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Is That Route Really the Most Fuel-Efficient?

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POLICY BRIEF

BACKGROUND AND OBJECTIVES

Many travelers use Google Maps to select the route for their trip and the Google recommendation can therefore have a significant impact on traffic congestion. Google recently added a new route option: the most fuel-efficient route. The algorithm behind this route selection (RouteE, developed by the National Renewable Energy Laboratory) and the information presented by Google to the users at the time of writing claim to examine the current travel conditions on available routes and estimate typical fuel consumption based on those conditions. This should include acceleration/deceleration events as these change of speed events significantly impact fuel consumption and are a critical aspect of selecting the most fuel-efficient route. This consideration is most relevant when comparing the estimated fuel efficiency of a congested highway trip against a free-flowing highway trip, for example when drivers are faced with an option between congested general-purpose lanes (GPLs) or a fast-moving Express/Managed Lane (ML). Initial testing of the Google Maps' routing recommendations indicates it may not account for these speed changes. This study examines if the new route guidance from Google Maps is accurately identifying the most fuel-efficient routes and tests the RouteE API models that generate the underlying route-specific emissions. The study then develops a new methodology for calculating fuel consumption on a route using real-world data.

METHODOLOGY

Several vehicles equipped with on-board diagnostic (OBD) data loggers recorded key aspects of the vehicle operations while driving in real-world traffic conditions. These vehicles were driven on two Dallas–Fort Worth freeways (both GPLs and MLs) during various traffic conditions, which allowed for detailed fuel consumption to be gathered based on the OBD data collected. The data collected from OBD devices were then compared with RouteE and MOVES for their fuel consumption estimation accuracy.

RouteE and MOVES were both found to underestimate the fuel consumption on congested highway trips by a significant margin, which is attributed to the models' lack of consideration of vehicle speed changes under real-world conditions. Thus, it was not surprising that Google Maps would usually identify the GPLs as the most fuel-efficient route when comparing GPLs and MLs. Using the real-world fuel use data along with detailed speed profiles, researchers developed equations that could be used to estimate fuel consumption based on microscopic traffic data on vehicle speeds and speed changes.

RESEARCH FINDINGS

We developed a series of real-world based fuel consumption equations that estimated the fuel used over a 0.2-mile segment of freeway. The equations were built for four different vehicle types (SUV, pick-up truck, sedan, and hybrid) and varied based on the average speed over the 0.2-mile segment, divided into 5 mph groupings. For each vehicle type and average speed, an equation was developed that related the change in speed over the 0.2-mile segment to the fuel used. For example, for a sedan with an average travel speed between 50 and 55 mph that increased speed over the 0.2-mile segment, its fuel consumption in gallons over that 0.2 miles would be 0.0041 + 0.0003 x the speed increase in mph.

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Using our real-world based fuel consumption equations along with detailed Wejo speed traffic data, we found the MLs to be more likely to be the most fuel-efficient, but this varied based on the exact traffic conditions. This was based on a small set of fuel consumption data and is intended to serve as a proof of concept that highlights the importance of including speed changes in the fuel consumption analysis. There needs to be considerably more data collected in real-world conditions to further refine these models of fuel consumption and possibly incorporate these models into route recommendation algorithms. This research shows that this proof of concept model is helpful in estimating route-specific fuel consumption, and thus emissions, when combined with either high-resolution data like that from Wejo or lower-resolution data like that from Google. This model could be used to provide a more accurate estimate of which route really is more fuel-efficient.

POLICY AND PRACTICE RECOMMENDATIONS

The next steps for this effort include working with NREL, Google, Cintra, and MapUP to collect additional real-world data on fuel consumption from a larger variety of vehicles over a greater distribution of roadways. These data would then be used to refine our models of fuel consumption. These models would then be combined with either (a) historical data to estimate typical fuel consumption between origin-destination pairs or (b) real-time data to provide the current, most fuel-efficient route between origin-destination pairs. Both efforts may lead to reduced fuel consumption and emissions anywhere Google Maps is used—particularly where travelers have a choice between free-flow travel and travel with significant speed fluctuations.