DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Advanced Traffic Signal Control Algorithms, Phase 2

Provide driver recommendations to encourage eco-friendly driving as the vehicle approaches an actuated signalized intersection through use of Signal Phase and Timing (SPaT) and Geometric Intersection Description (GID) information.

Transportation Safety and Mobility

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Project Title:
Advanced Traffic Signal Control Algorithms

Task Number: 2529

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WHAT WAS THE NEED?

In 2008, the Environmental Protection Agency (EPA) required that all new vehicles comply with The Society of Automotive Engineers (SAE) Onboard-diagnoistics (OBD) II standards (Title 40, Code of Federal Regulations, Part 86.1806-05), effectively allowing third-party access to fuel economy and instantaneous fuel consumption data on all new vehicles. While many automotive OEM's already offered fuel economy information displays to drivers, the 2008 EPA requirement also spawned an increasingly rich market for aftermarket eco-driving systems and smart phone based eco-driving systems, utilizing the data available that is now available through the vehicle's OBD II port.

The open OBD II standard, the skyrocketing cost of fuel over the first decade of the new millennium, the introduction of hybrid-electric and electric vehicles to the market, and the global focus on reducing greenhouse gas emissions have all contributed to the recent interest in and growing body of research related to the development of eco-driving assistants. In terms of all energy and environmentally beneficial ITS applications, those involving traffic signals are promising in the near term, primarily because many of the supporting technologies exist today and can be readily utilized, resulting in potentially significant environmental benefits.

The concept of "Eco-signal" operation applications can be generalized to include the use of connected vehicle technologies to decrease fuel consumption as well as greenhouse gases (GHGs) and criteria air pollutant emissions on roadways with traffic signals by reducing the number of stops and idling, avoiding unnecessary acceleration and deceleration events, and improving traffic flow at actuated signalized intersections.

WHAT WAS OUR GOAL?

The goal of the project was to design and implement an in-vehicle system that calculates and provides speed advice to the driver of the vehicle, using Signal Phase and Timing (SPaT) and Geometric Intersection Description (GID) information, allowing the driver to adapt the vehicle's speed to pass through the upcoming actuated traffic signal(s) on green or to decelerate to a stop at a red signal in the most environmentally efficient manner.

WHAT DID WE DO?

The California Department of Transportation (Caltrans) contracted the California Partners for Advanced Transportation Technology (PATH) University of California Berkeley and College of Engineering - Center for Environmental Research and Technology (CE-CERT), to design, develop, implement and test, in the real world traffic, the in-vehicle driver speed advisory system for actuated traffic signals using the SPaT and GID information.

WHAT WAS THE OUTCOME?

After testing the system, it was found that the fuel saving performance varies from 0% to 22% for different driving scenarios. The three scenarios of "speed up to pass (during green)", "have to stop (from green to red)" and "maintain speed to pass (from red to green)" can potentially make improvements by following in-vehicle speed advisory recommendations. Having considered the occurrence chance of every scenario, the statistical results show that the real achieved benefit for the tests ranges between 3% to 4%.

WHAT IS THE BENEFIT?

The benefits resulting from this task are expected to reduce the production of millions of pounds of GHG from the atmosphere. Each gallon saved reduces the amount of 20 pounds of Carbon dioxide (CO2) from the atmosphere. Based on traffic data from 2012, a 3% savings in fuel consumption in California would equate to savings of about 210 million gallons of gasoline, and a reduction in GHG of about 7 billion pounds of Carbon Dioxide.

LEARN MORE

View the Final Report
https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/ca16-2529-finalreport-a11y.pdf

IMAGES

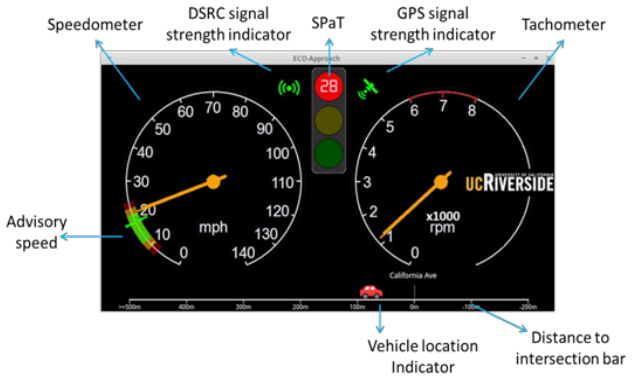

Image 1: An example of in-Vehicle Speed Advisory System

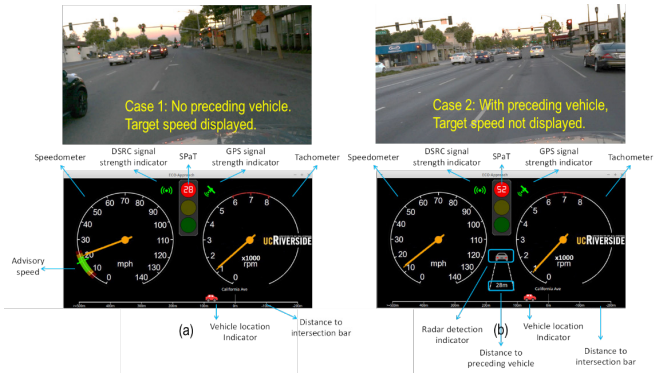

Image 2: (a) In-Vehicle System displaying target speed with no preceding vehicle.(b) In-Vehicle system not advising speed due to preceding vehicle.