UTSA The University of Texas at San Antonio™

PROJECT SUMMARY

Texas Department of Transportation

0-7080 Develop Roadway and Parking Design Criteria to Accommodate Automated and Autonomous Vehicles

Background

Automated vehicles (AVs) are predicted to be available for public use within a decade or so. An adequate planning is needed for optimally designing infrastructure to accommodate AVs. This study conducted research into the best practices for accommodating AVs under mixed traffic scenarios. This research aims to: (1) propose updates to Texas roadway design standards, and (2) suggest changes in road design and parking infrastructure.

The objectives of this project are to (1) literature review and assessment of Texas Road Design Standards under Automated Vehicle (AV) scenarios, (2) estimate the AV market penetration levels, (3) analyze the impact of AV on road capacity, (4) conceive innovative road design, and conceive innovative parking solutions under AV scenarios. These objectives will prepare Texas for automated future.

What the Researchers Did

- Conducted information search from three important aspects: 1) estimation methods of AV adoption, 2) roadway design to accommodate AVs and, 3) changes required in parking demand and infrastructure for automated future.
- Conducted a review of current road design standards to analyze the pros and cons of various road design elements accommodating AVs and use insights from information search findings to identify customizations in design standards for efficient AV implementation.
- Calibrated Bass Diffusion model to estimate market penetration and adoption scenarios of AVs.
- Calibrated microsimulation parameters for model that best represented the study region while examining traffic models (e.g., car-following models, lane change models). Using calibrated model, examined various Society of Automotive Engineers AV levels on the traffic capacity and performance in both freeway and urban corridors.
- Investigated innovative infrastructure elements based on the findings from the expert opinion study for AV deployment under mixed traffic environment.
- Suggested innovative road design and parking elements for the optimal operation of AVs under mixed environment with human driven vehicles (HV).

Table 1 Different SAV level market diffusion scenarios used for traffic performance evaluation

Scenarios	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
No Automation	65%	35%	25%	10%	5%	0%
Level 1	20%	45%	30%	20%	15%	10%
Level 2	15%	20%	40%	55%	45%	35%
Level 3	0%	0%	5%	15%	30%	50%
Level 4	0%	0%	0%	0%	0%	5%
Level 5	0%	0%	0%	0%	0%	0%

Scenarios	Scenario 7	Scenario 8	Scenario 9	Scenario 13	Scenario 14	Scenario 15
No Automation	40%	25%	5%	0%	0%	0%
Level 1	20%	15%	10%	40%	20%	5%
Level 2	25%	30%	25%	32%	45%	55%
Level 3	15%	25%	45%	8%	10%	7%
Level 4	0%	5%	15%	20%	25%	33%
Level 5	0%	0%	0%	0%	0%	0%

What Was Found

- Past research suggests high trust in technology, positive attitude towards AVs and greater benefits may lead to increased chances of AV adoption.
- At present, AVs rely on visual detection and interpretation for movement. Hence, road markings and traffic signs should be developed as per requirements of AVs.
- When the roadway monitoring task is transitioned to AVs, video cameras and sensors replaces human eyes. The critical difference between AV and HV in terms of sight distance presents opportunities for optimization of current road geometric design standards.
- Design of geometric elements to accommodate AV, looking from the perspective of AV, would need to consider the operational features of AVs in specific operation design domains as well as safety of the passengers and other road users.
- AV adoption depends on several variables such as: consumer acceptance, affordability, sufficient supply, safety, etc. Steps to boost the market penetration of

AVs include favorable plans and policies by the local and state government. However, high initial cost, safety, security, and lack of standardization in traffic control devices and pavement markings might hinder the already uncertain adoption rate of AVs.

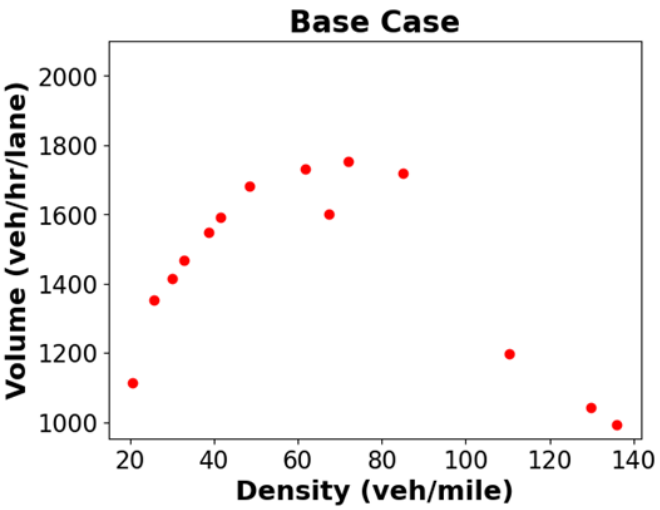

Figure 1 Flow vs Density curve for base scenario

- Results revealed that under uninterrupted traffic conditions, the partial automated vehicles have significant performance improvement when they are restricted to "near dedicated" lanes such as HOV lanes. In contrast, for highly automated vehicles substantial improvements in capacity are observed at high market penetration levels while utilizing all the available travel lanes (Figures 1 and 2 illustrates).
- Majority of the experts agreed that markings and signages are critical in the AVs deployment. Additionally, pavement markings and signages must be uniform, well-maintained and visible in all conditions.
- Cross-sectional width requirements will govern the future design of AV parking infrastructure. In the long run, medians might be shortened or abolished since opposing-direction traffic may no longer require a safety buffer. Reduction in parking width by up to 20% from the existing, will help in freeing up city spaces. Additionally, it will be important to have pick-up and drop-off lanes and charging stations for deployment of AVs.

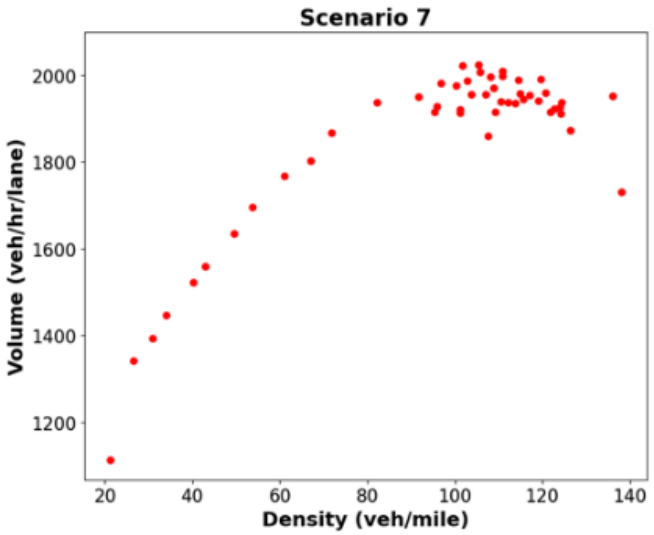

Figure 2 Flow vs Density curve for scenario 7

What This Means

Project 0-7080 may be used to direct management and policy decisions by TxDOT to guide investment on road infrastructure for increased AV performance.

The implementation of project 0-7080 recommendations would have significant impact on quality of life and mobility access by increasing capacity of existing road and parking infrastructure.

Project would have significant impact on environmental sustainability considering the possible reduction in road capacity demand associated with AVs. The results of project 0-7080 contribute to improve capacity, reduce crashes and reduce travel time with significant economic benefits to the State of Texas.

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