Assessment of Safety and Operation Performances of CFIs and DDIs in Utah

CTIPS-014 – UTC Project Information

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Center Name:	Center for Transformative Infrastructure Preservation and Sustainability
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Principal Investigator(s):	Milan Zlatkovic
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Project Description

Alternative intersection and interchange designs, such as the Diverging Diamond Interchange (DDI) and the Continuous Flow Intersection (CFI), have garnered significant attention among transportation agencies, researchers and practitioners over the past 15 years, due to their ability to improve operations and safety of transportation systems. The Utah Department of Transportation (UDOT) is recognized as a national leader in the design and implementation of innovative intersections and interchanges. Currently there is not a lot of information on field-based performance measures of these designs. As it has been 16 years since the first CFI was implemented, followed by many more CFIs and DDIs, UDOT's databases contain a lot of useful data regarding operations and safety of these designs. The accelerated deployment of DDIs and CFIs necessitates the needs for more in-depth assessment of their benefits and impacts. The objective of this study is to perform safety and operational assessment of CFIs and DDIs in Utah. It will develop Utah-specific Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) for these designs. The study will also assess the operational performance of CFIs and DDIs, and explore ways in which operations can be improved (geometry, control, signalization).

USDOT Priorities

The proposed study will be relevant to all USDOT Strategic Goals, to varying degrees. The study will be mostly relevant to the Safety goal, as it will perform detailed safety analyses of DDIs and CFIs using

statistical models and machine learning. The safety assessment will incorporate all travel modes. Within the Economic Strength and Global Competitiveness goal, the study will be related to the resilient supply chains, and system reliability and connectivity. Under Equity, the study will have impacts on access and proactive intervention, planning and capacity building. The Climate and Sustainability goal will be impacted through reduced emissions and infrastructure resilience. The Transformation goal will be mainly impacted through flexibility and adaptability. Finally, the Organizational Excellence goal will be mainly related to data-driven programs and policies, and sustainability initiatives.

Outputs

The research team will reach out to the transportation community to discuss and present the methodologies and results of the study. Practitioners and researchers will be the target audience, since the study aims to develop control programs that can be implemented in the field. This will be done through personal communication, web sites, social media, conferences and journal publications. The research team will seek input from other interested parties to improve upon the study design and methodology. UDOT has also approved this study, so their personnel will be involved through all phases of the research. The study will be presented at the CTIPS seminars. In addition, the research team will submit and present the results of the study at engineering conferences and journals.

Outcomes/Impacts

Through a comprehensive review of literature and practice, this study will first provide a synthesis of results, best practices and lessons learned from implementations and analyses of DDIs and CFIs. The review will assist with establishing performance metrics and evaluation criteria to assess the success and effectiveness of DDIs and CFIs in addressing traffic congestion, enhancing safety, and improving mobility. Ultimately, this review will assist with planning and designs of future deployments. Through modeling and simulation applications, the study will enhance the understanding of traffic flow dynamics, operational characteristics and capacity limitations, as well as provide tools to assess the performance of DDIs and CFIs under various traffic volumes, geometric configurations, and signal timings. The study will also provide methodologies for the integration of real-time data, computer vision and machine learning in the optimization of operations and safety of these designs.

The study is expected to have significant implications for future research directions. It will identify the research gaps and priority areas for further investigation, including the impact of emerging technologies, changing travel behavior, and evolving transportation trends on the performance of DDIs and CFIs. The study will have important implications for practitioners, such as technical guidance for design and operational strategies, assessment methodologies and tools and other materials to support planning, design and implementation of DDIs and CFIs.

The study will provide updated SPFs and CMFs for installation of DDIs and CFIs. These functions and factors will be created for Utah conditions; however, it will be possible to calibrate them for applications in other locations. Simulation models will be created and calibrated to assist with operational assessment and optimization, including complex traffic signal operations. Finally, the study will provide machine learning and computer vision tools capable of monitoring vehicle trajectories and vehicle maneuvers, and assisting in the safety and operational assessment using real-time video data.

Final Report

Upon completion, the final report link will be added to the project page on the CTIPS website.