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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Strategies for Improving Safety and Efficiency of Interaction Between Surface Traffic and Trunkline Transit

This research will focus on understanding the safety and efficiency issues involving interaction between transit and surface traffic; and study ways to apply Intelligent Transportation Systems (ITS) technologies to manage hazards while optimizing operation.

Geotechnical/ Structures

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Project Title: Strategies for Improving Safety and Efficiency of Interaction Between Surface Traffic and Trunkline Transit

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WHAT IS THE NEED?

The interaction between surface traffic and trunk line transit systems has presented significant challenges. To improve transit efficiency, signal priority and signal preemption have been implemented for certain light rail applications. While the signal priority is designed to reduce transit delays, it has led to an increased number of collisions between automobiles and transit vehicles, particularly when the buses operate on dedicated right-of-way.

One notable example is the Los Angeles County Metropolitan Transportation Authority (LACMTA) Bus Rapid Transit (BRT) Orange line (G-Line), which has encountered a high crash rate at intersections, resulting in injuries, property damage, substantial network delays, and significant public attention. These hazardous situations often involve cars running red lights or driving parallel to the BRT line and making turns at intersections without being aware of approaching transit vehicles.

California's light rail systems also face similar safety challenges, especially when vehicles travel alongside rail transit vehicles and attempt left turns. Another type of conflict arises on dedicated BRT lanes that run parallel to conventional traffic lanes, like the Alameda-Contra Costa (AC) Transit International Blvd BRT, where adjacent vehicles abruptly intrude into the BRT lane, resulting in collisions between BRT vehicles and surface traffic. Appendix A synthesizes the safety issues encountered by LACMTA, AC Transit, and Santa Clara Valley Transportation Authority (VTA).

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WHAT ARE WE DOING?

To tackle the safety concerns at intersections while minimizing the impact on BRT service, potential solutions will be evaluated. While physical barriers and adjacent conventional traffic lanes (traditional measures) can be effective, their operation significantly affects the flow of surface traffic and may result in reduced BRT capacity.

ITS has made significant advancements in traffic management and their use as solution will be explored.

There are several challenges that current ITS technologies must address to mitigate the safety hazards, including:

a) The absence of performance measures and management strategies capable of thoroughly assessing and addressing safety hazards.

b) The lack of methods for detecting and mitigating safety hazards, as well as for facilitating efficient coordination and management between transit vehicles and surface traffic. This coordination is essential to ensure safe operations without unduly compromising the efficiency of both transit and traffic systems.

These innovations may replace or complement traditional safety technologies, such as grade crossing controls, to provide effective solutions that enhance transit system safety while maintaining overall traffic efficiency.

WHAT IS OUR GOAL?

TTo investigate methods for assessing the safety hazards involving trunkline transit and surface traffic and to develop innovative approaches to detect and mitigate hazards and facilitate efficient management or coordination between transit vehicles and surface traffic.

To achieve these goals, the research aims to (1) collect and analyze traffic and transit data to understand that safety issues involving interaction between transit and surface traffic, (2) study ways to apply advanced ITS technologies to measure, detect and mitigate safety hazards while optimizing the operation of all modes, the treatments to be studied range from traditional grade crossings applied for transit trunklines to advanced ITS technologies.

WHAT IS THE BENEFIT?

As regions in California continue to expand their trunk line transit services, with a particular interests on dedicated BRT systems, it is crucial to address the safety and efficiency challenges associated with the interaction between trunkline transit and surface traffic systems. The insights obtained from this study will have widespread benefits for regions that currently operate or have plans for dedicated BRT and light rail systems, contributing to the development of a transportation system that is safe, sustainable, integrated, and efficient. Furthermore, the findings of this study will be valuable to BRT agencies across the country, providing them with valuable insights and recommendations for improving the overall efficiency, safety, and functionality of these systems, leading to more effective integration and enhanced performance.

WHAT IS THE PROGRESS TO DATE?

Task 1 efforts focused on building a strong foundation through problem identification, literature review, and analysis of real-world conflict scenarios. This work clarified key risk areas and helped focus subsequent tasks on critical interaction points, particularly at signalized intersections.

This quarter, the team advanced its core objective of improving safety and efficiency at the interface between trunkline transit and surface traffic, with emphasis on the identification of system performance measures (Task 2) and the evaluation of innovative Intelligent Transportation Systems (ITS) technologies through the development of a "toolbox" of strategies (Task 3).

To inform the development of performance measures, the team evaluated a range of advanced ITS strategies aimed at mitigating conflicts and improving coordination between transit and traffic. These included approaches such as transit signal re-service (TSR), enhanced detection systems, and cooperative tools like bus speed advisories and operator warnings. Findings indicate that while individual strategies can reduce risk and delay, their combined application, supported by accurate detection and signal timing, offers the greatest potential benefit.

Significant progress was made in developing a framework for performance measurement. Through the analysis of ITS approaches, the project established clear linkages between operational strategies, safety risks, and system capabilities. By integrating insights from TSR performance, red-light-running detection, and bus–signal cooperation, the team defined a comprehensive framework centered on service outcomes, safety exposure, and real-time responsiveness. Categories of performance measures have been identified that address transit reliability, traffic impacts, and safety exposure at critical interaction points, providing a foundation for evaluating improvements during design and implementation rather than relying solely on post-deployment metrics.