Research Report Summary

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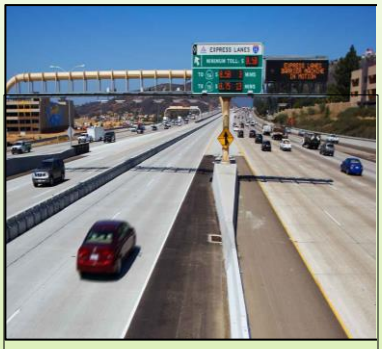
EVALUATION OF MANAGED LANE FACILITIES IN A CONNECTED VEHICLE ENVIRONMENT

On freeways, managed lanes (MLs) have emerged as an effective dynamic traffic management strategy. MLs are designated lanes where the flow of traffic is managed by limiting vehicle eligibility (e.g., High Occupancy Vehicle [HOV], Truck Only lanes [TO]), restricting facility access (e.g., Reversible Lanes [RLs], Express Lanes [ELs]), employing fixed or dynamic price tolls (e.g., toll ways, Express Toll Lanes [ETLs]), pricing and vehicle eligibility (e.g., High-Occupancy Toll [HOT], Truck Only Toll [TOT] lanes), or vehicle eligibility and access control (e.g., Bus Rapid Transit [BRT] lanes, dedicated truck lanes, transit ways) (Fitzpatrick et al., 2017; Perez et al., 2012). In this research, it is first proposed that there might be a new designation for managed lanes as designated Connected Vehicles' lanes. The first part of the projects was undertaken for investigating the safety and operational effect of adding connected vehicles (CVs) and CV lanes to the managed lanes network with the intention of maximizing system-wide efficiency. Microscopic traffic simulation techniques were developed and applied, including 9 mi corridor of MLs segment on Interstate (I-95) in South Florida. In this study, several scenarios were tested using microscopic traffic simulation to determine the optimal CV lane configuration design while taking into consideration the market penetration rate (MPR %) and traffic conditions (i.e., peak, off-peak). Both safety (i.e., conflict frequency, conflict reduction)



An example of Dynamic Toll Pricing Lanes

An example of High Occupancy Vehicle (HOV) lanes

and operation (i.e., average speed, average delay) performance measures were included in the analyses. . The results of the safety and operational analysis suggested that a MPR% between 10% and 30% was recommended when the CVs were only allowed in MLs. By converting one lane of the general-purpose lanes (GPLs) to a lane of the MLs, the MPR% could reach 60%. It was also concluded that restricting CVs to only the CV lane was not recommended. Lastly, the findings suggested that by allowing the CVs to use all the lanes in the network (MLs, GPLs, CV lane), the optimal MPR% could reach between 70% and 100%. For the second part of the projects, we evaluate the longitudinal safety of managed-lane CV platoons on expressways based on simulation results. The simulation experiments were designed, by deploying managed-lane CV platoons and all lanes CV platoons on a congested expressway. Then, a vehicle behavior model for CV platoon was used based on the IDM model and five surrogate safety measures, standard deviation of speed, TET, TIT, TERCRI, and SSCR were measured as safety indicators. The results showed that both CV approaches (i.e., managed-lane CV platoons, and all lanes CV platoons) significantly improved the longitudinal safety in the studied expressway compared to the non-CV scenario. In terms of surrogate safety measures, the managed-lane CV platoons significantly outperformed all lanes CV platoons with the same MPR

"Connected vehicle lane has both safety and operational benefits of the managed lane in the expressways"

Outcomes

This study has major implications for improving managed lanes (MLs) by recommending the optimal CV lane configuration and market penetration rate for each design. Hence, recommending the managed lane as connected vehicle lane might have essential benefits of the transportation road network for the expressways of United States. On the other hand, one of the biggest issues facing CVs popularization associates it with the market penetration rate (MPR). For the policy point of view, this study provide useful insight for the management of CV MPR as managed-lane CV technologies in terms of CV transition period.

Reference

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