Neural Network-Based Battery Management System for Through-the-Road Hybrid Electric Vehicle

M. F. M. Sabri[1(✉)], M. F. Rahmat[2], M. H. Husin[1], and K. A. Danapalasingam[2]

[1] Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia
msmfaizrizwan@unimas.my
[2] Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia

Abstract. Battery management system (BMS) plays a big role in the safety, performance, and longevity of batteries especially in sophisticated systems such as electrified vehicles. Among all the techniques involved in BMS, the state of charge (SOC) estimation is one of the most important elements as battery utilization depends heavily on it. Unlike other physical parameters, real-time monitoring of SOC is almost unattainable due to its non-linear characteristics which cannot be measured directly. Typically, indirect methods such as open-circuit voltage (OCV) estimation and Coulomb counting are used to estimate the SOC level to a certain degree of accuracy, but these methods are not applicable to all types of batteries which raises the issue of reliability. This reliability concern is related to the efficiency of the main system as the recharging process is directly affected and might jeopardize the operational safety and usage of battery in electrified vehicles. An efficient and reliable BMS can prevent batteries from damages and improves the energy conversion efficiency which can lead to the lower fuel consumption in systems such as hybrid electric vehicles (HEV). In this paper, a neural network-based BMS (NN-BMS) is developed for a through-the-road hybrid electric vehicle (TtR HEV) focusing on the recharging capability of the TtR HEV. A real-time neural network SoC estimator is proposed and the BMS performance is evaluated in Simulink to observe the performance that improves the SOC management of the TtR HEV model by accumulating up to 46% of charging time under extreme condition on NEDC.

Keywords: Battery management system · Neural network · Hybrid electric vehicles

1 Introduction

1.1 Research Background

Fossil fuels still stand as the primary source of energy throughout the various sectors of human activities all over the world. The main reason for this is because fossil fuel currently is still the most convenient source of energy which leads to the production rates to rise annually as the demand increases despite the volatility of its supply chain

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