Investigating the Impacts of Truck Platooning on Transportation Infrastructure in the South Central Region

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$365,894

Investigating mobility-, environmental- (fuel savings), and infrastructure-related (pavement) impacts of truck platooning through a series of modeling case studies

A critical component to the economy of the southern U.S. is the efficient movement of freight – especially to states in Region 6 (AR, LA, NM, OK, and TX). Truck platooning is a connected and automated vehicle (CAV) application of interest to the freight industry due to its potential energy savings, safety benefits, and ability to reduce highway congestion. However, the short following distances maintained between vehicles and more precise lane-keeping lead to a higher concentration of load being placed on the transportation infrastructure. It is unclear how these greater weight concentrations and new load configurations will impact the deterioration to pavements. The main objectives of this study are: through a series of modeling case studies, the operational and environmental (fuel savings) impacts of various truck platooning configurations will be quantified at both the corridor- and network-level and impacts to the structural pavement resulting from these truck platooning implementations will be investigated and quantified using finite element (FE) modeling.

Problem Statement

Freight and the efficient movement of freight is a critical component to the economy of the southern U.S. – especially to states in Region 6 (AR, LA, NM, OK, and TX). Several of the largest freight distribution hubs (e.g., Houston, TX, New Orleans, LA, Oklahoma City, OK, and Dallas-Fort Worth, TX) and most valuable truck corridors in the U.S. are located in this region. However, several challenges exist in supporting a strong freight economy: (1) efficiency of freight movement muffled by an infrastructure system in need of repair, limited capacity, and severe congestion and (2) mitigating negative community impacts.

Connected and automated vehicle (CAV) technologies offer potentially transformative societal impacts including significant mobility, safety, and environmental benefits. One CAV application of particularly interest to the freight industry is truck platooning. Truck platooning describes a number of trucks equipped with CAV technology that closely follow one another in a "platoon". Benefits of truck platooning include energy savings from aerodynamic drag reduction, reduced highway congestion due to short following distances, and safety improvements from faster reaction times and automated support systems (i.e., truck platooning has great potential in addressing current challenges facing freight movement).

Self-driving truck technology is continually being developed and will grow increasingly more available on public roadways (see Figure 1). Even though this technology is not available to the public, it is envisioned to include short following distances and accurate lateral positioning (i.e., limited lateral wander). It is unclear how these greater weight concentrations and new load configurations will impact the deterioration/damage to pavements. Addressing this uncertainty is critical, especially considering the current state of severe financial constraints in which not all state-owned infrastructure can be maintained.

Objectives

The main objectives of this study are:

1. Through a series of modeling case studies located in Region 6, the operational and environmental (fuel savings/emissions) impacts of various truck platooning implementations, configurations, and assumptions will be quantified at both the corridor- and network-level;

2. Utilizing traffic outputs from the corridor-level modeling, and documented pavement characteristics of major corridors, finite element (FE) modeling will be used to quantify the impact on structural pavement layers and long-term performance resulting from truck platooning; and

3. A feasibility study for implementation will be performed comparing the (potential) operational and environmental (fuel savings/emissions) benefits of truck platooning with the (potential) costs associated with increased pavement loads.

This will also be compared with an equivalent "base case" with human-driven trucks.

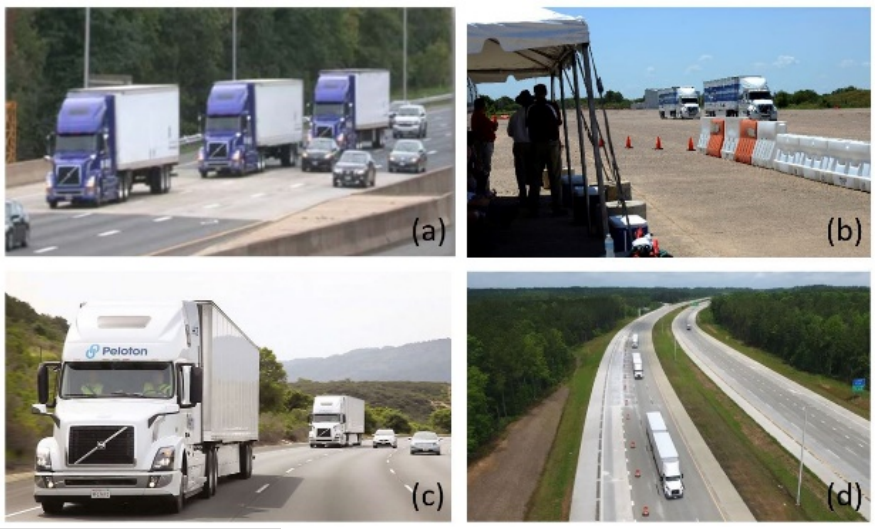

Figure 1. Various truck platooning demonstrations: (a) joint demonstration by FHWA, FMCSA, and Volvo, (b) joint testing by FHWA, TxDOT, TTI, and several private companies, (c) demonstration by Peloton, and (d) demonstration by Volvo and FedEx.

Intended Implementation of Research

Education and workforce development activities: (a) presenting on the available methods and appropriate assumptions to model truck platooning implementations at an upcoming "SimCap Louisiana" educational meeting, (b) training graduate students on this emerging topic, CAV technology in general, and how it may affect road infrastructure, (c) developing two educational modules summarizing the operational/environmental analyses and pavement analyses conducted, and (d) 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 study will produce new, meaningful knowledge, quantifying the mobility-, environmental-, and infrastructure-related impacts of truck platooning in Region 6. Although the benefits of truck platooning has been extensively studied, only a handful of realistic, "real-world" modeling case studies have been investigated, especially at the network-level. Furthermore, this study will adopt advanced modeling techniques to quantify pavement damage due to truck platooning.

Results of the case studies may inform CAV-related policy, planning, and integration strategies – including changes to asset management and maintenance procedures (i.e., results have the ability to shape impactful agency initiatives, potentially leading to mobility, safety, and environmental benefits provided by truck platooning). Recommendations may also be developed in this study as to platoon trucks in a way that does not accelerate road deterioration in the Region.

Web Links

- TranSET's website (https://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1642183)

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.