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Caltrans Division of Research, Innovation and System Information

Research Notes

Impacts of Connected and Autonomous Vehicles on the Performance of Signalized Networks: A network fundamental diagram approach

Evaluate the impacts of connected and autonomous vehicles (CAVs) on the performance of signalized networks at the aggregate level.

Advanced Research

MAY 2021

Project Title:
Connected and Automated Vehicle (CAV) Planning and Policy Development

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WHAT IS THE NEED?

Connected and autonomous (CAV) are expected to improve or alleviate traffic congestion, but their impacts are usually evaluated at the microscopic level (e.g., through the design of optimal vehicle trajectories or optimal operation of individual intersections).

There is a need to develop a new performance evaluation framework through Network Fundamental Diagrams (NFD), which capture the relationship between the average flowrate and density at the network level. Studying and understanding how individual advisory speed limits of connected vehicles and different start-up (acceleration) and clearance (aggressiveness) behaviors of autonomous vehicles can increase the network capacity and reduce the start-up and clearance lost times.

WHAT ARE WE DOING?

The research team at the University of Southern California will perform research with simulation algorithms to evaluate impacts of start-up and clearance behaviors of autonomous vehicles, using different combinations of connected and autonomous vehicle technologies to determine whether their impacts are additive or alternative. They will evaluate the impacts of individual advisory speed limits using different market penetration rates of autonomous vehicles, which lead to heterogeneous traffic streams with both autonomous and human-driven vehicles.

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WHAT IS OUR GOAL?

The goal is to evaluate how individual advisory speed limits of connected vehicles and different start-up (acceleration) and clearance (aggressiveness) behaviors of autonomous vehicles can increase the network capacity and reduce the start-up and clearance lost times. Also, to determine whether their impacts are additive or alternative.

WHAT IS THE BENEFIT?

The researchers will analyze and evaluate through simulations how individual advisory speed limits of connected vehicles and different start-up and clearance behaviors of autonomous vehicles can increase the network capacity and reduce the start-up and clearance lost times.

The results of this research have the potential to help improve the traffic network capacity and reduce traffic delays due to start-up and clearance lost times.

WHAT IS THE PROGRESS TO DATE?

Researchers continued to revise the article entitled "Impact of advisory speed limit on the overall performance of signalized networks: A network fundamental diagram approach", which was presented in the 2020 Transportation Research Board Annual Meeting.

Researchers also extended the study on "Periodicity Detection of Simulated Traffic Data and Calibration of Network Fundamental Diagrams in Signalized Road Networks". In the extension, the researchers compared the network fundamental diagrams in stationary states with those in long-time averages. Also discussing the advantages and disadvantages of each approach.