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ANN Based Energy Management Strategy for Electric Vehicle with Battery & Ultra-Capacitor Module

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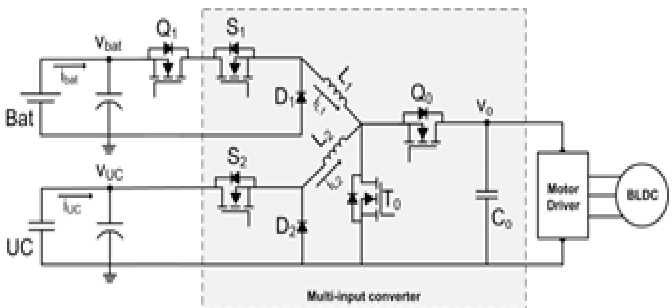
Abstract

Multi-input converters (MICs) uses less number of components that other converters in Hybrid Energy storage systems (HESS). It is simple in control over multiple energy sources. The power levels of sources can be easily manipulated by an Energy Management Strategy (EMS). This system comprises in EMS which confines a battery/ultra capacitor, HESS that contains bidirectional Microphones to the electric vehicles (EVs). Energy transfer is easily managed between battery and UC. The planned EMS mainly focuses on the charge of UC, its control and its life cycle of the battery with the use of an Artificial Neural Network (ANN). Therefore, it increases the life of battery as well as ultra capacitor..

Keywords; *Battery, Energy Management Strategy, Electric Vehicle, Ultra capacitor, Hybrid energy storage system.*

I. INTRODUCTION

Figure 1 shows the MIC used in this proposes work and it has used for detailed analysis. it comprises of four switches, S1, S2, T0, and Q0, two power diodes namely, D1 & D2 with 2 inductors, L1 and L2, and a capacitor (output) represented as Co. This MIC operates in three modes as denoted in Figure 2. In mode 1, it operates in discharging state. During this way, the output has been supplied by inputs referred to states S1 and S2 and T0. Diodes D1 and D2 operate are in complementary mode operation with respect to S1 and S2 state.



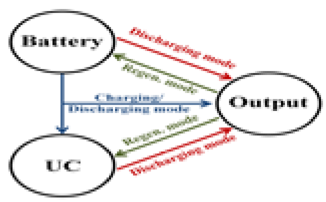


Fig. 2. Operation modes of the MIC

In mode 2 it operate in regenerative mode, during this mode, Q0 controls does the operation of regenerative braking energy to energize ESSs voltage levels. The Q1 switch is inserted at the output of battery enabling the control over charging current. During regenerative mode of operation, diodes D1 & D2 kept in OFF state, the diode T0 will conduct for carrying the inductor currents when Q0 is at OFF condition. Mode 3 operation is termed as charging/discharging mode, During this mode ,the surplus power available can allowed to store into the other input source mode when the power of output power is limited than that of the input power. Depending upon the reference value of input power we can assume and control S1 or S2 accordingly and

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T0 switch is provided to control and regulate the dc bus. Equivalent circuits applicable for this is been included for these modes and are as depicted in Figure 3. Under III. Regenerative mode with UC in on state takes place mainly when Q1 is OFF Equation (1), (2) & (3) is closely associated with the input source voltage and output voltage during discharging, regenerative, and charging/discharging modes .

$$V_0=V_{bat}\frac{ds_1}{1-d_{T0}}=V_{UC}\frac{ds_2}{1-d_{T0}} \quad (1)$$

$$V_0=\frac{V_{UC}}{d_{Q0}} \quad (2)$$

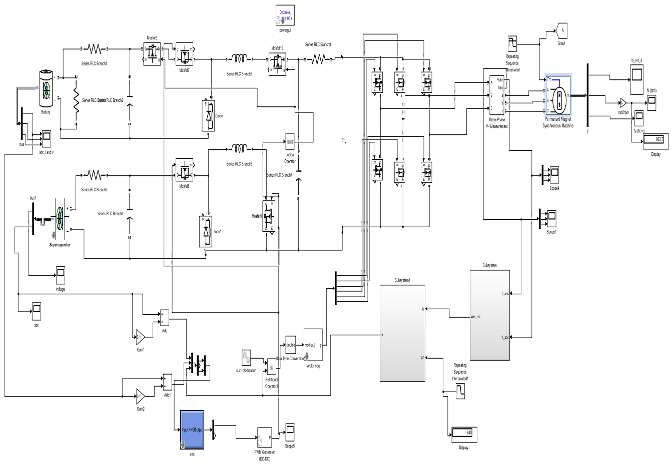
$$V_0=V_{bat}\frac{ds_1}{1-d_{T0}}=V_{UC}\frac{1}{1-d_{T0}} \quad (3)$$

v_0,v_{bat},v_{UC}, , represents the output voltage, battery voltage and UC voltage during steady state operation.ds_1,ds_2,dT_0,dQ_0 indicates the duty cycles of s_1,s_2,T_0, andQ_0.

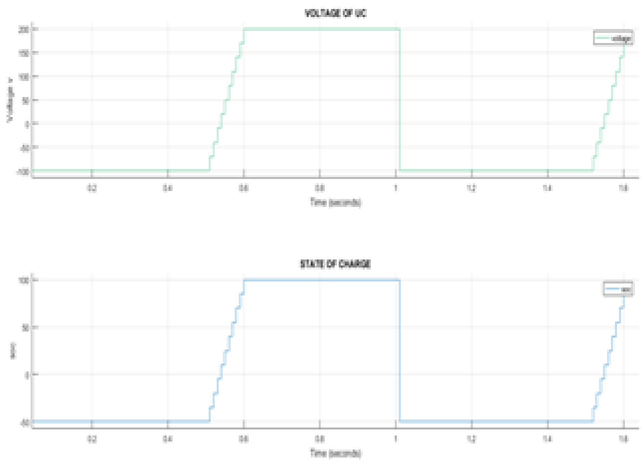
II. ENERGY MANAGEMENT STRATEGY

ANN based energy management strategy (ANNEMS) is established. Firstly ANNEMS clearly provides the processing mode by inspecting the output voltage. Keeping the battery power as the orientation, the output is obtained by using the ANN strategy and the SOC (UC). By maintain this battery reference power regulation is obtained and hence SOC control can be attained for the reference value. Based on this value the UC can supply required the demand of load and it also ensures that adequate capacity to manage all the obtainable decelerating energy of this planned control technique by selecting whichever charging or discharging modes and relating the battery and power output stages to charge ESS level. If the battery power is lesser than the output power, the quitting way is actuated; then, the incriminating way is initiated.

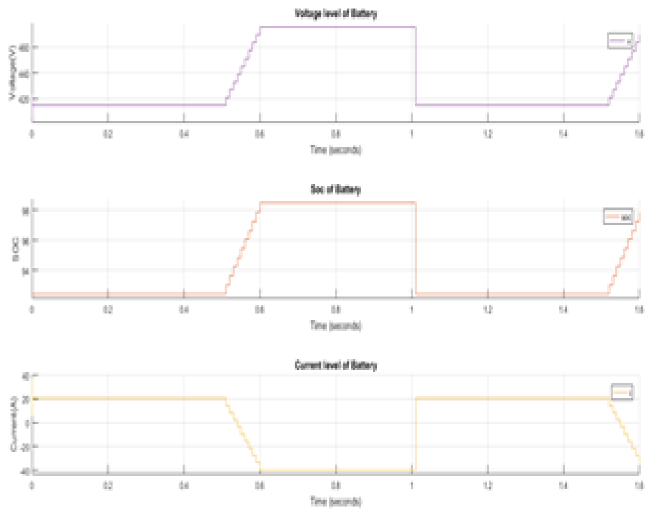
III. SIMULATION CIRCUIT



IV. SIMULATION RESULTS



4.1. Voltage and SOC of UC



4.2. Voltage, SOC and Current level of Battery

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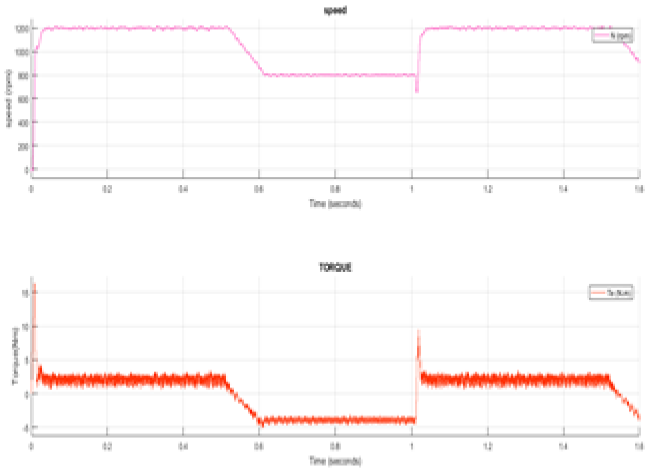

4.3.Speed and Torque of proposed system

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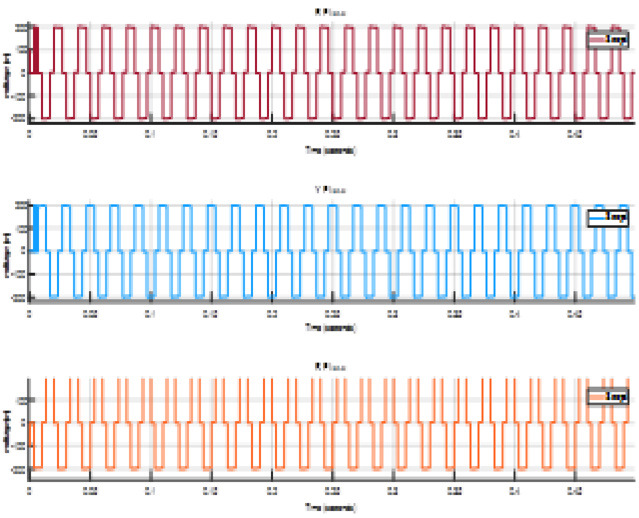
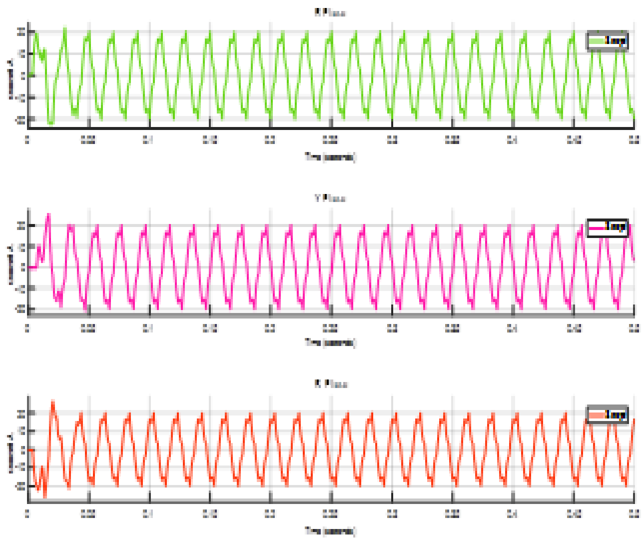


4.4. 3-Phase voltage of proposed system



4.5. 3-Phase current of proposed system

V ABBREVIATIONS AND ACRONYMS

UC	-	Ultra-capacitor
FLC	-	Fuzzy Logic Controller
SOC	-	State Of Charge
MIC	-	Multi Input Converter

VI CONCLUSION

This proposed system mainly focuses on a Battery&ultra-capacitor hybrid energy storage system (HESS) along with ANN Based Energy Management Strategy (EMS). The HESS is mainly focused on a system that has a two way non-isolated medium with multi-input DC to DC converter. It aims to provide and manage power form both the terminals that is the source and the output. The SOC is preferably obtained by an EMS and hence can control the battery power shape. The hybrid system with EMS provides high feasibility since it reduces the battery power peaks which in turn increases the battery lifespan sequence. After incorporating the planned system, it is tested for performance study using simulation that is based on UDDS. The simulation l outcomes clearly gives a positive approach on the proposed system. In conclusion, built on a battery model and experimental results, it is evident that the life cycle of the battery is better up to 55% owing to the battery/UC HESS. Using this proposed system we can conclude that the lifespan cycle of the battery is increased and feasibility of this proposed hybrid system is improved based on the clear input voltage arrangement of the converter.

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