Transportation Consortium of South-Central States (Tran-SET)

Analysis, Modeling, and Simulation (AMS) Case Studies of Connected and Automated Vehicle (CAV) Implementations Specific to the South Central Region

Conducting two mobility-based AMS case studies of CAV deployment strategies of importance and specific to the South Central region

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Connected and automated vehicle (CAV) technology can be integrated into existing congestion mitigation strategies to provide exceptional mobility benefits. However, due to uncertainty in the technological capabilities and infrastructure requirements, it is difficult for state departments of transportation (DOTs) to estimate such benefits and better prepare their transportation system for such technology. Emerging, research-based traffic analysis, modeling, and simulation (AMS) tools can provide an efficient means to evaluate potential CAV implementations. This study will conduct two mobility-focused AMS case studies of CAV deployment strategies of importance and specific to the South Central region – as to supplement and better inform CAV-related policy, planning, and integration strategies currently being developed by local and state DOTs. The case studies will produce new, meaningful knowledge, quantifying the (potential) mobility impacts of CAV deployments in the Region utilizing realistic, “real-world” transportation networks and deployment scenarios..

Problem Statement

Congestion is a wide-spread issue in urbanized areas across the U.S., negatively impacting system performance of both freeways and arterials. This is particularly true for Region 6 (AR, LA, NM, OK, and TX) as congestion trends in the Region continue to worsen. Significant state- and national-level guidance exists on successfully implementing congestion mitigation strategies. Emerging technologies, such as connected and automated vehicles (CAVs), can be integrated into such strategies to provide exceptional mobility benefits. For example, cooperative adaptive cruise control (CACC), cooperative speed harmonization, and cooperative merging are applications that have shown to improve operational performance of freeway systems. However, due to uncertainty in the technological capabilities, when the technology may be fully developed, its market adoption, and infrastructure requirements, it is difficult for state departments of transportation (DOTs) to estimate such benefits and better prepare their transportation system to maximize such benefits.

Traffic analysis, modeling, and simulation (AMS) tools provide an efficient means to evaluate transportation improvement projects prior to deployment. However, traditional AMS tools are not well-suited for evaluating CAV applications due to their inability to incorporate vehicle connectivity/communication and automated features. The research community has recognized this research gap and developed several traffic models replicating the operation and performance of a CAV (e.g., car-following models). The final format of these models and how they will be incorporated into existing AMS commercial products is unclear. There is an obvious disconnect between developing these models and providing the models in a format that is readily accessible and usable by state DOTs.

As it relates to preparing for and adopting CAV technology, four of the five states in Region 6 (AR, LA, NM, and OK) can be considered early or late majority adopters – and have taken a more “reactive” approach in their preparation strategies. However, it is clear they are still interested in exploring how CAV applications can benefit their transportation systems.

Objectives

The main objective of this study is to conduct two mobility-focused AMS case studies of CAV deployment strategies of importance and specific to Region 6 – as to supplement and better inform CAV-related policy, planning, and integration strategies currently being developed by local and state DOTs in Region 6. It is envisioned that the case studies will focus on low levels of automation; perhaps replicating the first CAV applications that will be deployed on a system-level, such as: CACC, truck platooning, cooperative speed harmonization, cooperative on-ramp merging, lane speed monitoring schemes, platooning-based intersection management, and advanced traffic signal coordination (Figure 1).

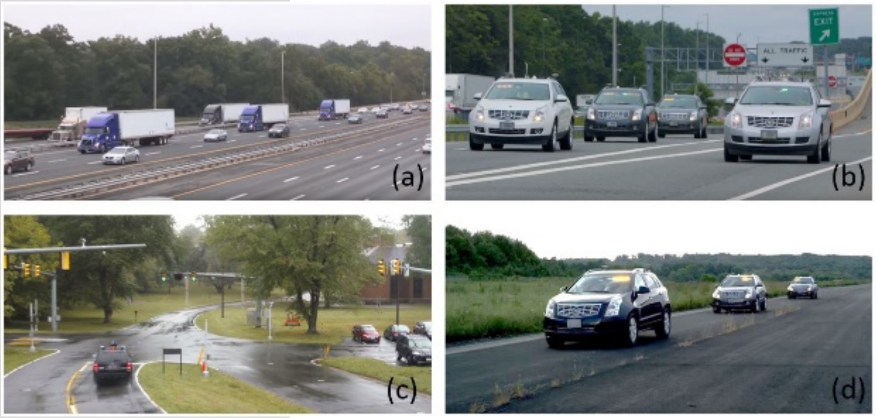

Figure 1. Examples of mobility-based CAV applications: (a) truck platooning, (b) cooperative merging, (c) signalized intersection approach and departure, and (d) CACC.

Intended Implementation of Research

Education, Workforce Development and Outreach activities: This project includes actvities such as (a) presenting on the best practices of applying AMS models, tools, and methods to evaluate potential CAV implementations at an upcoming "SimCap Louisiana" educational meeting, (b) training a graduate student on this emerging topic, CAV technology in general, and how it may affect transportation infrastructure, (c) developing one educational module summarizing the case studies and modeling techniques utilized, (d) presenting at a local ITE student chapter meeting, and (e) leveraging and participating in Tran-SET's programmatic outreach activities, including organizing and developing a webinar to be integrated into the "Joint Tran-SET Webinar Series". Note: co-founded by the PI, "SimCap Louisiana" is a volunteer network of professionals that supports, promotes, and improves best practices in the application of traffic simulation and capacity analysis. It is an active, formal workforce development entity.

Anticipated Impacts/Benefits of Implementation

The case studies will produce new, meaningful knowledge, quantifying the (potential) mobility impacts of CAV deployments in Region 6. Although the benefits of CAV technologies have been extensively studied, only a handful of realistic, "real-world" AMS case studies have been investigated and none specifically addressing the needs of the South Central region of the U.S. Outputs of the study will be implemented in two distinct ways: (1) the white paper and modified CAV models will be prepared as to be as readily usable by DOTs as possible in future studies and (2) results of the case studies will inform CAV-related policy, planning, and integration strategies. The white paper and packaged CAV models will also be specifically designed to further the traffic modeling capabilities of the regional workforce.

Web Links

- TranSET's website (https://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1642181)

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.