Prediction of lithium-ion battery temperature in different operating conditions equipped with passive battery thermal management system by artificial neural networks

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ABSTRACT

Lithium-ion batteries generate an enormous amount of heat during constant operation or rapid charge and discharge, which can result in a substantial increase in temperature, affecting the battery performance, reducing its cycle life, and potentially posing a safety issue. As a result, phase change materials (PCMs) based battery thermal management system (BTMS) can be used to control temperature of the battery and improve its performance. Moreover, with the increasing usage of artificial intelligence in a variety of disciplines, it appears to be worthwhile to investigate artificial intelligence approaches to evaluate various types of battery thermal management systems. The main aim of this study is to develop an artificial neural network (ANN) model for prediction of lithium-ion battery temperature equipped with a BTMS. The inputs of the model are discharge rate (1,2 ,3 and 4C), PCM thicknesses (0, 3, 6, 9, and 12 mm), Time (s) and PCM (with and without paraffin/ graphene PCM composite). The output of the model is temperature of the battery (C). Totally, 2012 data points were used to train, validation and test the model. The results of the study revealed capability of ANN to predict battery temperature in various operating conditions of BTMS. The R2, MSE, MAD and MAPE of the model were 0.99, 0.0173, 3.84 and 0.331, respectively. The results of the study have approved suitability of the ANN to predict performance of the passive BTMS.

KEYWORDS

Ann; Battery thermal management; Bfgs; Li-ion; Nepcm

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