Simulation and Analysis for Forward Powertrain of Hybrid Electric Vehicle

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ABSTRACT

This study is proposed to establish integration technology and methodology for powertrain dynamic performance simulations in Hybrid Electric Vehicle (HEV) system. HEV powertrain system performance integration including the engine, motor control system, and the electronic transmission control system. Data from sensors of each individual system were collected, analyzed and executed according to different vehicle operating conditions. The control strategies of engine, motor and transmission were compared to properly process the sensor data and the corresponding related actuators to achieve the designed HEV performance targets. The HEV powertrain dynamic models were established by using an object-oriented simulation software Matlab/SimulinkR to analyze relationship between the HEV parameters and its performance. This study established HEV plant models with parallel engine and motor configuration. The related HEV parameters effects on performance were compared to evaluate the HEV powertrain performance. The HEV performance calculated including output torque, fuel consumption, vehicle speed, etc. The simulation program was based on the specific engine and motor dynamometer test data; the related control principles were incorporated to modify the dynamic performance response of the HEV. The simulation program contains several submodels to calculate the needed parameters. The fuzzy controllers were developed for forward simulation power distribution for HEV. Models were built and validated by experimental input data including the pedal position and loading torque. The control strategies between different performance such as HEV tractive force requirements for emission, gradability, and acceleration were incorporated with the engine management system to match simulation process. The simulation results were compared with an HEV simulation program ADVISORR. The models developed in this study were used to calculate the fuel consumption and exhaust emission for the future research and development of the HEV. Simulated dynamic performance data correlation can be used for future reference of the HEV design and HEV powertrain management controller settings, reducing the corresponding trial-and-error effort, saving the research and development time and cost.

Keywords : Parallel Hybrid Electric Vehicles, Hybrid System, Power Split.

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