Neural Network Based MPPT Controller with Boost Converter For Fuel Cell Based Electric Vehicle Applications

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Abstract

As a result of stricter regulations on carbon emissions and fuel economy, Fuel Cell Electric Vehicles (FCEV) vehicles are becoming increasingly popular in the automotive industry. This paper presents the neural network Maximum Power Point Tracking (MPPT) controller of the 1.26 kW Proton Exchange Membrane Fuel Cell (PEMFC), which provides the electric vehicle's powertrain using DC-DC power converters. The proposed neural network MPPT controls using the Radial Basis Function Network (RBFN) PEMFC Maximum Power Point (MPP) tracking algorithm. High frequency switching and high DC-DC converting power are important for the continuation of FCEV. For maximum power gain, the three-phase power supply Interleaved Boost Converter (IBC) is also designed for the FCEV system. The interleaving process reduces the current input pressure and power pressure on the semiconductor power devices. FCEV system

performance analysis with RBFN based MPPT control compared to Fuzzy Logic Controller (FLC) on the MATLAB / Simulink platform.

Keywords: *Fuel cell, boost converter, high voltage gain IBC, PEMFC, MPPT, RBFN*

Introduction

Due to The Environmental Pollution And Finite Reserves Of Fossil Fuels, Automobile Industries Are Showing More Interest In electric cell Electric Vehicles (FCEV). The Rapid Advancements In Power Electronics And electric cell Technologies Have Empowered the numerous Development In Fcevs. Fuel Cells Have the advantages of fresh Energy Production, High Reliability, High Performance And Low Sound.. counting on the kind Of Electrolyte Substance cells Are Categorized Into differing types like

Proton Exchange Membrane Fuel Cell (PEMFC), Alkaline cell (AFC), oxyacid electric cell (PAFC), Solid oxide cell (SOFC) and Molten Carbonate electric cell (MCFC). within the midst of all of this, Pemfcs controls the automotive industry because of its cold and fast start.

FUEL CELLS

Thanks to Environmental Pollution and also the End of Natural Oil Depot, the Automotive Industry Shows More Interest in Electric Electric Vehicles.

Fuel Cells Have the advantages of unpolluted Power Generation, High Reliability, High Efficiency And Low Noise.

PEMFCs Are Dominating the car Industry due to Their Low Operating Temperature and also the fast Start-up.

MPPT

The MPPT Algorithms, P&O is easy, popular and straightforward to use. P&O And Incremental Conduction Methods Produces Oscillations At Steady State which is able to Reduce Efficiency Of cell System.

To beat This Problem, symbolic logic Controller And Neural Network Algorithms Are Introduced to trace MPPT With Increased Efficiency And Accuracy.

Radial Basis Function Network (RBFN) MPPT Base Control Suggested PEMFC MPPT Tracking.

Objectives

The primary objectives of this study are often summarized as follows:

1) To study the Neural Network Based MPPT Controller.

2) To understand the Boost Converter concept deeply.

3) To study the novel MPPT topology, modulation strategy & operating principles in

detail.

4) To study simulation validations of the proposed system.

Literature survey

1 Bagai "High Voltage Gain Interleaved Boost Converter and Neural Network Based MPPT Controller Fuel Cell Based Electric Vehicle Applications" International Journal of Technology in Modern Engineering & Science Volume 5, Issue 5, May 2019

This Paper cater to Environmental Pollution And Finite Reserves Of Fossil

Fuels, Automobile Industries Are Showing More Interest In cell Electric Vehicles (FCEV). The Rapid Advancements In Power Electronics And cell Technologies Have Empowered the numerous Development In Fcevs . Fuel Cells Have the benefits of unpolluted Power Generation, High Reliability, High Efficiency And Low Noise. counting on the kind Of Electrolyte Substance cells Are Categorized Into differing kinds like Proton Exchange Membrane Fuel Cell (PEMFC), Alkaline electric cell (AFC), oxyacid cell (PAFC), Solid Oxide electric cell (SOFC) And Molten Carbonate electric cell (MCFC). Among All of those, Pemfcs Are Dominating the car Industry because of Their Low Operating Temperature and also the Quick Startup.

2 El Mana Bahoumi, Ikram Ben Belgacem "A Neural Network Based Four Phases Interleaved Boost Converter for cel System Applications" IJERT December 2018

This paper presents an easy strategy for controlling an interleaved boost converter that's accustomed reduce the present fluctuations in proton exchange membrane fuel cells, with high impact on the electric cell lifetime. to maintain the output power at the required reference value under strong fluctuations in flow rate, power supply, and temperature, a neural network controller is constructed and operated using Matlab-Simulink (R2012b, Math Works limited, London, UK). The advantage of this controller resides in its simplicity, where limited number of tests is administrated using Matlab- Simulink to construct it. to analyze the robustness of the proposed converter and therefore the neural network controller, strong variations of the fuel rate of flow, fuel supply pressure, temperature and air supply pressure are applied to both the cell and therefore the neural network controller of the converter. The simulation results show the effectiveness and also the robustness of the both the proposed controller and converter to regulate the load voltage and minimize this and voltage ripples. As a result, the current oscillation of the cell is greatly reduced on the one hand, while on the other hand, the load voltage stabilizes during the variation.

Problem Identification

EXISTING CONFIGURATION

The wheelwork Architecture of FCEV Is

Shown in Fig. A Stack of PEMFC Produces an Unregulated Low Dc Output Voltage.

Boost or step-Up DC-DC Converter Is Required to spice up and Regulate the PEMFC Output Voltage.

A quadratic boost converter composed of two boost converters is proposed to understand high voltage gain. But, using of two boost converters may reduce the efficiency of the system. A 2-phase flexible converter amplified between DC-DC protective is typically recommended. However, this topology suffers from poor reliability and fewer efficiency.

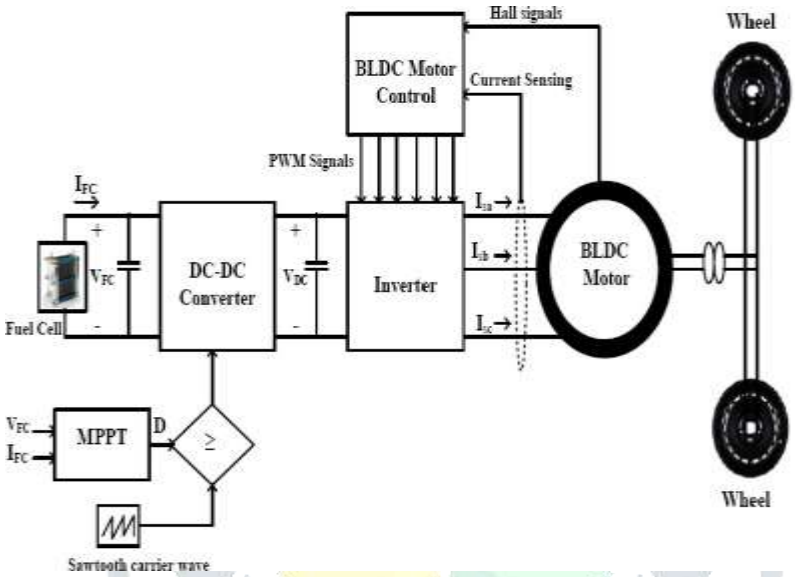

Fig 1. Conventional configuration of cell fed BLDC motor driven electric vehicle

DISADVANTAGES OF EXISTING CONFIRGURATION

Poor Reliability

Less Efficiency.

Expensive

For Low Power Applications, the standard Boost Converter is utilized As an influence Electronic Interface Whereas for prime Power Applications Boost Converter won't Be Compatible because of Its

Low Current Handling Capability And Thermal Management Issues.

To Overcoming These Variable Voltage Gain Dc-Dc Built-In Information.

Proposed Configurationwork

The project proposes that high voltage acquisition of three single-phase interleaved boost converter (IBC) of fuel-efficient metals for low switching difficulties and high voltage gain. The method used to save time increases the reliability of the fuel cell and provides high power of Fig. Displays the proposed FDCV.

FDCV system with IBC with a higher level. It consists of 1.26 Kw PEMFC, an IBC with a 3-phase high-voltage power supply, voltage source inverter (VSI) and a BIDC motor. The third phase of the IBC serves as an interface between PEMFC and VSI. The RBFN-based algorithm is designed to deliver high power to a fuel cell. The I-3-phase IBC provides BLDC vehicle power with VSI. VSI switching is controlled using the BIDC motor electronics. The motor shaft is connected to the car's wheels for the propulsion.

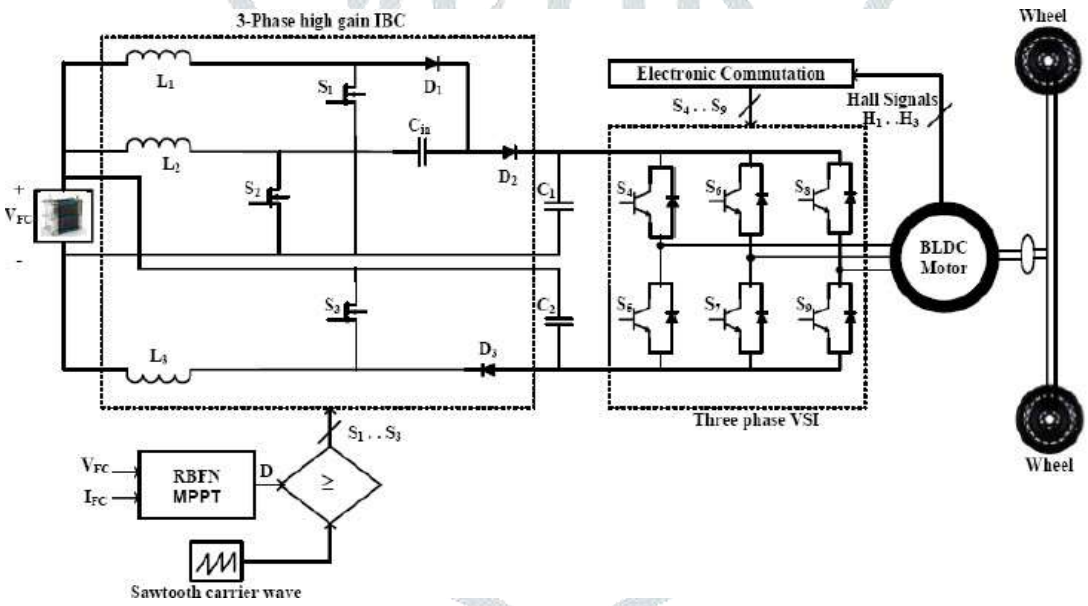

Fig.2. The proposed BLDC motor driven FCEV system with three-phase high voltage gain IBC

- ***ADVANTAGES OF PROPOSED CONFIGURATION***

1. *Clean power generation,*
2. *High reliability,*
3. *High efficiency*
4. *Low noise*
5. *High voltage gain*

- ***APPLICATIONS***

1. *Fuel cell applications*

2. *Solar power applications*

Conclusion

High Phase Converter DC-DC Converter is proposed for FCEV applications. The Proposed Converter Has Reduced The Fuel Cell Input Current Ripples And The Voltage Stress On The Power Semiconductor Switches. The RBFN Based MPPT Technique Is Designed For 1.26 Kw PEMFC For Extracting the Maximum Power From The Fuel Cell At Different Temperatures. Suggested MPPT Method Compared with FLC MPPT Controller. The Simulation Results Reveal That the RBFN Based MPPT Controller Has Tracked The Maximum Power Point Faster When Compared To The Fuzzy Logic Controller. Also, Different Performance Characteristics Of The BLDC Motor Such As Electromagnetic Torque, Speed And Back EMF Are Analyzed At Different Temperatures Of The Fuel Cell System.

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