MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-470 (project 599) | July 2022

Connected-autonomous Traffic Control Algorithms for Trucks and Fleet Vehicles

the **ISSUE**

Connected vehicle (CV) technologies enable vehicles to exchange information with each other (vehicle-to-vehicle [V2V]) and with the roadside infrastructure (vehicle-to-infrastructure [V2I]) in real time. The CV systems combine different technologies, such as wireless communications, advanced vehicle sensors, advanced roadside infrastructure, onboard computers/processing, and others. Autonomous vehicles (AV) use various technologies (e.g., radar sensors, LiDar, and GPS) to sense their surroundings and take driving functions from the driver at different levels. The connected-autonomous vehicles (CAV) integrate the functions of CVs and AVs for a greater benefit. The Wyoming Department of Transportation is upgrading six traffic signals and installing CAV hardware and software, creating opportunities for developing strategies that would benefit traffic operations and safety, sustainability, and economic development.

the **RESEARCH**

The goal of this study is to develop and test traffic signal control algorithms that utilize CAV technologies to optimize signal operations, enable special signal controls (such as priority and preemption), and CAV mobility and safety applications.

The USDOT has defined several CV applications for mobility improvements. The applications analyzed in this study include intelligent traffic signal system (ISIG), queue warning (Q-WARN), freight signal priority (FSP), transit signal priority (TSP), dynamic speed harmonization (SPD-HARM), and emergency vehicle preemption (PREEMPT). Researchers conducted a review of literature and practice, collected existing field data, and created traffic microsimulation models to develop, test, and select the most appropriate CAV control algorithms for ISIG, FSP, TSP, SPD-HARM, Q-WARN, and PREEMPT. Field data (geometries, traffic, and control) were collected from selected test sites and used in the analysis and models development. The algorithms were developed according to the actual standards and protocols for CAV technologies. Traffic microsimulation software VISSIM was used extensively to develop and test actual control programs that are field ready. The focus of the algorithms was to improve traffic operations as well as create traffic conditions that will benefit safety.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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Connected-autonomous Traffic Signal Control Algorithms for Trucks and Fleet Vehicles

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the **FINDINGS**

The latitude/longitude coordinates of CAV-equipped vehicles and signalized intersections can be used to establish communication, define the detection zone, update the position and speed of the vehicles, and determine the status of the current signal phase. CV-based FSP can reduce truck intersection delays by 10% to 70%. CV-based TSP implementation can reduce transit delays more than 50% and increase transit speeds 70%. Speed harmonization can reduce truck intersection delays 1% to 80%. Queue warning would bring significant safety benefits. Preemption can reduce emergency vehicle delays 15% to 36% and improve their speeds by more than 50%.

the **IMPACT**

This research developed new and improved existing vehicle communication protocols and created signal control programs for special signal operations with the goal of improving operations and safety at signalized intersections. It has the potential to improve the control strategies related to speed harmonization, queue warning, and preemption/priority, especially on facilities with high truck traffic percentages and high-ridership transit routes.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1089

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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