

RESEARCH SUMMARY

An Integrated Intelligent Intersection Control System (III-CS) for Safety Improvement and Delay Minimization

WHAT WAS THE NEED?

According to the statistics by NHTSA (2019), intersection related crashes constitute 28.8% of the 52,645 total fatal crashes in 2017; around 70% of such are either rear-end collisions or angled crashes (AASHTO, 2010). Despite sustained investment in traffic safety by both federal and state transportation agencies over the past several decades, how to effectively minimize intersection crashes remains a critical yet imperative task.

WHAT WAS THE GOAL?

The primary objectives of this research are to develop and test an Integrated Intelligent Intersection Control System (III-CS) that can concurrently address both safety and efficiency issues. The proposed III-CS will have the following key features: execute the optimal green termination algorithm under the actuated control function to concurrently minimize the likelihood of rear-end collisions and total traffic delay, and dynamically extend the all-red extension to prevent angled crashes.

WHAT DID THE RESEARCH TEAM DO?

To accomplish the research objectives, the project is divided into three parts: theoretical development of two control algorithms for dynamic green extension, integration of the developed algorithms with existing dynamic all-red extension system and intersection signals for field deployment, and conduct extensive before-and after field studies for benefit assessment of the developed *III-CS*. Future extension for safety improvement at the arterial level has also been addressed in this project.

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WHAT WAS THE OUTCOME?

A rigorously deployed III-CS can provide the following benefits: (1) decreasing the number of near-conflicts that may result in rear-end collisions between vehicles trapped in the dilemma zones during phase transitions; (2) shaping the behaviors of the driving population when they encounter a yellow phase, as reflected in their much lower average and maximum acceleration/ deceleration rates during the yellow phase after the III- CS deployment; (3) incentivizing more drivers to choose the stop decision when encountering a yellow phase, and observing fewer drivers that ran through the intersection during the red and all-red phases; (4) the dynamic green extension function provided by the III-CS not only minimizes the likelihood of incurring rear-end collisions, but also concurrently contributes to a reduction in red-light running as well as the need to activate the all-red extension; and (5) reliably activate the dynamic all-red extension functions to prevent angled crashes, although at some level of false alarms.

Further studies along this line of concurrently improving intersection safety and maximizing arterial flow efficiency shall include the following tasks: (1) deploying the developed III-CS at more intersections with different geometric features and congestion levels to ensure its effectiveness and identify any potential limitations; (2) collecting more after-deployment data to assess the short- and long-term impacts of an III-CS's deployment on the distribution of the target intersection's traffic speeds, drivers' responses during a yellow phase; and (3) exploring the potential of extending the III-CS's functions to address the crashes between left-turning vehicles and opposing through traffic with minimal additional hardware.

HOW WILL MDOT SHA USE THE RESULTS?

The MDOT SHA is currently operating the system at the intersection of MD 4 and Forestville Road and will continue monitoring its effectiveness. Additional deployments at other candidate intersections will be evaluated by the Office of Traffic and Safety.

LEARN MORE

To view the complete report, click [here](#).

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