CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-6838: Bringing Smart Transport to Texans: Ensuring the Benefits of a Connected and Autonomous Transport System in Texas

Background

This project developed and demonstrated a variety of smart-transport technologies, predictions, policies, and practices for Texas highways and freeways using highly automated or fully autonomous vehicles (AVs), connected vehicles (CVs), inertial movement units (IMUs), roadside equipment, and related technologies. The work's products provide ideas and equipment for more efficient intersection and network operations for connected, autonomous vehicle (CAV) operations, alongside a suite of behavioral and traffic-flow forecasts for Texas regions and networks under a variety of vehicle mixes (smart plus conventional, semi-autonomous versus fully autonomous, connected but not automated, passenger vehicles and heavy trucks). The effort supports proactive policymaking on vehicle and occupant licensing, liability, privacy standards, variable tolling, shared AV (SAV) fleet operations, and mode-choice incentives as technologies become available and travel behaviors change.

What the Researchers Did

The researchers surveyed 2500 American adults to anticipate travel choices and forecast changes under a variety of policy and technology scenarios. They assessed how CVs and CAVs can collect external traffic data and simultaneously communicate with nearby vehicles and infrastructure managers to improve traffic flows and roadway safety. The team explored pricing strategies, using the agent-based modeling program MATSim, and developed a Hybrid Autonomous Intersection Management, or H-AIM, to coordinate more efficient travel across intersecting networks, with a mix of human-driven and self-driving vehicles. Finally, the team assessed legal barriers to implementation of AVs, including policy changes at the state and federal legislative levels.

What They Found

Example results include passenger vehicle-miles traveled (VMT) predicted to rise 12.4% across Texas, and truck flow ton-miles predicted to rise 11% across the U.S. Both traditional and advanced congestion pricing strategies can significantly reduce the added traffic congestion caused by the added VMT. Use of self-driving, lower-cost trucks is likely to increase U.S. exports and domestic truck flows across a number of commodities.

AVs and SAVs are forecast to become a popular long-distance travel mode (especially for business trips) at distances up to 500 miles. AV implementation could greatly impact the air

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travel market, causing revenues to fall nearly 50%, everything else constant.

The cost of using a hybrid electric-vehicle fleet for SAVs is found to be just 49¢ per revenue-mile across the six-county Austin region. Using battery-only, range-constrained SAVs or "SAEVs" (with longer charging or refueling times) requires building and serving charging stations, and costs about 60 ct/mile but enables use of renewable energy sources for power generation. SAVs will require some empty driving (approximately 10% empty), but SAVs that use dynamic ride-sharing (DRS) (real-time carpooling with strangers, essentially) offer meaningful VMT savings. In simulating the entire Austin region as well as the entire Orlando region (using special cellphone data), each SAV was shown to replace around eight conventional vehicles, by working eight hours per day, rather than running about one hour per day, keeping its engine warm and lowering emissions.

H-AIM systems were found to be effective at many CAV penetration levels. Allowing CAVs to use all available incoming lanes (at intersections) can reduce average delays at low-demand intersections. At high volume-to-capacity intersections, however, lane assignment policies favoring CAVs are counter-productive.

User-compliant agents in a network—those that are willing to increase the length of their travel time to reduce overall system congestion (e.g., delivery vans or service vehicles)—are a valuable opportunity for transportation stakeholders. As network size increases, however, a greater fraction of compliant travelers is needed to help achieve system optimum flow.

Wrong-way-driving safe-disable systems, emergency-vehicle alert systems, and other CAV and CV demonstrations illuminated ways for departments of transportation (DOTs) to protect lives and property, while improving flow and network efficiencies. High-accuracy IMU technology was used to quickly and consistently provide pavement serviceability ratings, presenting another opportunity for DOTs to benefit greatly from Project 0-6838 research.

Finally, the team found that legal terminology between states is already conflicting and will become more problematic over time, so we urge TxDOT to use standardized nomenclature. Another key issue is preemption conflict at local and state levels. The team recommends continued monitoring of activities within federal governing bodies as well as the California, Michigan, and Nevada legislatures.

What This Means

CAVs and SAVs present impressive opportunities for travelers, consumers, shippers, and system managers—with little to no transportation infrastructure changes. It is important for transportation stakeholders to consider measures that enhance such benefits, while avoiding rising traffic congestion and emissions limiting liability, and maximizing crash reductions, in anticipation of this technology's implementation. Research undertaken in this work indicates that a calculated public outreach effort by both state and local governments may be needed to alert people to the many benefits that AVs provide. Proper education can speed AV, SAV, and DRS adoption and use.

For More Information

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