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Implications of safety definition for automated driving

The developments of advanced sensing, communication and vehicle technologies in the past two decades have significantly changed the technological composition of road vehicles. It has become an expectation that automated vehicle technologies, including driver assistance system that are already in use on the roads and future automated driving systems at their mature state will have the potential to reduce crashes, prevent injuries, and save lives. To fulfill the promise of eliminating most crashes, automated vehicles must be designed safe. While the industry has been working diligently to ensure functional safety of automated vehicle functions, questions remain -- how should safety of automated vehicles be defined, quantified and measured? As the safety operation of automated vehicles must interact with nested transportation systems including infrastructures, human drivers, pedestrians, how would the automated vehicles impact the safety and efficiency of the future transportation systems? This talk addresses implications and gaps in defining safety of automated vehicles, intending to foster a discussion among the workshop participants.

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“Implications of Safety Definition for Automated Driving”

This presentation was verbal only, and a written version was not available.

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The presentation focused on liability as a major obstacle. Some of the key points suggested include:

- Removing the human driver from the chain of events that lead to crashes (NHTSA)
- The creation of new safety hazards (creating some new risks because of automated vehicles)
- False positives
- The importance of media between information source and receiver
- Challenges related to control
  - NP-hard problem with deep RL
  - Lack of data representation of all scenarios
- Interaction with drivers/pedestrians
  - Defense driving and testing that humans do
- Human backup
  - Uncertainty in driver reaction
  - Driver monitoring
- Liability definition
  - Nominal (meeting standards)
  - Substantive (based on performance)
- Safety definition
  - Fail-safe (railways)
  - Safe life (aviation)
- Safety states
  - Normal
  - Fail-safe
  - Fail-soft
  - Fail hazard
  - Markov process connecting them

Discussion

- Petros: raised questions about ignoring the fundamental speed vector and considering only the longitudinal impacts, and wondered whether frequent low severity collision is acceptable to people

- Matt discussed the transition from manual to automation and whether there is a need to retrain the drivers.
  - The driver should be a backup driver. But the more people drive the automated system, the harder it is to train them (they don't know what they don't know)
  - Comparison to pilots Is not accurate. Pilots are professionals. Drivers don't know how to drive professionally
- Chumin mentioned that Safety should come first
  - There are trade-offs between Safety and efficiency
  - How to define hazard and for what risk tolerance
- Monty discussed Safety as an "after-the-fact" statistic that the public and decision-makers would not tolerate versus the risk as a "before-the-fact" variable that people can be more tolerant with

Wei Bin Zhang holds appointments as a Senior Research Scientist at University of California at Berkeley and at Lawrence Berkeley National Laboratory. He has served as an independent consultant in ITS.

Wei-Bin joined UC Berkeley Institute of Transportation Studies in 1987 and participated in the early founding of PATH program. As a Program Manager, he led research on a broad spectrum of ITS, with considerable emphasis on advanced vehicle control and safety technologies. In the 1990s, he served as the Technical Director of the National Automated Highway Systems Consortium (NAHSC), responsible for overseeing NAHSC's technical activities and managed the development of the automated platooning system for a U.S. Congress-mandated national technical feasibility demonstration of Automated Highway Systems in 1997. Since 2000, he directed federal and state sponsored research programs on advanced vehicle automation and safety technologies for highway and transit applications. In 2015, Wei-Bin led the USDOT funded Vehicle Assist and Automation program which, for the first time in the US, implemented automatically guided transit buses for field operational tests in revenue services in Eugene, Oregon. He also led California research efforts on Connected Vehicle based multimodal traffic and transit applications. Recently, he has been working with USDOE on assessment of Eco-driving technologies.

Wei-Bin has published over two hundred papers and reports. He is a Fellow of Institute of Electric and Electronic Engineers (IEEE) and was the President of IEEE ITS Society (2020-2021). He also served on various Technical and program committees for TRB, ITS America and APTA.