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Fuzzy Logic and Passivity-Based controller applied to Electric Vehicle using Fuel Cell and Supercapacitors Hybrid Source

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Abstract

Electric vehicles using Fuel Cell (FC), as a substitute for internal-combustion-engine vehicles, have become a research hotspot for most automobile manufacturers all over the world. Fuel cell systems have disadvantages, such as high cost, slow response and no regenerative energy recovery during braking; hybridization can be a solution to these drawbacks. This paper presents a modelling and control strategies of hybrid DC link which is equipped with a fuel cell system as a main source and a supercapacitor (SC) as an auxiliary power source as well. An energy management strategy based on passivity based control using fuzzy logic estimation, which is employed to control the power source, is described. This fuzzy estimation is capable to determine the desired current of SC according to the SC state of charge (SoC) and the FC remaining hydrogen quantity (QH_2). Finally, the computer simulation results under Matlab verify the validity of the proposed controller and demonstrate that the proposed controller provides robust dynamic characteristics.

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Keywords: Fuel cell, Supercapacitor, Passivity-Based Control, Energy Management, Fuzzy Logic Estimator, Hybrid Vehicle;

1. Introduction

Researches on the power propulsion system of EVs have drawn significant attention in the automobile industry and among academics. EVs can be classified into various categories according to their configurations of the used power sources e.g. pure EV or hybrid EV. On other hand, Fuel cell vehicles have been proposed as a potential solution in the case of automobiles but a fuel cell system alone, integrated into a vehicular power, is not always sufficient to supply propulsion power for a vehicle, because fuel cell systems have some deficiencies, such as high cost, slow response and no regenerative energy recovery during braking. Hybridization of a fuel cell system with energy storage devices

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