Florida Department of Transportation Research

Extended Development and Testing of Optimized Signal Control with Autonomous and Connected Vehicles

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BDV31-977-109

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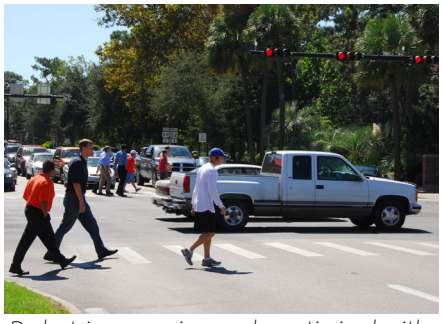
Current Situation

Automation and driver assistance have been increasing in cars for many years, from automatic transmissions and antilock brakes to more recent features like automated parking and braking. As technology matures, more automation is available to drivers, both in vehicles and roadway infrastructure, leading to advances in vehicles that are self-driving (autonomous) and those that communicate with other vehicles and infrastructure (connected) to assist the driving experience. The first fully automated, self-driving cars are already being tested on public roadways, and planners, designers, and engineers are looking ahead to self-driving vehicles available for the public. However, there are several questions to answer before widespread adoption of autonomous and connected vehicles is possible, including how these vehicles interact with pedestrians and how governing authorities like FDOT will need to manage the data being shared between connected vehicles and the roadway infrastructure (V2I).



Pedestrians crossing can be optimized with vehicles for greater safety and efficiency.

Research Objectives

University of Florida researchers developed a system for automatic detection of pedestrians at signalized intersections and a new approach to vehicle-infrastructure (V2I) data sharing to maximize safety outcomes.

Project Activities

In a previous project (BDV31-977-45), the researchers developed the real-time intersection optimizer (RIO), a set of algorithms, software, and hardware solutions to optimize traffic signal control operations with traffic movement. That work integrated intersection technologies with traffic that includes autonomous, connected, and conventional vehicles. The current project extended the RIO system to include pedestrian traffic at intersections. RIO detects vehicles using video and, additionally for connected vehicles, dedicated short-range communications (DSRC). To detect pedestrians, the team designed and implemented a LIDAR-based detection system. This addition required changes to the RIO's communications and computation capabilities.

The RIO system was evaluated for a variety of vehicle and pedestrian interactions at an intersection at FDOT's Traffic Engineering and Research Laboratory (TERL). The system served both vehicle and pedestrian demand in all cases evaluated. Although COVID-19 precautions prevented full testing of the system with bicycles and scooters, the detection system reliably located pedestrians for the RIO, thus making timing for pedestrian crossing part of the overall optimized timing for intersections.

The researchers found that system components, such as the roadside units that collect and process traffic data, were operating at their limits, indicating how the system components would have to be scaled to handle more approaches and more traffic. A next step for the enhanced RIO could be implementation at one or more signalized intersections for evaluation and refinement using video cameras, LIDAR, and RSUs at each intersection.

Project Benefits

The results of this project offer new technology that can provide optimal vehicle trajectories and detection of pedestrians resulting in better utilization of the intersection by providing phasing and timing to match trajectories and pedestrian demand to reduce queues, delays, and safer road user behaviors.

For more information, please see www.fdot.gov/research/.