RESEARCH SUMMARY

Intelligent Dilemma Zone Protection System at High-Speed Intersections

WHAT WAS THE NEED?

Drivers' actions in an intersection's dilemma zone – the area where the decision to stop at a yellow light or continue through it is not clear-cut – can lead to side-angle and rear-end crashes. In Maryland, researchers developed an intelligent dilemma zone protection system (DZPS) that is reducing these crashes by anticipating drivers' decisions and responding.

WHAT WAS THE GOAL?

The objective of this project was to design, deploy, and evaluate the DZPS at two high-speed intersections in Maryland.

WHAT DID THE RESEARCH TEAM DO?

The DPZS was developed by the University of Maryland and its early version was deployed by the Maryland Department of Transportation State Highway Administration (MDOT SHA) at the intersection of US 40 and Red Toad Road in Cecil County, Maryland in 2012.

In this project, an improved version of DPZS was deployed at two high-speed rural intersections (US 40@Western Maryland Parkway, "Intersection-1," and MD 213@Williams/Locust Point Road, "Intersection-2"). It consists of the following principal

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components: (1) two wide-range sensors to track the speeds and locations of all vehicles within the identified dilemma zones; (2) software to predict the response of drivers during a yellow phase and to activate the all-red extension function if needed; and (3) a web-based module for engineers and technicians to monitor the system's performance from a control center.

WHAT WAS THE OUTCOME?

Field evaluations of the deployed DZPS were conducted about one month after the system activation dates, and real-time system monitoring and performance analysis was carried out with respect to the traffic flow characteristics impacts and the all-red extension activations.

The analysis results showed that the DZPS system reduced the maximum length of the dilemma zones by 30% and total length weighted by traffic volume in each speed bin by 40%.

A higher percentage of drivers made the conservative decision of "stop" during a yellow phase after DZPS deployment. Such change was not observed, however, in aggressive drivers, justifying the need for all-red extensions to help prevent crashes between red-light running vehicles and vehicles entering from the cross street.

The DZPS initiated extension calls in 99 of the 312 observed signal cycles at Intersection-1 and in 78 of the 441 observed signal cycles at Intersection-2. The rate of

false-positives, i.e., predicting that a passing vehicle would not clear the intersection when it actually did before the light turned red, was 30% for Intersection-1 and 16% for Intersection-2; perhaps because the driver accelerated. More importantly, the video taken at the target approach showed that the DZPS successfully provided all-red extensions to the twelve observed red-light running instances at the two intersections, demonstrating the significant safety benefits.

HOW WILL THE RESULTS BE USED?

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

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