CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

5-7081-01: Implementation of Understanding the Impact of Autonomous Vehicles on Long-distance Travel Mode and Destination Choice in Texas

Background

As privately owned and shared autonomous vehicles (AVs and SAVs) and automated trucks (ATrucks) become available, TxDOT and partner agencies must anticipate their travel, trade, emissions, cost, and other implications. Introducing these modes can significantly alter mode choices for passenger travel and freight and impact traffic volumes and congestion throughout the network. The researchers significantly modified TxDOT's Statewide Analysis Model (SAM) to predict travel and traffic impacts of AVs, SAVs, and ATrucks on passenger and freight flows across Texas.

What the Researchers Did

Researchers modified SAM's mode choice models to integrate AVs, SAVs, and ATrucks as added transportation modes. For long-distance (LD) passenger trips (> 50 miles, each way), the nested logit model was modified to include AVs and SAVs under the drive-alone and shared-ride options. Values of travel time (VOTT) for AVs and SAVs were assumed to be 20% less than traditional human-driven vehicles (HVs), with operating costs of $0.60 and $1 per mile, respectively. ATruck operating costs were assumed to be 1.5 times those of HTrucks with a 25% VOTT reduction and no rest time needed.

For shorter-distance trips, SAM requires fixed passenger mode shares (based on transit availability and income group, by trip purpose). In areas with no transit, the new model assumes 40% split for HVs, 40% for AVs, and 20% for SAVs (for DA, SR2, and SR3+ modes). In areas with transit availability, no-AV-case transit mode shares were assumed to lose half their travelers to SAVs. Researchers studied six scenarios for the 2040 model year, as described in Table 1.

Researchers also explored alternative data sources that could be used to validate SAM and introduce demand variations. These datasets include RITIS's (Regional Integrated Transportation Information System) Nextgen Trip Analytics V4, Replica, and 300+ permanent traffic recorders (PTRs). These observed data were compared with SAM forecasts.

What They Found

Researchers found that the addition of AVs and SAVs to SAM resulted in individuals choosing more remote destinations, as seen by an 18% rise in average trip length of LD (50-400 miles) business travel (from 121 miles to 142 miles) and 13% for non-business travel purposes (135 miles to 151 miles). AVs plus SAVs are estimated to have a combined mode share of 14% for "drive alone" LD trips (and 9% and 15% for SR2 and SR3+ modes), leading to a 17 percentage- point decline in the human-driven mode share for LD trips. ATrucks emerged as the dominant choice, carrying approximately 43% of tons moved, while human-driven truck tonnage fell 39%. Without travel demand management (like credit-based congestion pricing), congestion issues will grow, thanks to an average VMT rise of 25.6% (from

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1.09 to 1.37 billion miles per day) and 44% lower average speeds (across the two peak periods). Vehicle-hours of travel (VHT) are predicted to jump 304%, largely thanks to passenger travel favoring the AM and PM peaks and mid-day, where travel speeds fell by 68%, 67%, and 40%. (Nighttime speeds were stable.) Interestingly, network values did not vary much across the 6 AV scenarios (Table 1), but that is mostly due to SAM's fixing all "short-distance" (under 50- miles each way) passenger travel demand.

INRIX/RITIS' light-duty vehicle (LDV) trip table averaged over 31 weekdays aligned well with SAM's predictions and demonstrated regular demand patterns over the days of the year. INRIX/RITIS data suggest that HDV trip counts and VMT rise about 100% and 50%, respectively, when looking at weekdays rather than weekends, which is striking.

What This Means

Introducing AVs, SAVs, and ATrucks will result in major changes in Texas' passenger and freight mode choices and network congestion unless demand management takes place. Thoughtful modeling is needed, but those efforts may be hindered by SAM's excessive run times, 20 hours per scenario without any feedback loops. Bush-based traffic assignment algorithms and increasing concurrent model executions could shorten run times, but will also raise SAM's already resource requirements, so memory usage should also be optimized.

Table 1 Scenarios Description

NO-AV (SAM Default)	-
AVs + SAVs have 20% & ATrucks have 25% reduced VOTT.	
Base - AV	$0.6/mile for personal AVs, $1/mi for SAVs, & ATrucks are 50% more expensive than Htruck.
AV1	Lower-Cost AVs: SAVs have a 40% reduced cost than Base-AV, & ATrucks cost 20% more than HTrucks.
AV2	AV operating costs rise 33%.
AV3	AV VOTTs fall by 50%.
AV4	No HV or HTruck options in mode choice models.
AV5	Only SAVs & HVs available.
AV6	To better reflect empty AV travel, we used 25% higher PCE for AVs.

For More Information

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