Extending range of electric vehicles by 10 percent with GPS-like device

July 18 2012

Researchers at the University of California, Riverside believe they can extend the range of electric vehicles by at least 10 percent by taking into account real-time traffic information, road type and grade and passenger and cargo weight.

The researchers, who work at the Center for Environmental Research and Technology (CE-CERT), which is part of the Bourns College of Engineering, have received a nearly $95,000 one-year grant from the California Energy Commission to develop a eco-routing algorithm that finds the route requiring the least amount of energy for a trip.

"This is particularly useful given the limited range of electric vehicles," said Guoyuan Wu, an assistant researcher at CE-CERT and the principal investigator on the project. "It should really help cut down on what has become known as range anxiety."

Wu will be assisted by co-principal investigators Matthew Barth, director of CE-CERT and the Yeager Families Professor of Engineering, and Kanok Boriboonsomsin, a research faculty member at CE-CERT.

The work on electric vehicles builds upon research by Barth and Boriboonsomsin. They found eco-routing navigation systems can potentially reduce fuel consumption and greenhouse gas emissions in fossil fuel-powered by 5 to 15 percent.

Most electric vehicles have a manufacturer estimated range of 100 miles

or greater. However, range can vary drastically. For example, the range of the Nissan LEAF may vary between 47 and 138 miles depending on driving conditions, such as air temperature, traffic congestion and road grade, according to EPA testing.

In the last decade, there has been a proliferation of GPS-guided navigation systems that assist drivers on which routes to take to their destination. Most attempt to minimize distance traveled. But, in many cases that route doesn't minimize energy consumption or emissions.

Newer generation navigation systems use predicted travel time. But, even the shortest-time route doesn't ensure the minimum energy consumption or emissions.

A number of factors affect vehicle energy consumption, including:

- Traffic conditions: Stop-and-go movement in congested traffic wastes fuel. So, the vehicle energy consumption increases significantly under this traffic condition.
- Road type: Driving patterns on different road types are different. For example, driving on highways often involves cruising at higher speeds. Driving on surface streets often involves more frequent stops due traffic signals, stop signs and more idling. These differences have significant impacts on vehicle energy consumption.
- Road grade: Climbing a steep road grade requires higher power from the engine to overcome the added gravitational force. This increases vehicle energy consumption.
- Weight: A vehicle carrying more weight requires more energy to run, thus impacting its energy consumption rate.
- Weather conditions: Weather conditions have direct and indirect impact on energy consumption. For instance, headwind increases

vehicle energy consumption as the vehicle needs additional power to combat the wind drag. And, using the heater or air condition during hot or cold weather also increases energy consumption.

With the grant from the California Energy Commission, energy consumption data will be collected when an electric vehicle is driven under a variety of real-world driving conditions, including different vehicle speeds, traffic congestion levels, road types, and road grades, with varying number of passengers.

Tables created from the data will be used to develop real-time energy consumption estimate models for the test electric vehicle. The models will then be integrated into an eco-routing algorithm.

The algorithm will then be incorporated into a prototype eco-routing navigation system, which will resemble a small computer screen and be placed on the dashboard. Once in place, testing using an electric vehicle will begin.

Provided by University of California - Riverside