Project Number
BDV31-977-45

Project Manager
Elizabeth Birriel
FDOT Traffic Engineering and Operations Office

Principal Investigator
Lily Elefteriadou
University of Florida

Florida Department of Transportation Research

Development and Testing of Optimized Autonomous and Connected Vehicle Trajectories at Signalized Intersections

December 2017

Current Situation

Visions of self-driving vehicles abound in popular science and entertainment. Many programs are at work to make a reality catch of this imagination. Vehicle automation has progressed rapidly in recent years, from simple driver assistance technologies like cruise control and in-vehicle wireless, to production-line vehicles that park themselves or stop if they detect an obstacle. These capabilities are being extended by technologies that allow vehicles to navigate the roads without a driver by communicating with traffic control devices and using onboard sensors and GPS. Each step in this development requires the efforts of many specialists – engineers, programmers, mathematicians, scientists, and planners. Even as self-driving vehicles become more common, they will have to share the road with conventional, human-driven vehicles. Therefore, the infrastructure that helps to guide driverless vehicles will have to understand the behavior of automated and conventional vehicles.

The automated car used in this project displays an array of sensor and communications technologies.

Research Objectives

University of Florida researchers developed, tested, and deployed an intelligent real-time intersection traffic control system that was able to simultaneously optimize signal control and automated vehicle trajectories, considering the presence of autonomous, connected, and conventional vehicles in the traffic stream.

Project Activities

The researchers simulated their control system in the MATLAB computer environment, testing 3,000 scenarios to consider every variation of demand level, communication range, automated vehicle percentage, and following distances/times at traffic saturation (saturation headways). They found that automated vehicles increase traffic efficiency. For example, automated vehicles can operate at shorter headways, decreasing average travel time as the percentage of automated vehicles increases.

Many other lessons learned during the simulation helped to refine the overall system that was then implemented and tested at the Florida Department of Transportation's Traffic Engineering Research Laboratory (FDOT TERL). This required development of numerous hardware and software components, including a local server, DSRC receiver for the server, interface to the signal controller, sensor fusion system, radio communication software, and hardware for vehicle-to-infrastructure communications. TERL testing was conducted for a wide variety of scenarios. The outputs and video footage (http://avian.essie.ufl.edu/gallery/) showed that the system is capable of providing optimal trajectories to automated vehicles in order to reduce delays. Future work will allow the system to consider congested conditions, lane changing, and the presence of pedestrians and bicycles.

Project Benefits

Automated vehicles present many opportunities. They offer safer and more efficient travel for passengers, new economies to businesses, and new transportation options for those who cannot drive.

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