Project Title: Estimating the Effects of Vehicle Automation and Vehicle Weight and Size on Crash Frequency and Severity: Phase 1

Recipient/Grant (Contract) Number: Carnegie Mellon University, Grant #: 69A3552344811

Center Name: Safety21 National University Transportation Center for Promoting Safety

Research Priority: Promoting Safety

Principal Investigator(s): Corey Harper Carnegie Mellon University

PI Contact: cdharper@andrew.cmu.edu

Project Partners:

- City of Pittsburgh
- Pennsylvania Department of Transportation

Research Project Funding: $200,000.00

Project Start and End Date: 07-01-2023 to 06-30-2024

Project Description:

Most light-duty vehicle (LDV) crashes occur due to human error. The National Highway Safety Administration (NHTSA) reports that eight percent of fatal crashes in 2018 were distraction-affected crashes, while close to ninety-four percent of all crashes occur in part due to human error. Crash avoidance features could reduce both the frequency and severity of light and heavy-duty vehicle crashes, primarily caused by distracted driving behaviors and/or human error by assisting in maintaining control or issuing alerts if a potentially dangerous situation is detected. As the automobile industry transitions to partial vehicle automation, newer crash avoidance technologies are beginning to appear more frequently in non-luxury vehicles such as the Honda Accord and Mazda CX-9. Additionally, the market penetration of electric vehicles (EVs) is increasing, in turn increasing the weight and size of vehicles on the road. This project develops a replicable, open, deployable model that can: 1) estimate the upper-bound crash avoidance potential that could be achieved as the effectiveness of warning and partial automation systems improve and adoption increases, 2) estimate the societal costs and benefits of fleet-wide deployment of crash avoidance technologies considering technology costs and benefits from avoided and less severe crashes, 3) estimate the number of lives that have been saved by forward collision warning, lane departure warning, and blind spot monitoring, and 4) estimate the effects of vehicle weight and size on crash frequency and severity. Our hypothesis is that crash avoidance features are becoming more effective over time and helping to reduce the severity and frequency of crashes. However, there are not many frameworks and tools to help state and local agencies assess the private and societal cost and benefits of increased market adoption and how many lives have been saved by these technologies. We also hypothesize that the trend of increasing vehicle weight and size increases the severity of crashes. This paper builds off previous UTC research by starting with a method similar to Harper et al. (2016) and Khan et al. (2019) but uses more recent insurance and crash data, contributes estimates of lives saved in addition to private net benefits and overall societal net benefits, and conducts exploratory analysis on the role that EVs and heavier vehicles play in crash safety. In the first part of this project, we will compile insurance institute data on crashes and crash severity, helping us to better understand observed changes in crash frequency and severity in vehicles that are equipped with warning and partial automation systems. Second, we will conduct a cost-benefit analysis to estimate the net-private and net-societal benefits of fleet-wide deployment of existing partial automation and warning systems. Third, we will develop a method to estimate the number of lives saved by crash avoidance technologies. Finally, we will conduct exploratory analysis on the role that EVs and heavier vehicles play in crash safety. To do this analysis, we will utilize several publicly available datasets such as 2022 Fatality Analysis Reporting System and observed insurance data from the Insurance Institute for Highway Safety. In this phase of this project, we will mainly focus on automation and its effects on crash severity and frequency and will use similar datasets to conduct a more in-depth analysis on how EVs and heavier vehicles affect crash safety in future iterations. By focusing on both technologies independently (i.e., non-EVs with partial automation and EVs without partial automation), we can better understand the different ways they are impacting crash safety and how to mitigate any negative effects through policy. References Harper, C. D., Hendrickson, C. T., & Samaras, C. (2016). Cost and benefit estimates of partially-automated vehicle collision avoidance technologies. Accident Analysis & Prevention, 95, 104-115. Khan, A., Harper, C. D., Hendrickson, C. T., & Samaras, C. (2019). Net-societal and net-private benefits of some existing vehicle crash avoidance technologies. Accident Analysis & Prevention, 125, 207-216.

Outputs:

Anticipated outputs from this proposal include:

1. Novel methods to develop to evaluate the safety implications of EVs and AVs

2. Data sets, modeling results, and online/offline tools to deploy and validate the proposed methods.

3. Memorandum to the City of Pittsburgh and PennDOT and the development of a policy brief to inform future policymaking.

4. Journal paper to disseminate results to research community.

Outcomes/Impacts:

This project will have a variety of outcomes and impacts:

1. Designing the framework to assess the safety impacts of EVs and AVs lays the foundation for federal, state, and local organizations to better understand cost and benefits of wide-scale deployment of warning and partial automation systems as well as how heavier vehicles on the road could affect road safety.

2. Working closely with the City of Pittsburgh and PennDOT could help inform local and state crash safety policy as the number of EVs and AVs on the road increase.
Additionally, this will provide an opportunity for students to network and learn the missions and goals of the City of Pittsburgh and PennDOT, providing them with pathways to obtain internships and higher paying jobs after graduation (e.g., director of planning, policy analyst).

3. Journal papers and policy briefs can inform decision makers and researchers about pathways to help achieve safety goals such as zero roadway fatalities.