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ANF-RBC CONTROLLER TO REGULATE POWER FLOW OF ELECTRIC PROPULSION IN ELECTRIC VEHICLES

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ABSTRACT–In this paper design and simulation of a rule-based controller explained with performance analysis by using an adaptive-neuro-fuzzy and hybrid electric energy storage system to regulate power flow of electric propulsion in EVs named as (ANF-RBC) controller. In this proposed controller a hybrid electric energy storage system (HEESS) generated reference current and proposed controller for decreasing non-linear similarity generated by the usage of HEESS. Performance analysis of proposed controller carried out under three different load conditions and comparative analysis performed with existing one linear and three non-linear controllers. For performance trac under various loaded conditions done with greater than or equal to 90 % of battery current. By observing performance results of proposed controller, reducing non-linearity generated by HEESS and smooth tracking done well than that of traditional linear and non-linear controllers used in EVs. In performance analysis by using obtained results, we can infer proposed controller 17 %, 12 %, 10 % higher than existing RFOSM control, when compared with ASMC controller the proposed controller 25 %, 17 %, 13 % greater, proposed controller performance is 29 %, 21 %, 15 % greater than that of SMC controller and in case of comparing with existing PIDC controller with that of proposed controller performance is 32 %, 26 %, 19 % greater under heavily loaded, mediumly loaded and under lightly loaded condition respectively for all linear and non-linear traditional controllers.

KEY WORDS : (ANF-RBC) controller, Takagi sugano fuzzy based rules, HEESS, Performance analysis, Different load conditions

NOMENCLATURE

ANF-RBC : (ANF-RBC) controller
LiBs/ECDLSCs : lithium-ion batteries/electro chemical double layer super capacitors
RFOSMC : robust fractional-order sliding mode control
ASMC : adaptive sliding mode control
SMC : sliding mode control
PIDC : proportional integral derivative controller
HEVs : hybrid electric vehicles
EVs : electric vehicles
EMSs : energy management systems
HEESS : hybrid electrical energy storage systems
PMBLDC : permanent magnet brushless direct current
DCBV : direct current bus voltage
SCC : supercapacitor current
IAE : integral absolute error

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1. INTRODUCTION

Pure and hybrid electric vehicles invention solving the problems arising with the usage of conventional transport-tation vehicles such as saving fueling and maintenance cost, usage of EVs for effective environment protection (Luin *et al*., 2019), no toxic emission and with easy operation. In different types of modes of transportation electric and hybrid electric vehicles were preferred. Because of different types of issues percentage of EVs and Hybrid EVs as mode of transportation percentage is very less globally. Selecting an appropriate energy management system for storage (Goud *et al*., 2020b) and reduction of energy consumption and designing suitable controller to solve problems due to energy storage systems were some of major problems in EVs and HEVs. Jaiswal *et al*. (2013) designed speed control in DC motors used in EVs, Hu *et al*. (2014) proposed advanced characteristics used in HEESS, Matsumura *et al*. (1993) were developed an EV using PID controller to control speed, Miao *et al*. (2019) and Kouchachvili *et al*. (2018) designed a hybrid energy storage system to balance power in case of accelerated and regenerative conditions, which in turn reduce size, cost and