Title

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Authors
Wu, Guoyuan
Wei, Zhensong
Oswald, David
et al.

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Benefits of a Connected Corridor: Early Results from Testing Eco-Driving Applications in the City of Riverside

Guoyuan Wu, Zhensong Wei, David Oswald, Peng Hao, and Matthew Barth
Center for Environmental Research and Technology, University of California, Riverside

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Issue

Roadway infrastructure is essential for fostering the continued economic growth in California. It is the backbone of transportation systems, facilitating the delivery of public services and moving people and goods across the state. Infrastructure assets are usually costly and require long-term investment. The Road Repair and Accountability Act of 2017 (SB 1) dedicated nearly $55 billion in funding for repairs and maintenance of the California's highway system as well as for improvement of major transportation routes and corridors. With the advent of connected and automated vehicles (CAV) technology, these funds also provide a rare opportunity for transportation agencies to upgrade road infrastructure to support wireless vehicle-to-vehicle (V2V) communication and vehicle-to-infrastructure (V2I) communication. To better understand the benefits of upgrading infrastructure to support cellular communications, researchers at the University of California at Riverside (UCR), collaborated with the City of Riverside, CA, to develop a CAV testbed along a portion of University Avenue to test V2V and V2I applications.[1]

Key Research Findings

Upgrading road infrastructure to support V2V and V2I applications can save drivers time and fuel while reducing emissions. The UCR research team developed a Connected Eco-Approach and Departure for Actuated Signalized Corridors application that provides real time information to drivers about optimal vehicle speeds when approaching or leaving an intersection to reduce fuel consumption and pollution without sacrificing mobility. This application is an improvement over existing “eco-driving” applications as it uses a corridor-based approach that simultaneously collects signal phase and timing (SPaT) information from multiple downstream traffic intersections (instead of at one time) and can be used with traffic signals that do not have a fixed timing cycle but vary the time between lights based on the volume of local traffic. The UCR research team tested the application on a section of the CAV testbed in Riverside and found that it improved fuel economy in the test vehicle in the range of 12.5 to 15.6 percent , reduced CO2 emissions by up to 15.6 percent, and shortened average travel time by up to 6.3 percent.

Cellular communications can supplement existing dedicated short-range communications (DSRC) to improve data collection from connected vehicles and infrastructure. DSRC is a set of wireless protocols that support high speed communications between vehicles (or V2V) and between vehicles and roadside infrastructure (or V2I). However, DSRC range is limited to about 300 meters (about 2/10 mile) and signals can be blocked by obstructions like nearby buildings and trees. Cellular communication (the same advanced 5G technology that cellular phones use) can significantly increase that range to support advanced corridor-based eco-driving applications, such as the one developed by the UCR team and described above. While communication delays associated with cellular networks are much higher than those of DSRC (in the range of 200 microseconds compared to around 50 microseconds) this does not seem to be a problem for environmentally-friendly applications such as the eco-driving application developed by the UCR team, though it may be an issue for other safety-oriented CAV applications.

Broadcasting Radio Technical Commission for Maritime Services (RTCM) messages is a cost-effective way to improve positioning accuracy for connected vehicles. RTCM is a communication protocol for sending differential corrections and integrity monitoring of satellite signals to a GPS receiver. Standard on-board GPS units can generate vehicle positioning errors up to 6 meters (2–3 meters on average), which cannot guarantee the consistent lane-level accuracy critical to many CAV applications. By equipping vehicles with an off-the-shelf single-frequency Realtime Kinematic-capable receiver (at the price range of $200) that can receive RTCM correction messages, the vehicle positioning error can be reduced to about four inches.

More Information

This policy brief is drawn from the report "Assessing Roadway Infrastructure for Future Connected and Automated Vehicle Deployment in California" prepared by Guoyuan Wu, Zhensong Wei, David Oswald, Peng Hao, and Matthew Barth with the University of California, Riverside. The report can be found at: https://www.ucits.org/research-project/2020-14. For more information about findings presented in this brief, please contact Guoyuan Wu at gywu@cert.ucr.edu.

[1]The research team has compiled a list of CAV testbeds in California available at http://itssrv.engr.ucr.edu/ucits/

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