Determining the Energy and Emissions Characteristics of Autonomous Vehicles

OVERVIEW

Autonomous Vehicle (AV) technology can pilot vehicles more efficiently than humans in one of two ways: **First:** Vehicle-centric efficiency. AV driving behavior is expected to be smoother than human driving behavior, particularly improving fuel economy on city streets. **Second:** Paradigm-centric efficiency. AVs can deliver themselves to meet the needs of the passenger, and Americans only need a single seat vehicle for 76% of their driving activities. An on-demand transit paradigm would deliver exactly what the consumer needs for that trip, resulting in a more efficient allocation of transportation resources. Battery Electric Vehicles (BEVs) are currently being tested as platforms for AV technology, and offer centralized charging platforms.
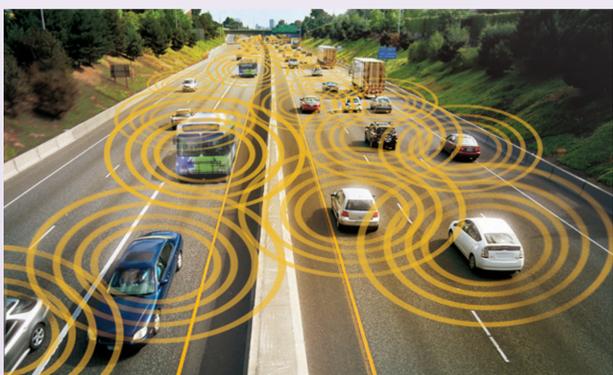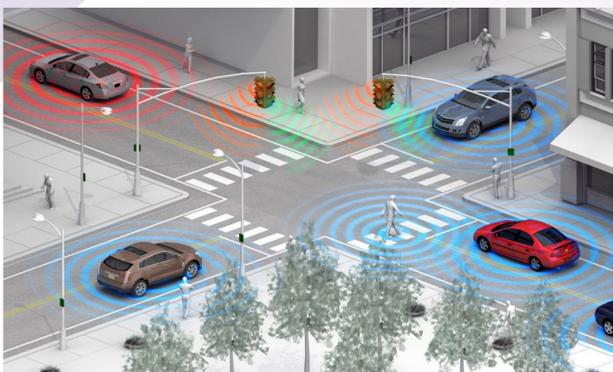
GOALS

The main goals of this research effort are:
- Determine the Vehicle Centric Efficiency of an AV
- Determine the Paradigm Centric Efficiency of an AV
- Calculate overall AV efficiency, resulting AV emissions
- Calculate the energy requirements of alternatively fueled vehicles, such as BEVs, and FCEVs.
- Model the air quality impact of deploying AVs of various powertrains in the South Coast Air Basin
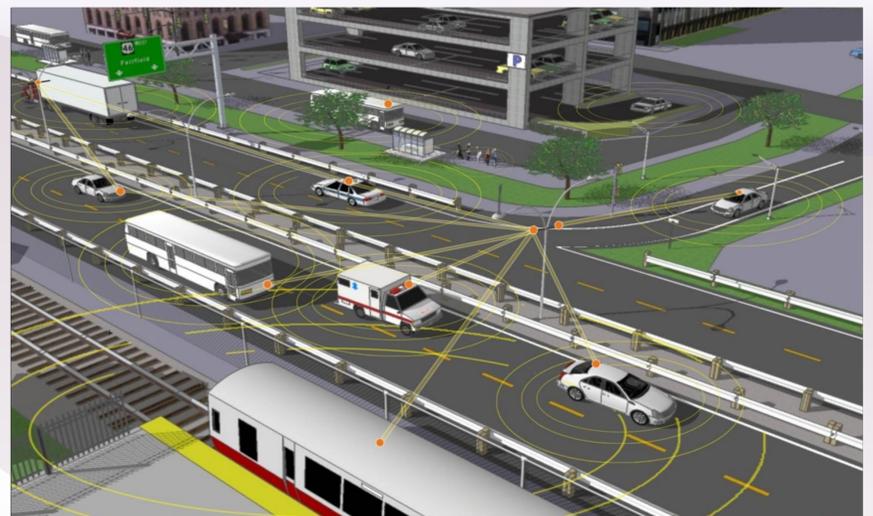
RESULTS

Integrating various advanced environmental sensor technologies on present-day vehicles can lead to efficiency improvements of 3-40%, depending on the technology and the integration strategy. Vehicle to vehicle (V2V) and Vehicle to Infrastructure (V2I) communication systems which exchange transit information have particularly large impact for a relatively modest OEM investment.

V2V Communication

V2I Communication

V2V and V2I Communication

FUTURE RESULTS

For further understanding of the energy impact of light duty transit networks, traffic simulation software is being developed to measure the changes in 1) vehicle behavior with the advanced information that V2V and V2I can provide 2) the resulting changes in energy demand (whether ICE, BEV, FCEV), and 3) the local air quality impacts.

Self-Driving Vehicle

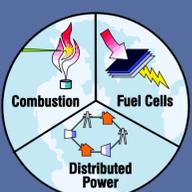**Future of Human Driving**

RECENT PUBLICATIONS/PAPERS

Wifvat, V.T., Brendan Shaffer, G. Scott Samuelsen, "A Survey of Environmental Signals, Sensor Technologies, and Sensor Integration Strategies to Enhance Vehicular Fuel Economy." Transportation Research Part C: Emerging Technologies, Submitted.

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