

2022 Mid-Continent Transportation Research Symposium

Ames, Iowa

September 14–15, 2022

intrans.iastate.edu/events/midcon2022/

Estimating Energy Efficiency of Connected and Autonomous Vehicles in a Mixed Fleet

Jing Dong-O'Brien, Iowa State University

Liang Hu, Iowa State University

Abstract

Connected and autonomous vehicle (CAV) technologies are likely to be gradually implemented over time and in a traffic environment consisting of conventional gasoline vehicles and a significant share of alternative fuel vehicles (AFV). Therefore, operational performance of different engine technologies and the market penetration of CAVs need to be taken into account when designing and evaluating personalized speed advisory and control systems that are targeted at minimizing the energy consumption of individual vehicles as well as the entire system. The objective of this paper is to estimate fuel efficiency of a mixed fleet consisting of CAVs, AFVs and conventional vehicles, taking advantage of on road vehicle energy consumption data and car-following models. In particular, on-board diagnostics II (OBD-II) loggers are installed on a fleet of vehicles to collect vehicle location, velocity, and energy consumption for a period of one year. The fleet consists of 14 conventional gasoline vehicles and 2 plug-in electric vehicles with a variety of size, model and year. For each vehicle, we establish relationships between energy consumption and speed and acceleration profiles. By simulating the car-following behaviors of CAVs and manually driven vehicles in a mixed fleet with different percentage of CAVs, we estimate the energy consumption based on the relationships established from on road fuel economy data. This paper lay foundations for designing control strategies and personalized information systems to minimize energy consumption of the next generation vehicles.