UNIVERSITY OF MINNESOTA
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Route-Based Optimization of Plug-in Hybrid Electric Vehicle (PHEV) Powertrain Operation

A method and system to optimize electric vehicle energy use to limited recharging and refueling

IP Status: US Patent Issued; Patent No. 12,325,322

Applications

- Global connected truck services
- Delivery/last mile vehicles
- Fleet or delivery vehicles
- IoT connected vehicle market for heavy-duty delivery fleet vehicles
- Plug-in hybrid electric vehicles (PHEVs)
- Non-commercial passenger cars; autonomous vehicles
- Transit buses
- Emergency services such as firefighting, ambulance services and police departments
- Rideshare companies

Key Benefits & Differentiators

- **Improved fuel economy and emmisions in PHEV:** Algorithm utilizes historical powertrain data to maximize efficiency of engine in charging battery
- **Increased range of electric vehicles:** Utilizes real-time interaction with the engine's software to predict optimal use and power output of an onboard battery charger

V-PRO minimizes fuel consumption, maximizes battery range

New vehicle powertrain and routing co-optimization (V-PRO) technology helps plug-in hybrid electric vehicles (PHEVs) minimize fuel consumption while maximizing battery range. Using Vehicle to Cloud (V2C) technology, V-PRO merges physics models with spatial data analytics to guide powertrain decisions about energy flow strategy. The cloud-based software as a service (SaaS) platform employs fast computer algorithms that use historical vehicle data and current exogenous parameters (e.g., terrain, weather and traffic) to preprogram a vehicle's powertrain controller at the beginning of the route to optimize efficiency.

Improves battery range, fuel economy and emissions

PHEVs must minimize fuel consumption while maximizing battery range. Current routing software does not interact with powertrain control in vehicles, nor does it consider exogenous factors. These drawbacks limit its ability to make informed, real-time decisions that improve engine performance and fuel economy. V-PRO provides real-time interaction with the engine's software using Vehicle-to-Cloud (V2C) connectivity and integrates routing, two-way telemetry and cloud computing in order to improve battery range, fuel economy and emissions. The technology uses exogenous parameters and routing information in a computationally efficient vehicle model to predict optimal use and power output of an onboard battery charger (generator).

Technology ID

2019-352, 2019-344, 20180025

Category

All Technologies
Engineering & Physical Sciences/Energy
Engineering & Physical Sciences/Instrumentation, Sensors & Controls
Engineering & Physical Sciences/Sustainable Technology
Engineering & Physical Sciences/Transportation
Software & IT/Algorithms
Software & IT/Communications & Networking
Software & IT/Transportation

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Unique algorithms minimize energy costs

The V-PRO algorithm determines each vehicle's required battery charge and extended fuel range based on historical powertrain consumption. The algorithm, which commands a vehicle's engine as to when and how fast to charge the battery, optimizes the engine to run the appropriate duration required so the vehicle returns with the customer-determined charge state (usually around 10%). Recently, newer algorithms were developed for multi-modal vehicles (e.g., Chevy Volt) and electric-only vehicles (e.g., Volvo trucks). Case ID 2019-344 features an algorithm that minimizes energy costs associated with multi-modal vehicles, and Case ID 2019-352 features an algorithm that minimizes energy costs associated with electric-only vehicles and is primarily focused on long-range electric semi-trucks.

Phase of Development

TRL: 4-5
Prototype developed

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

Please contact our office to share your business' needs and learn more.

Press Releases

Kare 11 November 9, 2017, article about initial grant award

Researchers

- **William Northrop, PhD** Professor, Department of Mechanical Engineering