Mechanical Engineering Master's Defense

Look-Ahead Information Based Optimization Strategy for Hybrid Electric Vehicles

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abstract

Advanced Driver Assistance Systems (ADAS) is an essential aspect of the automotive technology in this era of technological revolution, where the goal is to make vehicles more convenient, safe, and energy efficient. Taking advantage of more degrees of freedom available within PHEV, HEV, and FCHEV "energy management" allows more margin to maximize efficiency in the propulsion systems. Road elevations are obtained by use of Geographic Information System (GIS) maps to optimize the controller. The optimization is then reflected on the powertrain of the vehicle.

The approach uses a Model Predictive Control (MPC) algorithm that allows the energy management strategy to leverage road grade to prepare the vehicle for minimizing energy consumption during an uphill and potential energy harvesting during a downhill. The control algorithm will predict future energy/power requirements of the vehicle and optimize the performance by instructing the power split between the internal combustion engine (ICE) and the electric-drive system. Allowing for more efficient operation and higher performance of the PHEV, and HEV. The Thesis presents multiple control strategies designed, implemented, and tested using real-world road elevation data from three different routes. Initial simulation based results show significant energy savings. The savings range between 11.84% and 25.5% for both Rule Based (RB) and DP strategies on the real world tested routes. Future work will take advantage of vehicle connectivity and ADAS systems to utilize Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), traffic information, and sensor fusion to further optimize the PHEV and HEV toward more energy efficient operation.

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