FIRE: THE FIRST-YEAR INNOVATION & RESEARCH EXPERIENCE

SUSTAINABILITY ANALYTICS

Relationship between Autonomous Vehicle (AV) Usage and Traffic Safety

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Abstract

This project explores the role of autonomous vehicles (AVs) in enhancing urban safety and sustainability. By analyzing their impact on traffic safety, we look into whether AVs truly deliver on the notion of reducing accidents and improving transportation efficiency. Our goal is to evaluate the effectiveness of AVs and identify how they contribute to creating safer, more sustainable cities.

Introduction

Autonomous Vehicles (AVs):

- AVs are self-driving vehicles that operate using sensors and machine learning algorithms.
- AV deployment is growing rapidly in urban areas with strong technological infrastructure such as California.

Traffic Safety:

- Traffic safety incidents include collisions, traffic violations, and roadway hazards involving vehicles, pedestrians, or cyclists.
- Improving traffic safety is a main goal of AV development.

Methods

1. Explored datasets on AV disengagement reports from the California DMV [1] and crash reports from manufacturers and operators of vehicles equipped with Levels 3–5 Automated Driving Systems (ADS) in California [4].
2. Filtered data to look at manufacturers with the most amount of data.
3. Used R to make bar plots and stacked bar charts to visualize frequency distributions and interactions of variables: Pre-Crash Speed by. AV Manufacturer and Disengagement Location by AV Manufacturer.

Research Question

What is the relationship between the autonomous car usage and the traffic safety events in the state of California?

Hypothesis: Traffic safety incidents from AVs are more frequent at lower speeds in dense network areas such as urban streets, due to higher traffic and pedestrian volumes as well as increased regulation from traffic signals.

Results

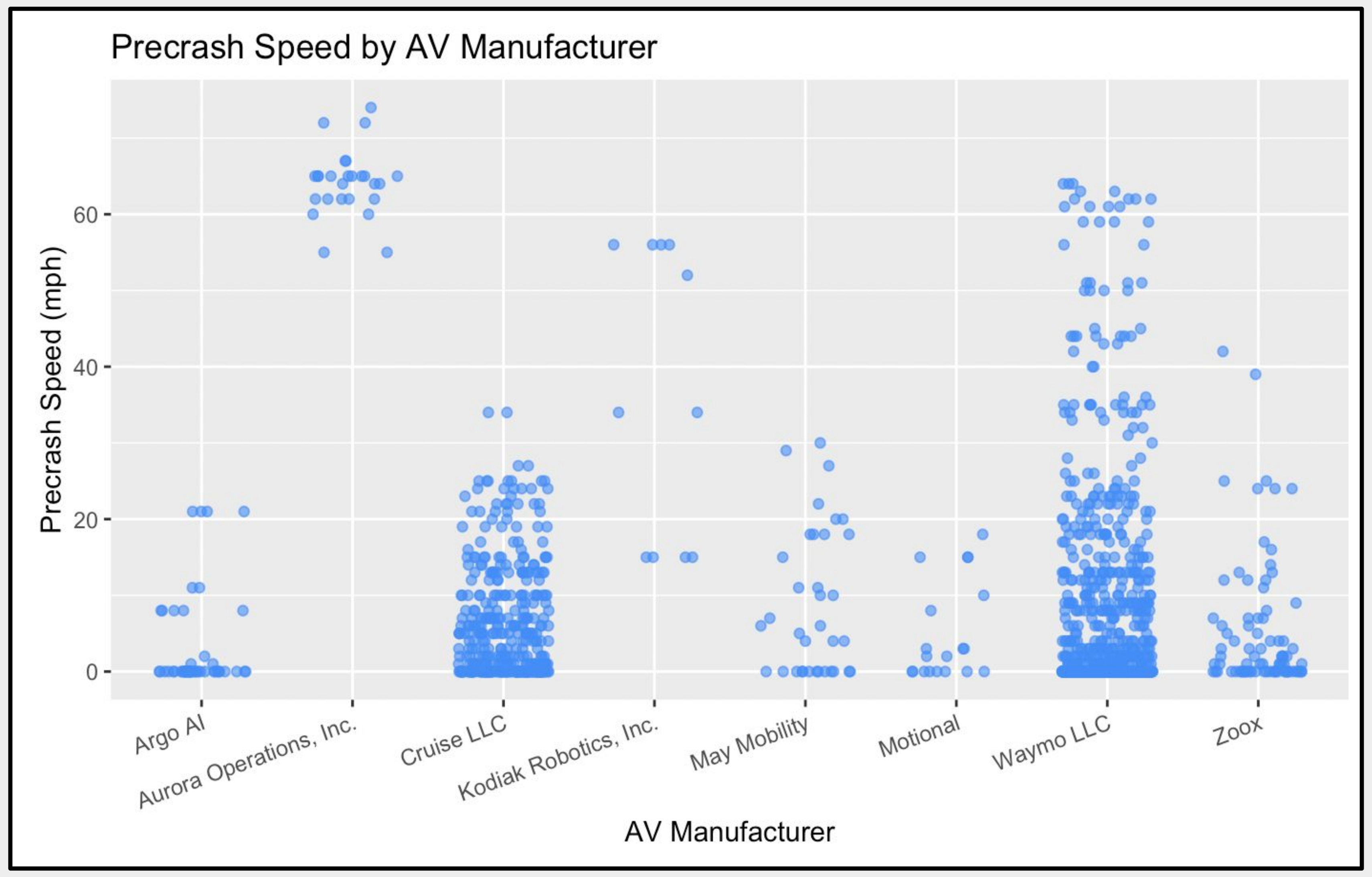

Figure 1: This scatter plot visualizes the relationship between the manufacturer of the AV vehicle and its speed (mph) before a crash occurred. As seen in the graph, Cruise LLC, Waymo LLC, and Zoox are concentrated towards lower pre-crash speeds compared to Aurora Operations, Inc and Kodiak Robotics, Inc.

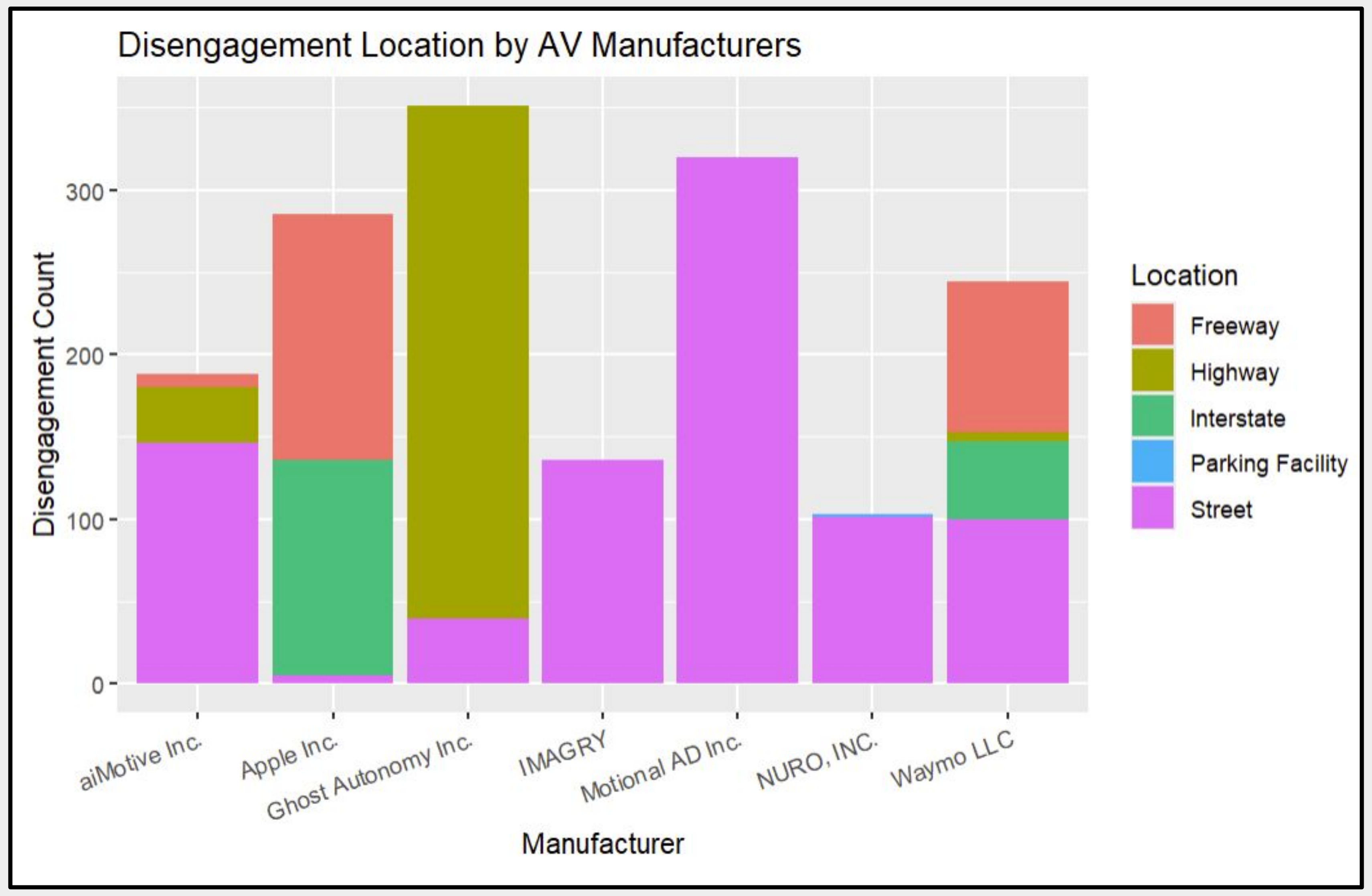

Figure 2: This bar graph shows the number of times a vehicle had to be disengaged (due to technological failures or situations that required the operator to take control for safety) from autonomous mode during tests for each manufacturer. The graph further breaks down these disengagement by road type, which reveals the distribution of failures across different driving contexts.

Conclusions

- As seen in Figure 1, more crashes occur when AVs were travelling at lower speeds than when AVs were travelling at higher speeds. This indicates that low-speed urban environments present a higher likelihood of collisions compared to high speed environments like highways.
- As seen in Figure 2, most AV manufacturers' disengagements occurred in streets, which are lower speed environments and generally pertain to urban settings.
- The frequency of crashes and disengagements in lower-speed settings shows that providing safety is a greater challenge for AVs in urban areas than in non-urban areas.
- Our conclusions supports our hypothesis.
- Our results convey that in California, manufacturers of AVs and the government should be more focused on ensuring AV safety in urban areas.

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