Using the evolutionary mating algorithm for optimizing deep learning parameters for battery state of charge estimation of electric vehicle

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ABSTRACT

This paper presents the application of a recent metaheuristic algorithm namely Evolutionary Mating Algorithm (EMA) for optimizing the Deep Learning (DL) parameters to estimate the state of charge (SOC) of a battery for an electric vehicle in the real environment. The recorded data were obtained from 70 real driving trips of a BMW i3 EV, where the inputs of the DL were the voltage, current, battery temperature and ambient temperature while the output was the real SOC recorded during all trips. The data were divided into 60 trips for training and the final 10 trips for testing the performance of the developed EMA-DL model. The findings of the study demonstrated the promising results of EMA-DL in terms of obtaining the minimum error, which significantly increases the accuracy of the SOC estimation. To show the effectiveness of EMA-DL, comparison studies were conducted among other metaheuristic optimizers that were also used to optimize the DL parameters viz, Particles Swarm Optimization (PSO), Genetic Algorithm (GA), Differential Evolution (DE) as well as the Adaptive Moment Estimation (ADAM). According to the simulation results, the proposed EMA-DL algorithm was found to outperform all the other compared algorithms based on the evaluated metrics. Thus, it can be employed as a proficient technique to accurately estimate the state of charge (SOC) of electric vehicle batteries.

KEYWORDS

Battery state of charge estimation; Deep learning; Electric vehicles; Evolutionary mating algorithm; Metaheuristic algorithms; Weights and biases optimization

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