesla drivers that are not certified test drivers but are promotors of Tesla with their you-tube channels act as test drivers and freely experiment anywhere they like on public roads (it is easy to find videos of these on the internet proliferating by the day and where you can see many cases of clearly faulty (safety compromising) behavior by Tesla cars showing clearly they are anything but FSD) basically acting like test drivers but without any ODD restrictions and without any permission. With this free testing and using public as pawns/guinea pigs, Tesla is trying to fulfil its ambition of building a L4/L5 system eventually. This must stop immediately. The driver disengagement was already a hard lesson learned by Uber AVs murder of the pedestrian because of their pedestrian AI, even with so called qualified test drivers in their cars. Was this fatality not enough to learn the lesson that non L4/L5 steering control is obviously flawed from the get-go? How many innocent people must die for NHSTA to wake up and do its job? Another company operating like Tesla is comma.ai, many videos on the internet showing free range driving on public roads for long durations without any hands on the steering.

L4/L5:

NHSTA needs to get serious about regulating L4/L5 vehicles. It needs to start working immediately towards an enforceable framework for safety requiring but not limited to the following:

1. Require all existing automotive standards compliance – certificates of compliance of ISO26262, SOTIF, UL4600 etc. and periodic and surprise audits in companies. The audits are not just about showing evidence of procedural documentations and records but NHSTA officials must be allowed access to closed course testing and be able to try market vehicles of the company on such courses on their own during the surprise audits. The surprise audits should include interviewing the engineering team to make sure they are not being made to work under stress for example to meet artificial deadlines driven by monetary goals and that the team has internalized safety i.e the company is breathing safety every day, not just using “safety culture” as an empty phrase. Laws need to be passed for whistleblower protection within companies to ensure whistleblowers can flag a subculture that may be loose on safety principles for example.
2. Research in establishing comparison standards for AV driving competency with competent human driver, not average human driver. A competent human driver among other things is the one who has many miles of driving experience in a variety of traffic situations and geography, has no speeding tickets, was never in an accident of her/his own fault, is always well rested, alert, never drunk, keeps his/her cool while driving, never engages in road rage, and drives defensively in general. This is not an idealization, there are many drivers like this.
3. Require clear demonstration proof that the cars can perceive and act properly in novel scenarios – not show crash causing behavior, show crash avoiding behavior in general while not showing erratic/unnaturalistic behavior freaking out other human drivers in harmless novel scenes, basically how a competent human driver would. The present technology of AI/Machine Learning can generalize up to some extent but there needs to be clear evidence that the vehicle has generalized intelligence to an extent that it demonstrates an intrinsic sense of what safety is (what a crash is and what crash avoidance is for example) i.e that safety is a top priority followed by naturalistic driving as a 2nd priority, like humans who have the intrinsic understanding that there is bodily suffering and pain when there is crash, not to mention empathy to other users (including animals) on the road. The human can perceive many novel situations without requiring practice and train over millions of miles or thousands of iterations over each scenario. Car companies cannot be simply allowed to train themselves away on a scenario-by-scenario basis because the scenarios are virtually infinite, they must show that the

intelligence is able to generalize and demonstrate an intrinsic sense of safety (I am not talking about AGI which is about general intelligence like in humans that can do many different domains but just to demonstrate a general intelligence within the domain of driving). Towards this end and while allowing companies the design freedom (e.g not requiring them to necessarily have a physics based parallel safety layer for example), NHSTA needs to develop independent testing for getting a high degree of confidence whether a L4/L5 car has such an intrinsic sense of safety. NHSTA may need to think out of the box about how to test this. One idea is that it should design a course where it can present very novel scenarios (that are mostly straightforward for human driver) but so that companies simply do not train themselves away on these, the test should be secretive and if they fail to pass without zero crashes, they cannot be given any hints on even what kind of scenarios they failed. NHSTA itself probably does not have the competency of maintaining secrecy but they can consult DoD and others in the military to either adopt their secrecy protocols or probably the more practical choice is to consider even "outsourcing" this task to them [talk to congress if necessary, to allow for the cross agency activity and be sufficiently budgeted]. A few examples of such scenarios [this is obviously in public domain so cannot be used as is but they are just to inspire novel scenario creation]:

a. Balloon/feather/plastic bag or other light object is floating and slowly descending or ascending at some distance from the AV car. Does the car come to a stop until the balloon clears up (thinking it is to avoid colliding with the balloon) or does it ignore the balloon and continue driving like a human would? How does this change if there is some car from behind that is too close to be safe for the AV car to stop suddenly?
b. Does AV vehicle recognize puddles and potholes and how does it deal with them?
c. What happens when AV notices an object in the scene (static or dynamic) that is in the collision path that it has never seen during training? i.e in the absence of knowing that there is something but not knowing what it is (the "other" category, vs a known or "no object" category), does it stop or try to maneuver to avoid colliding with the object OR does it go to the minimal risk condition? OR does it continue to drive and collide with the object?
d. Related to above question, what happens when it sees a person or a group of persons crossing in front of the AV car that are wearing different Halloween costumes (their natural faces covered, only eyes visible)? And a person in Halloween costume dragging his bike with him?
e. Does the vehicle freak out when seeing a burning bush on the side of the road?
f. Behavior when tree is in the motion of falling in the path of driving.
g. Behavior when it sees a tree in the motion of falling away from the path of driving (does it freak out?)
h. While in motion, behavior when vehicle in front is releasing some materials e.g some debris coming off its cargo (e.g leaves flying off from a landscape company truck), ladder slipping etc.
i. While in motion, behavior when vehicle in front is leaking oil, paint or water.
j. A car in front of AV (both in motion) and the front car is convertible with a kid sitting in a way facing the AV car and making faces (when in motion), does AV freak out (stop suddenly or other erratic safety jeopardizing behavior)?
k. Can AV vehicle identify the signage on electronic boards that can display different messages on the side of the road or on overhead bridges etc for directing/informing drivers?
l. How does AV vehicle behave when motorcyclists are zipping past cars in a zigzag manner (on a highway but also in non-highway)? A human driver in this situation will

understand at a high level what is going on and simply maintain lane and speed as if nothing is happening as a best safe outcome (i.e let the motorcyclists successfully carry out their "pleasure algorithm" that in turn is based on the assumption that cars will continue their normal behavior), does the AV car freak out (stop or drive in a chaotic manner potentially causing accident or freaking out other drivers)?

m. Does the AV car recognize expressions of frustration (through facial or other bodily gestures) from human actors in the scene and are these logged and later examined to find out why AV behavior was annoying to the actors? (basically, unnaturalistic driving not necessarily causing safety risk)

NHSTA can also additionally have non-secretive testing. For both these kind of tests, multiple AV vehicles from the same vehicle provider bought randomly must be tested and all must have zero crashes as a minimum qualification. Once any provider has achieved pass status, additional novel scenarios must be created to challenge the AV on an ongoing basis. Human mind is highly creative at doing this, but these should be such that a competent human driver can handle them. Only when a car has zero failures with such intense testing should it be allowed to operate on public roads. This should be a minimum qualification. Additional qualification could be to create scenarios that a competent human driver may not do well but the machine is expected to perform well because for example, it has much more sensing capability (multi-modal and multi-instance sensors covering full 360 degree scanning much faster than a pair of human eyes) and lower lag in sensing and acting compared to the human.

4. Require all passengers in the ADS vehicle to wear a seat belt. For example, Waymo presently (as seen from their public safety documents) does not mandate, only encourages seat belt wearing. The states may not require but federal standard should be there.
5. Establish labeling requirement for vehicles to clearly display signs on the outside including the Lx label allowing other road users to be able to identify the AV car to let them keep appropriate distance in case they do not trust them.
6. Must require simple outside electronic (with sufficient lighting to read in the dark but not blinding to the eye) display that AV writes as a way of messaging to other road users for safety purposes (not for marketing/advertising purposes) e.g to give an indication for pedestrian or bicyclist to pass (like how human drivers wave their hand inside the car after making eye contact with the pedestrian/bicyclist).
7. Increasingly large number of pedestrian/bicyclists are dying because of cars, the AV must be tested to make sure it can handle a lot of novel scenarios in these cases.
8. Regarding active sensors - radar and lidar for example, the industry has yet to show how they are handling or going to handle multiple vehicles sensor interfering with each other because of intersecting FOVs (Field of View), this is going to be there both on highway and even worse in urban environments, particularly given companies are advertising 360 degree sensing capability. Requirements must be put in terms of a) Being able to detect interference or prevent interference by design (if preventing, what is the compromise in sensing capability e.g slower sensing due to time sharing) and b) Audit the behavior during interference, how is safety affected? E.g if radar output is severely degraded, probability of object detection may decrease (or the probability of false detection may increase) to the point of jeopardizing safety (one cannot drive reliably when the sensors are getting blinded much like glare in the eyes of human driver). Does the vehicle when it detects interference go to a minimal risk condition or continue to operate in degraded state using camera output alone for example? If so, was it verified to operate with camera only operation during all of the testing? Many murky questions open up

with this thorny problem of interference but hardly any company is reporting this in their safety reports. Companies are in effect following a dangerously lazy approach of “wait until the problem shows up (with many more AVs)”, NHSTA needs to get ahead of this and not wait for injuries and fatalities to show up before taking action.

9. Requirements on clear communication with those residing in the ODD by the provider and the state government at least a month ahead of deployment with sufficient details on a) Why the ADS deployment was approved on their roads and what is the expected benefit and some details of testing done b) How to signal to the ADS for stopping etc and how to make “eye contact” with the vehicle etc. c) What laws are in place to protect the road users from ADS vehicle mistakes (redressal, compensation etc) and how to file complaints against the vehicles.

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