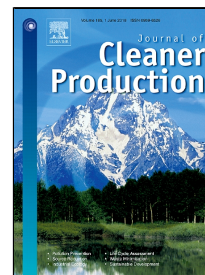


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Rule-Corrected Energy Management Strategy for Hybrid Electric Vehicles Based on Operation-Mode Prediction¹

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Abstract: The energy crisis and exhaust emissions are serious problems that are largely related to road traffic. One solution to these threats is to switch from traditional gasoline-based vehicles to hybrid electric vehicles (HEVs) or electric vehicles (EVs), which also has the benefit of promoting a more sustainable economy. Energy management strategies (EMS) for HEVs or EVs play an important role in improving fuel economy. As a stochastic prediction method, a Markov chain, has been widely used in the prediction of driving conditions, but the application of a Markov chain in the prediction of HEV-operating modes in a rule-based EMS has rarely been presented in the literature. In addition, the threshold selection of rule-based EMS is usually based on experience and it is difficult to achieve optimal performance. In this paper, the impact of operation-mode prediction on rule-based EMS fuel economy has been explored to achieve real-time on-line corrections to motor and engine torque and to enhance their capacity for on-line optimization. Thus, a new EMS for HEV has been proposed based on operation-mode prediction using a Markov chain, which determines the on-line correction of torque distribution between the engine and the electric motor. The Markov decision processes and transition matrix are introduced first, and then, the transition probability matrix and torque correction model are established using the MATLAB/Simulink platform. The results of the simulation show that the proposed approach provides a 13.1% and 9.6% improvement in real fuel consumption under the New European Driving Cycle and the Urban Dynamometer Driving Schedule

¹ The short version of the paper was presented at ICEEE2017/ISEV2017 on July 26-29, 2017 in Sweden. This paper is a substantial extension of the short version of the conference paper.

¹¹ DCT – Dual-clutch Transmission; ECMS – Equivalent Consumption Minimization Strategy; EMS – Energy Management Strategy; EV – Electric Vehicle; GIS – Geographic Information System; GPS – Global Positioning System; HEV – Hybrid Electric Vehicle; ISG – Integrated Starter Generator; ITS – Intelligent Transport System; NEDC – New European Driving Cycle; SOC – State of Charge; UDDS – Urban Dynamometer Driving Schedule.

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