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Research Notes

UTC-Dynamic Routing of Trucks and Truck Platoons Using Real-Time Traffic Simulators

Research the feasibility of using real time traffic simulators for routing trucks and truck platoons

Transportation Safety and Mobility

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Project Title:
UTC-Dynamic Routing of Trucks and Truck Platoons Using Real-Time Traffic Simulators

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WHAT IS THE NEED?

Recent advances in sensing and navigation technologies makes it easier to route vehicles from origin to destination based on assumed traffic characteristics from historical data and available real time traffic data. Google Maps and Waze are some of the most popular commercial applications used for routing instructions. These applications do not distinguish between different classes of vehicles and associated dynamics which often have a big impact on travel time and traffic flow characteristics. There is a need to research the feasibility of using real time traffic simulators for routing trucks and truck platoons, both diesel and electric, in configuration with a route optimizer in order to improve truck routing.

WHAT ARE WE DOING?

The research team at the University of Southern California (USC) will analyze existing optimization tools and focus on how such tools can be integrated with a real-time simulator in order to improve truck routing. They will develop a dynamic routing system for trucks and truck platoons that relies on a real-time traffic simulation model to provide information on the predicted state of traffic. The system will compliment historical and real time traffic information as well as take into account truck and platoon dynamics. More specifically, the research team plans to do the following:

- Develop a traffic flow simulation model with ability to reconfigure itself in real time and account for the dynamics of different classes of vehicles to predict travel times and flows
- Integrate the real time traffic simulator with vehicle routing

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optimization and evaluate the feasibility of the scheme for fast real time routing decisions
- Examine the impact of truck platoons, diesel and electric, on traffic flow and vehicle routing decisions
- Address scalability issues and trade offs

WHAT IS OUR GOAL?

Our goal is to have researchers use existing optimization tools and focus on how such tools can be integrated with a real-time simulator in order to improve truck routing.

WHAT IS THE BENEFIT?

The routing systems can improve the efficiency of truck routing, minimize truck traffic, and improve traffic flow for vehicles on all roads. For example, the system eliminates the driver's need to find the most efficient route since the system would automatically choose a route that minimizes the truck platoon's impact on the road network.

WHAT IS THE PROGRESS TO DATE?

Researchers performed an extensive literature review on characteristics of different types of commercial vehicles, fuel economy and refueling conditions of trucks that are already in service. The studies reviewed were: Port of LA Interim Electric Drayage Report, Foothill Bus Comparative Study, studies from California Air Resources Board (CARB), Frito-Lay Delivery Truck Comparative Study, Smith Newton Trucks Study, Navistar eStar Study, as well as a market survey developed by Giuliano et al.

Researchers used the fuel consumption model for heavy duty diesel trucks to describe the diesel engine and the electric engine of heavy-duty freight vehicles. Researchers used the following typical drive cycles provided by National Renewable Energy Laboratory (NREL): California Air Resources Board (CARB) Heavy Heavy-Duty Diesel Truck (HHDDT) Composite Cycle, CARB Heavy Heavy-Duty Diesel Truck (HHDDT) Creep Segment, CARB Heavy Heavy-Duty Diesel Truck (HHDDT) Cruise Segment, CARB Heavy Heavy-Duty Diesel Truck (HHDDT) Transient Segment, and City Suburban Heavy Vehicle Cycle (CSHVC).

Researchers tested drive cycles with diesel and electric engines and found that the percentage of energy improvements produced by the electric engine when compared with the diesel are summarized as follows:

- Percentage of energy improvement by electric during suburban cycle: 23%
- Percentage of energy improvement by electric during transient cycle: 32%
- Percentage of energy improvement by electric during cruise cycle: 75%
- Percentage of energy improvement by electric during creep cycle: -423%
- Percentage of energyimprovement by electric during composite cycle: 67%

Researchers selected a road network in the Los Angeles area that includes Interstate 710 and the area near the two major ports for their simulation analysis using the commercial VISSIM/VISSUM simulation software.

The next steps are for researchers to continue the work on the microscopic simulation model for the selected network. Also, for researchers to develop the optimization part of truck routing, this involves specifying the cost and adding all constraints especially in the case of truck platoons and electric trucks. Electric trucks will introduce constraints which may be static (i.e. location of charging stations, charging rates etc.) and dynamic (i.e. status of battery at origin, etc.) The results from Task 1 will be used in this task.

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