Eco-Driving of Connected and Autonomous Vehicles Approaching and Departing Signalized Intersections

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Principal Inverstigator(s):

Xiangyu Meng

Louisiana State University

Lead Institution:

Louisiana State University

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$ 120,000

Eco-driving of CAVs at signalized intersections

Autonomous vehicles (AVs) commonly known as self-driving vehicles have captured the attention of the public for decades and continue to be the center of attention of academic and industrial research activities worldwide. Their proliferation has rapidly grown, largely as a result of Vehicle-to-X (or V2X) technology which refers to an intelligent transportation system where all vehicles and infrastructure components are interconnected with each other. Therefore, the term "CAV", which is short for connected and autonomous vehicles, was coined. The connected here not only refers to the connections to infrastructures, such as traffic signals and GPS information, but also includes the communication among vehicles in the same vicinity. Connected and autonomous vehicles (CAVs) will have a profound impact on various aspects of urban mobility, such as safety, energy usage, and environmental sustainability, which are considered as the driving change for smart cities. The CAV technology provides an intriguing opportunity to better monitor transportation network conditions, which in turn helps optimize traffic flows, enhance safety, reduce congestion, and minimize emissions. Recent developments in artificial intelligence would make this once science fiction-sounding idea into reality. This project is going to address the safety and energy efficiency issues of CAVs approaching and departing multiple signalized intersections.

Problem Statement

Autonomous vehicles (AVs) commonly known as self-driving vehicles have captured the attention of the public for decades and continue to be the center of attention of academic and industrial research activities worldwide. Their proliferation has rapidly grown, largely as a result of Vehicleto-X (or V2X) technology which refers to an intelligent transportation system where all vehicles and infrastructure components are interconnected with each other. Therefore, the term "CAV", which is short for connected and autonomous vehicles, was coined. The connected here not only refers to the connections to infrastructures, such as traffic signals and GPS information, but also includes the communication among vehicles in the same vicinity. Connected and autonomous vehicles (CAVs) will have a profound impact on various aspects of urban mobility, such as safety, energy usage, and environmental sustainability, which are considered as the driving change for smart cities. The CAV technology provides an intriguing opportunity to better monitor transportation network conditions, which in turn helps optimize traffic flows, enhance safety, reduce congestion, and minimize emissions. Recent developments in artificial intelligence would make this once science fiction-sounding idea into reality. This project is going to address the safety and energy efficiency issues of CAVs approaching and departing multiple signalized intersections. AVs can visualize their environments with highresolution digital camera images and interpret environmental detail, e.g. signs, traffic lights, etc. Beyond the sensory system of a human being, these sensors and communication units provide more accurate information about the surrounding environment of an AV. Lidar systems enable AVs to detect small objects with high precision and calculate distances to objects. AVs equipped with GPS receiver can obtain geolocation and time information. Clearly, an AV can take advantage of information from various sensors in order to go beyond current "stop-and-go" to achieve "stop-free" driving. The challenges of current transportation networks stem from requirements for increased safety, increased efficiency in energy consumption, and lower congestion both in urban traffic with both CAVs and HDVs. Sensors, such as Camera, Lidar, etc., provides AVs with accurately perception of the environments, and AI algorithms enable AVs to navigate safety in the interaction of the environments.

Objectives

The research objective of this proposal is to apply the emerging artificial intelligence (AI) technology to solve the eco-driving problem of connected and autonomous vehicles (CAVs) approaching and departing signalized intersections in a cohabitation environment of CAVs and human-driven vehicles (HDVs)

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Figure 1. CAVs and HDVs approaching a signalized intersection with V2I and V2V communications

Intended Implementation of Research

The implementation of the developed algorithms on robotic cars will demonstrate the usefulness of the algorithms. It can be easily scaled up to apply to real autonomous vehicles.

Anticipated Impacts/Benefits of Implementation

The research activities will have a profound impact not only in terms of transportation system performance, but also in terms of broad economic, environmental, and social effects. The proposed research will directly involve students of undergraduate and graduate levels to train the next generation workforce in this field.

Web links

- Tran-SET's website
  https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.