SCDOT

Research Summary

South Carolina Department of Transportation | Office of Materials and Research

Project Information

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Research Administration

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This final report is available online at:

http://www.scdot.scltap.org/projects/completed/

ADAPTIVE SIGNAL SYSTEM SAFETY IMPACTS

Synopsis

The research team conducted a nation-wide survey and identified corridor characteristics that would allow for significant operational and safety outcomes after enabling the adaptive signal control system (ASCS) in the case of future deployments.

For the existing ASCS corridors in South Carolina, the research team evaluated the safety effectiveness of ASCS in terms of reducing the crash frequency and crash severity at 11 ASCS corridors with a total of 109 signalized intersections. The research team investigated the safety effects of ASCS on the likelihood of secondary crashes on freeways with alternate routes where ASCS has been deployed. The operational effectiveness of ASCS was also assessed in terms of reducing travel time and improving travel time reliability at 11 ASCS corridors with a total of 102 signalized intersections. Based on the study findings, the research team recommended the types of corridors that are best suited for ASCS implementation for traffic safety and operational improvement.

Problem

ASCS is typically deployed at intersections and corridors to improve operational performance, such as travel time and traffic delay. By handling conflicting traffic movements and establishing dynamic coordination between intersections along a corridor in real-time, ASCS can potentially improve traffic safety. The question the South Carolina Department of Transportation (SCDOT) had, and one that is addressed in this research, is: What are the safety benefits of ASCS, and which corridors would benefit the most from ASCS in terms of safety and operation?

Research

The research team focused on the following objectives:

1. Determine the effect of ASCS on the crash frequency.
2. Investigate the effect of ASCS on the crash severity.
3. Determine the effect of ASCS on the likelihood of secondary crashes on those freeway sections that have alternate corridors with ASCS.
4. Determine the operational effectiveness of ASCS for travel time and travel time reliability.
5. Recommend the type of corridors that are best suited for ASCS implementation for traffic safety and operational improvements.

A national survey was conducted to identify the corridors that could benefit from the ASCS deployments. Later, to determine the safety effects of ASCS on the crash frequency, the research team developed a fully Bayesian framework for a before-and-after study. The research team evaluated the safety effectiveness of ASCS at 11 ASCS corridors with a total of 109 signalized intersections. To determine the effect of ASCS on the crash severity, the research team developed random-parameter ordered regression models using crash data from 11 ASCS corridors with a total of 109 signalized intersections. All the ASCS corridors considered in this study have the same type of ASCS, SynchroGreen. To assess whether ASCS deployed on an arterial parallel to the freeway reduced secondary crashes on the freeway, the research team developed binary logistic regression models for I-26 (Eastbound and Westbound) in South

Carolina. To evaluate whether ASCS is effective in terms of travel time reduction and travel time reliability improvement, the research team evaluated 11 ASCS corridors with a total of 102 signalized intersections.

Results

The highlights of the research team's findings are:

1. The survey identified corridor characteristics, such as the design speed and Annual Average Daily Traffic (AADT) of an ASCS corridor, which would allow for significant positive operational and safety outcomes.
2. ASCS resulted in crash reductions for 9 out of 11 ASCS corridors. The safety effectiveness of ASCS varied across the intersections, depending on their characteristics, such as AADT and the speed limit at the major street.
3. ASCS was associated with lower crash severity for 9 out of 11 ASCS corridors. The maximum and minimum values of the speed limit in the study intersections are 55 mph and 20 mph, respectively. Analyses of these corridors suggested the followings: 1) when the speed limit difference between a major street and a minor street at an ASCS intersection is equal to or greater than 10 mph, and the average signal distance on an ASCS corridor is less than the threshold of 0.49 miles, ASCS was more likely associated with lower crash severity, and 2) when the speed limit difference between a major street and a minor street at an ASCS intersection is less than 10 mph, and the average signal distance on an ASCS corridor is less than the threshold of 0.69 miles, ASCS was more likely associated with lower crash severity.
4. Analyses revealed a 47% reduction in the likelihood of freeway secondary crashes when ASCS was deployed on the alternate route to the study corridor segment of the I-26 Eastbound freeway.
5. To calculate the overall operational benefits of ASCS in the study corridors, the research team used a weighted average value with data from the study corridors. Based on the analysis, it was observed that when ASCS was operational, it reduced travel time by 6.4% on average and improved travel time reliability by 31.4% on average for the study corridors, compared to when ASCS was not operational.

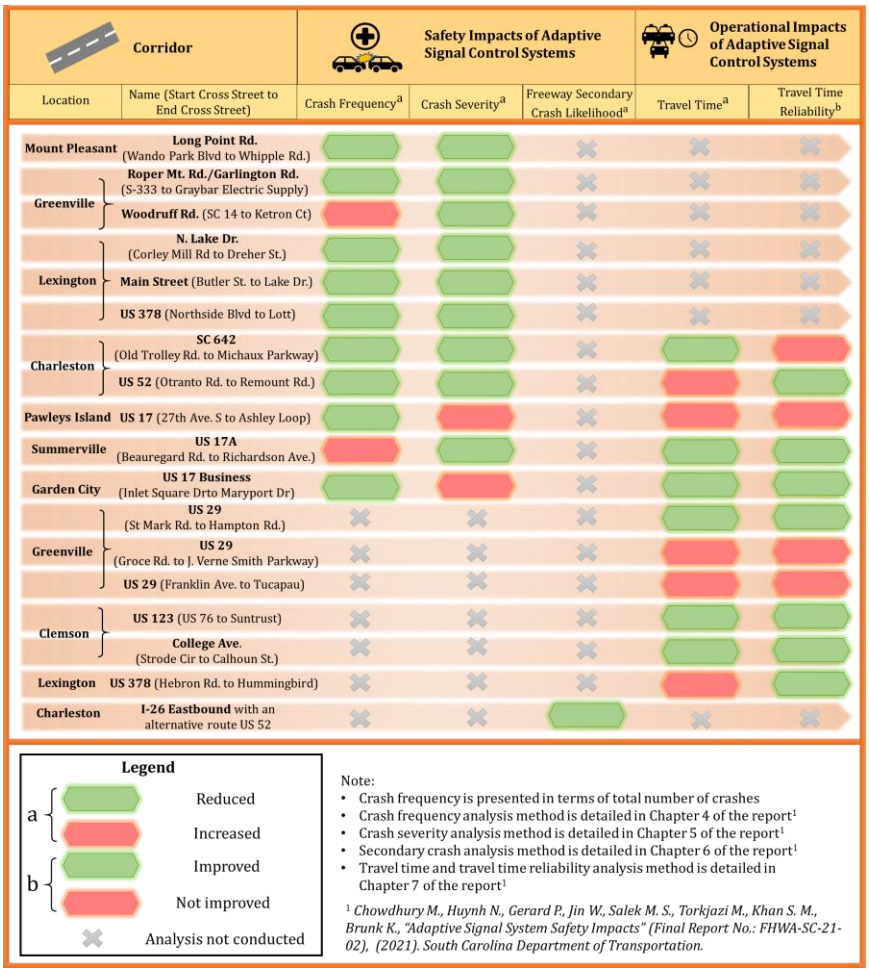

Figure 1. Safety and Operational Impacts of Adaptive Signal Control System at Study Corridors

Figure 1 highlights the safety and operational impacts of ASCS at the study corridors.

Value & Benefit

This project provides guidance to select future ASCS deployment sites, for traffic safety improvements, by considering intersection and corridor features, such as AADT at a major road, the speed limit at a major road, intersection geometry, average signal distance on a corridor, and whether a corridor could be used as a detour route when there is an incident on the freeway. The guidance will help SCDOT reduce crashes, crash severity, and the likelihood of freeway secondary crashes.

This project also provides guidance to select future ASCS deployment sites, for operational improvements, by considering corridor features such as the design speed, the average speed of vehicles, AADT, number of traffic signals on a corridor, presence of multiple peak periods, and traffic conditions. These recommendations will help SCDOT achieve reductions in travel time and improvements in travel time reliability.

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