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Project Title

Framework of Adaptive Intersection Traffic Control Strategy for Urban Traffic Network Subjected to Disruptions

University

Colorado State University

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Research Needs

For urban communities, congestion at traffic network poses serious societal and economical threats. In recent years, various advanced traffic control strategies, including ITS-based signal control plans, have been developed to mitigate the urban congestion [1-2]. However, most of existing studies are limited to recurrent congestions at normal driving conditions or single intersection optimization during incidents [1-4]. Urban traffic network experiences complex disruptions due to traffic crashes and adverse weather events, under which the induced congestion and deteriorated traffic performance become hard to be assessed or predicted [5]. As a result, traditional traffic control strategy at intersections do not meet the needs by offering optimal and timely mitigation results which are adaptive to specific disruptions. Moreover, single-intersection strategy may not offer the best solution for the whole urban traffic network and some adaptive strategies which can handle the needs at different spatial and temporal scales are desired.

Research Objectives

This study will develop a new traffic performance assessment and adaptive traffic control strategy framework which is adaptive to specific disruptions and offers multiple optimization plan for both single intersections and the whole network. The proposed framework, once developed, will help building safer and more efficient urban traffic network and more resilient transportation against various disruptions from hazards.

Research Methods

The proposed work will integrate data science technology, traffic network simulation and modeling and intersection signal optimization techniques to tackle this problem.

Firstly, a hybrid traffic network model for the selected community will be developed using SUMO software by integrating site-specific traffic characteristics captured from the actual site-specific traffic data to provide rich traffic simulation results under disruptions with validation.

Secondly, in addition to traditional traffic performance measures at smaller scales, some new performance measures under disruptions in terms of network robustness will be developed based on network science.

Thirdly, the feasibility of developing adaptive optimal intersection traffic control strategies to different disruptions is studied in order to provide the optimal traffic performance at both local (intersection) and global (network) scales.

Finally, a case study is conducted to demonstrate the proposed technique.

Expected Outcomes

The proposed methodology, once established, will (1) offer a new approach to combine the real traffic data and SUMO-based modeling techniques to provide reliable traffic performance simulation under disruptions; (2) study the feasibility of developing adaptive traffic control strategies to different disruptions at both local and network level.

Relevance to Strategic Goals

The proposed study specifically addresses USDOT strategic goal: Livable Communities. This study helps developing more resilient transportation infrastructure system, which can improve the life quality and the economic development of communities under various hazards.

Educational Benefits

A graduate student will involve in conducting this study. Some research outcomes will be incorporated in the transportation engineering class and seminars for graduate students in the future.

Technology Transfer

Technology transfer will be conducted through publishing papers on technical journals and also present in major conferences, such as TRB and ASCE Structure Congress conferences. Results will also be reported on website and news articles.

Work Plan

Task 1. Literature review

Extensive literature review will be conducted about 1) current progress on traffic performance modeling under disruptions at both intersection and network levels; and 2) existing studies on intersection traffic control strategies under various disruptions.

Task 2. Traffic network modeling and traffic performance simulation

This task will conduct traffic network modeling by integrating actual traffic data and SUMO-based modeling techniques. Several typical disruptions will be modeled realistically and the traffic performance such as travel speed and time at different roads, intersections and the whole

network will be analyzed. In addition to the traffic performance at the microscopic scale, the traffic network performance will be assessed by introducing the network robustness performance measures.

Task 3. Feasibility study of adaptive traffic control strategy for various disruptions and scales

This task will try to develop a framework of adaptive intersection traffic control strategy, which can offer the optimal traffic performance for a given disruptive scenario. The traffic performance will be optimized at both intersection level and the whole network level based on traditional traffic performance measures at microscopic scale and the network scale. Both traffic efficiency (e.g., delay) and network robustness will be considered in terms of optimal traffic performance.

Task 4. Demonstrative study

A case study will be conducted on the urban traffic network at City of Fort Collins to demonstrate the proposed technique, including parametric studies of some key parameters.

Project Cost

Total Project Costs:	$110,000
MPC Funds Requested:	$ 55,000
Matching Funds:	$ 55,000
Source of Matching Funds:	Colorado State University

References

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