ABSTRACT

The rapid advancement of the automotive industry has undoubtedly spurred societal progress, but there have also been pernicious consequences for the environment that cannot be ignored. Electric vehicles are the key technology to decarbonise road transport, a sector that accounts for around one-sixth of global emissions. They not only save money at large but also contribute to a green and sustainable environment. In spite of their numerous benefits, EVs also have their fair share of challenges. Limited range-induced range anxiety, energy minimisation and its conservation are prime factors that have influenced the acceptance of EVs to date. This research work introduces eco-routing in EVs and their potential to minimise energy usage. The main aim is to quantify the energy consumption during a manoeuvre and demonstrate the functionality of an eco-route, which contributes to extending the range of the EV. In this work, the major factors influencing the energy use in EVS have been identified and analysed. A road-load model based on those factors has been constructed to obtain the energy consumption of an EV. Special focus has been given to the factor of road grade, which is usually neglected in most researches. The performance of this model has been validated with data acquired from on-road tests performed on a lightweight BEV prototype that has been developed in the laboratory. Various sensors attached to the prototype help in obtaining real-time data on the energy contributing factors while driving the vehicle. Individual estimation methods have been applied in the test prototype to obtain these parameters for estimation of power consumed and the remaining range of the EV. This work also highlights the importance of using the electric motors at the correct operating range, and therefore a semi-automated technique for extracting the torque speed characteristics of DC motors has been proposed. Energy minimization includes good battery technology, and a method to extract important battery parameters and estimate its Coulombic efficiency has been presented. Additionally, an artificial neural network has been discussed that is used for the prediction of the energy consumption of an electric vehicle during a manoeuvre. This research will prove useful for electric vehicle-based applications that deal with energy-efficient communication and navigation.

Keywords: coulombic efficiency, eco-routing, electric vehicle, energy consumption, lead acid battery, PMDC motor , parameter extraction, range anxiety, state-of-charge.