BATTERY MANAGEMENT SYSTEM IN ELECTRIC VEHICLES

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Abstract: This study develops a newly designed, patented, bidirectional dc/dc converter (BDC) that interfaces a main energy storage (ES1), an auxiliary energy storage (ES2), and dc-bus of different voltage levels, for application in hybrid electric vehicle systems. The proposed converter can operate in a step-up mode (i.e., low-voltage dual-source-powering mode) and a step-down (i.e., high-voltage dc-link energy-regenerating mode), both with bi directional power flow control. In addition, the model can independently control power flow between any two low-voltage sources (i.e., low-voltage dual-source buck/boost mode). Here in, the circuit configuration, operation, steady-state analysis, and closed-loop control of the proposed BDC are discussed according to its three modes of power transfer. Moreover, the simulation results for a proposed system are provided to validate through MATLAB/SIMULINK software.

Keywords: Bi directional power flow control, MATLAB/SIMULINK model

1 Introduction

Nowadays the electric vehicle (EV) has been developed in such a way that electric motors, battery and charger replace the engine.In other word, instead of using fossil fuel to move the vehicle, in this case we used a pack of batteries to move it. Global climate change and the abnormal rising international crude oil prices call for the development of electric vehicles(EV's). This study reveals that the vehicles' operational constraints, such as initial acceleration and grade, can be met with minimum power rating if the power train can be operated mostly in the constant power region. Several examples are presented to demonstrate the importance of the constant power operation. Operation of several candidate motors in the constant power region are also examined. Their behaviors are compared and conclusions are made.

1.1 Objective

This study proposes a new BDC topology for FCV/HEV power systems that consists of an interleaved voltage- doubler structure [9, 28] and a synchronous buck-boost circuit. It features two main operating modes: a low-voltage dual-source-powering mode and a high-voltage dc-bus energy-regenerating mode. In addition, the proposed converter can independently control power flow between any two low-voltage sources when in the low-voltage dual-source buck/boost mode. A similar topology was introduced in [29] that only describes a brief concept. By contrast, this study presents a detailed analysis of the operation and closed-loop control of this new topology as well as simulation results for all its modes of operation. Moreover, this study expanded the topology presented in [29] because the proposed converter can operate over a wider range of voltage levels.

- To interface more than two DC sources for different voltage levels.
- It controls the power flow.
- It enhances static voltage gain.
- It possesses a reasonable duty cycle.

2 Overview

Global climate change and energy supply is declining have stimulated changes in vehicular technology. Advanced technologies are currently being researched for application in future vehicles. Among such applications, fuel-cell hybrid electric vehicles (FCV/HEV) are efficient and promising candidates. In the past, Ehsani et al. studied the vehicles' dynamics to look for an optimal torque-speed profile of the electric propulsion system. Emadi et al. discussed the operating properties of the topologies for different vehicles including HEV, FCV, and more electric vehicles. Emadi et al. also integrated power electronics intensive solutions in advanced vehicular power systems to satisfy huge vehicular load. Schaltz et al. sufficiently divide the load power among the fuel cell stack, the battery, and the ultra capacitors based on two proposed energy-management strategies. Thounthong et al.studied the influence of fuel-cell (FC) performance and the advantages of hybridization for control strategies.

2.1 Advantages:

The following are the advantages of Battery Management System in Electric Vehicles:

- Eco friendly system.
- Power flow control.
- Stable and reliable.
- Enhances the life span of the battery cells in EVs.
- Frequent Monitoring of Battery Health.

2.2 Limitations:

The following are the Limitations of Battery Management System in Electric Vehicles:

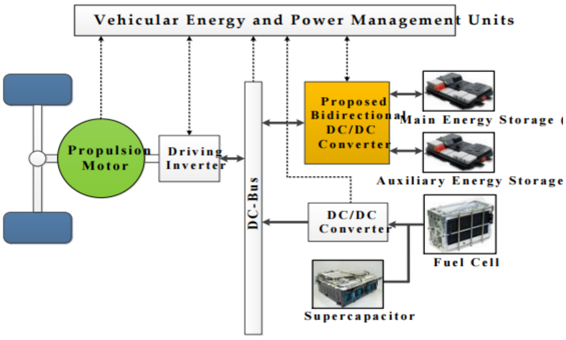
- Designing of internal battery pack topology.
- Including a mechanism for the BMS to balance the cells.

3 Methodology

The low-voltage FC stack is used as the main power source, and SCs directly connected in parallel with FCs. The dc/dc power converter is used to convert the FC stack voltage into a sufficient dc-bus voltage in the driving inverter for supplying power to the propulsion motor. Furthermore, ES1 with rather higher voltage is used as the main battery storage device for supplying peak power, and ES2 with rather lower voltage could be an auxiliary battery storage device to achieve the vehicle range extender concept. The function of the bidirectional dc/dc converter (BDC) is to interface dual-battery energy storage with the dc-bus of the driving inverter. Generally, the FC stack and battery storage devices have different voltage levels. Several multiport BDCs have been developed to provide specific voltages for loads and control power flow between different sources, thus reducing overall cost, mass, and power consumption.

A functional diagram for a typical (FCV/HEV) power system is illustrated in Fig.3.1.

Fig.3.1. Typical functional diagram for a FCV/HEV power system.



To overcome this drawback, a three-port power converter that has high-gain characteristic and contains FC, battery sources and stacked output for interfacing HEV, as well as a dc-micro grid was presented. Although the multiport BDC discussed can interface more than two sources of power and operate at different voltage levels, it still has limited static voltage gains, resulting in a narrow voltage range and a low voltage difference between the high and low-side ports.

4. Software Description

MATLAB is an intelligent framework whose fundamental information component is a cluster that does not require dimensioning. This permits taking care of numerous specialized registering issues, particularly those with network and vector plans, in a small amount of the time it would take to compose a program in a scalar non-intelligent language, for example, C or FORTRAN.

4.1 SIMULINK MODEL:

The Fig 4.1 & Fig 4.2 are the Simulation models of low-voltage dual source powering mode and high voltage dual regenerative mode of battery

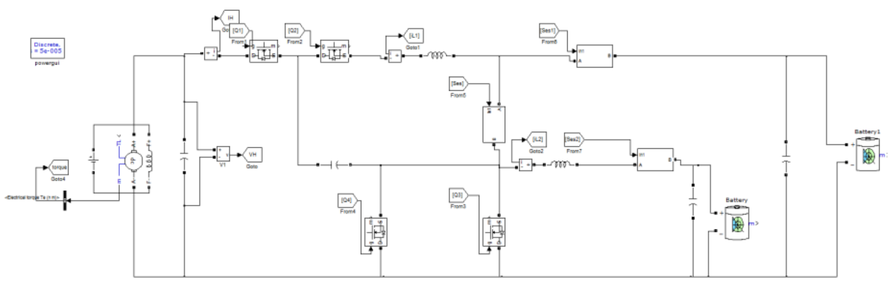


Fig 4.1: Simulation Block Diagram

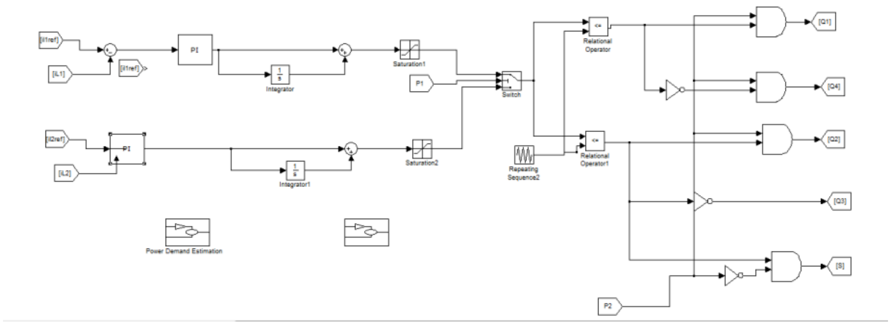


Fig 4.2. Simulation Control Diagram

4.2 OUTPUT RESPONSES:

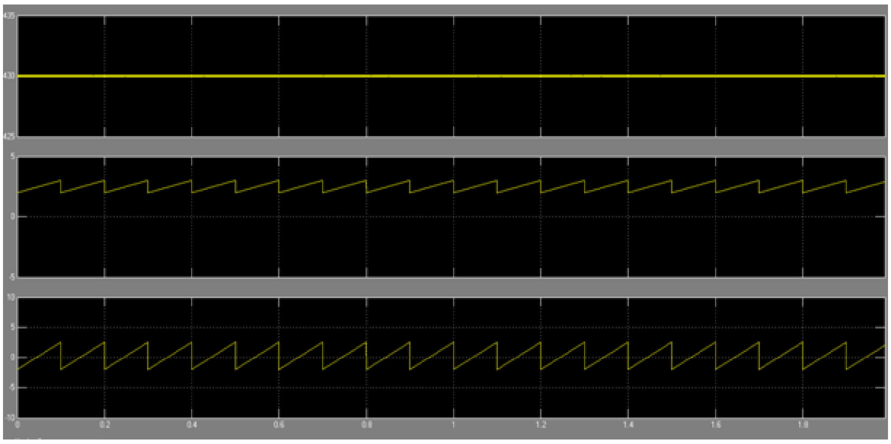


Fig 4.3 : Measured waveforms for low-voltage dual-source-powering mode: (b) output voltage and inductor currents.

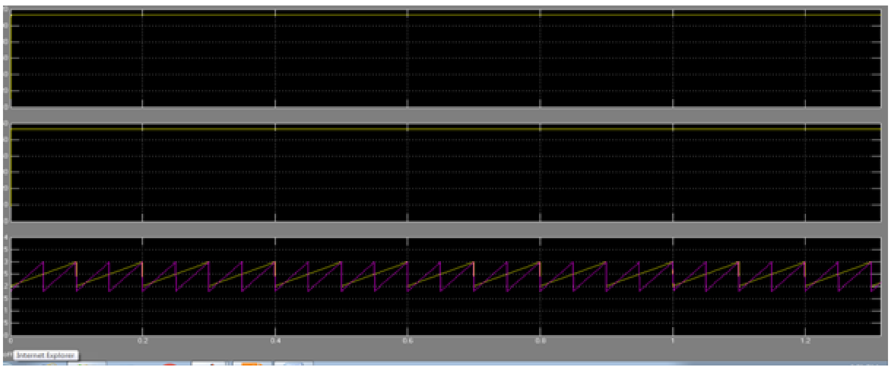


Fig 4.4 : Measured waveforms for high-voltage dc-bus energy-regenerating mode

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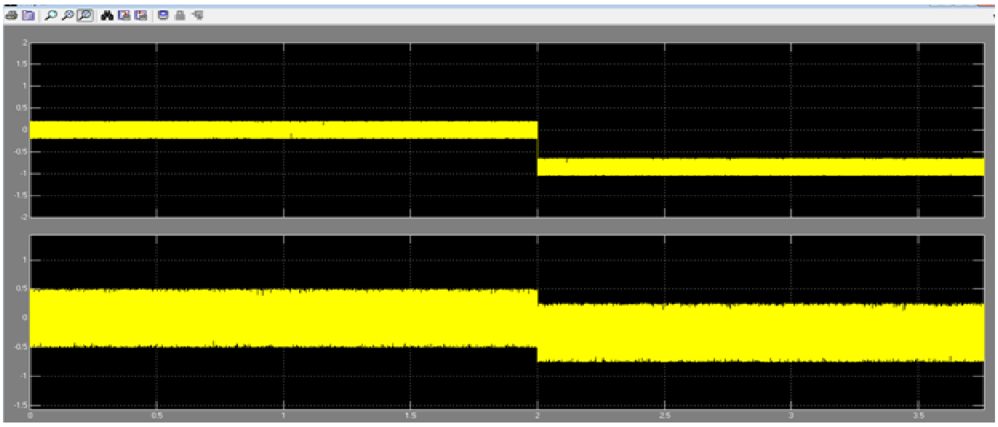

Fig 4.5: Waveforms of controlled current step change in the low-voltage dual-source-powering mode by simulation

4.3 SIMULINK MODEL OF FUZZY LOGIC:

The Fig 4.6 is the simulation model of fuzzy logic control in the low-voltage dual-source boost mode and low-voltage dual- source buck mode.

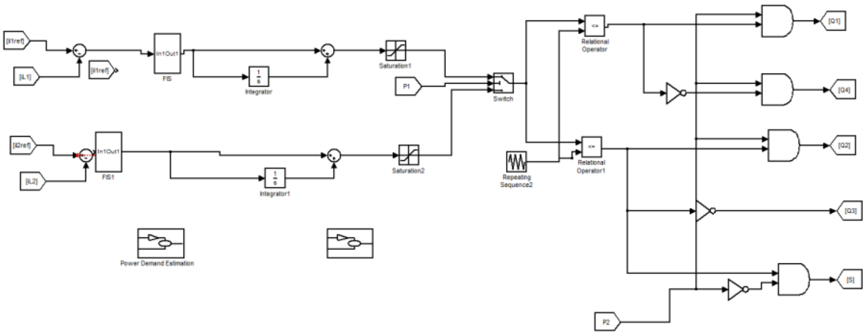

Fig 4.6. Simulation of fuzzy logic Control Diagram

4.4 OUTPUT RESPONSES OF FUZZY LOGIC:

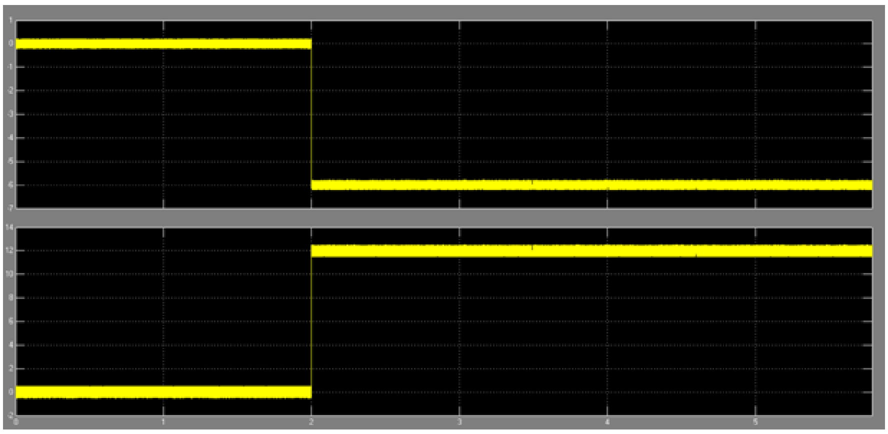

Fig 4.7. Waveforms of controlled current step change in the low-voltage dual-source boost mode: by simulation

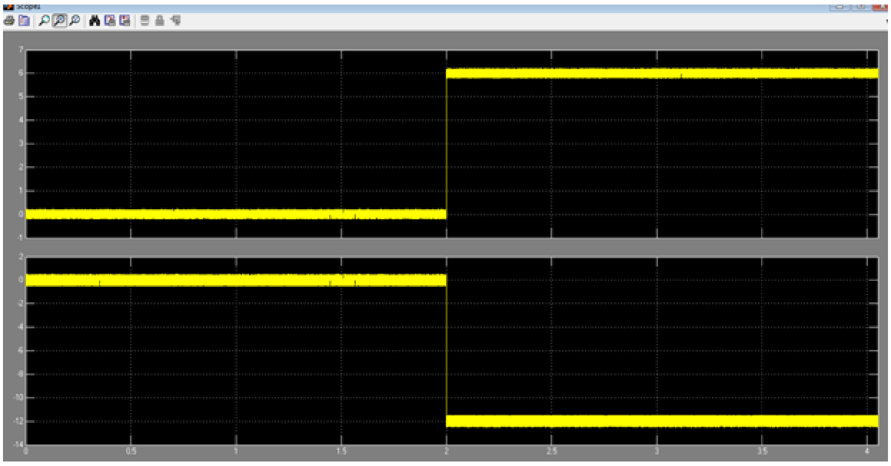

Fig. 4.8. Waveforms of controlled current step change in the low-voltage dual- source buck mode: by simulation

5. Conclusion

A new BDC topology was presented to interface dual battery energy sources and high-voltage dc bus of different voltage levels. The circuit configuration, operation principles, analyses, and static voltage gains of the proposed BDC were discussed on the basis of different modes of power transfer. Simulation waveforms for a 1 kW prototype system highlighted the performance and feasibility of this proposed BDC topology. The highest conversion efficiencies were 97.25%, 95.32%, 95.76%, and 92.67% for the high-voltage dc-bus energy-regenerative buck mode, low-voltage dual-source-powering mode, low-voltage dual-source boost mode (ES2 to ES1), and low-voltage dual-source buck mode (ES1 to ES2), respectively. The results demonstrate that the proposed BDC can be successfully applied in FC/HEV systems to produce hybrid power architecture.

6. Future Scope

- Urbanization has caused numerous effects on public life.
- Nowadays, the everyday exercises are for the most part dependent on vehicles.
- a large number of vehicles are generally subject to nonrenewable energy resources like petroleum and diesel.
- Lack of resources, the fuel costs increasing then we shift to different types of engines.

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