Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

Design of z-source inverter with hybrid energy systems for automotive applications

T. Sindhuja, M. Sasikumar
Jeppiaar Engineering College, Anna University, Chennai
***corresponding author:Email:sindhujagin@gmail.com**

ABSTRACT

Electric vehicles require power electronic components and electrical machines for obtain high speed. Devices allow the vehicle to use electrical potential from PV panel to assist the propulsion of the vehicle. One of most famous topology is the Z-source inverter (ZSI) employs an *LC* impedance network between the main inverter bridge and power source. The feature of the ZSI is that it can operate either in buck or boost mode with a wide range of obtainable output voltages from a given input voltage. This topology also exhibits better electromagnetic-interference (EMI) noise immunity when compared to a traditional voltage-source inverter (VSI). However, the *LC* impedance network of ZSI significantly increases the size and cost of the power converter and can make it unsuitable for low-power applications. It use shoot through state (ST) to boost the input voltage, and also improves the inverter reliability and reduce volume, give higher efficiency.

Keywords: Z-source inverter, reduced passive components, hybrid energy systems, shoot through technology, automotive applications.

INTRODUCTION

The renewable energy sources are widely available in various places, also environment friendly and decentralize the electrical power. We have different renewable energy sources with different characteristics. Using these energy sources depends on various locations and climatic conditions. Two or more renewable energy systems are called as hybrid energy systems (wind-solar, solar-biomass, wind-biomass, solar-diesel etc). The types of automotive electric vehicles are hybrid electric type vehicles, plug-in type hybrid electric vehicles, fuel cell type hybrid electric vehicles. The main components are as follows.

1. Z-source inverter (DC in to AC).
2. Input either from solar technology or from grid to z-source inverter.
3. Various control scheme for drives.
4. Batteries, super capacitors for electrical vehicles.

MATERIALS AND METHODS

Inverter design is a simple inverter circuit with an electromechanical switch and with a transistor switch.

Table.1.Components used detail

Component	Types	Quantity
Inverter	MOS or IGBT Transistor(IR2110)	500 volt
Microcontroller	AT89C2051	5 Volt dc
Oscillator	Crystal	10 MHz
Buffer	741s244	5 volt dc
Voltage regulator	LM7805	8-35V

Table.2.Various control scheme performance

Criterion	V/F(Scalar control)	IFOC (Indirect field oriented control)	DTC-SVM (Direct torque control-Space vector modulation)
Torque ripples	Medium	Large	Small
Speed errors	Large	Small	Medium
ZSI Performance	Good	Poor	Good
Efficiency	Medium	Low	High

Lithium-ion battery technology is one of the most popular technologies for high charge performance. The stored capacity of maximum voltage is above 60% and the current range is 5A. Fig. 1 shows the input voltage

applied to the converter from the PV panel. Fig. 2 shows the PWM pulse applied to the inverter for operate a system with rated speed. Fig. 3 shows the output voltage obtained from the converter system with modulation index of 0.8. Triggering pulses are applied to the converter switches are shown in Fig 4. The torque and speed obtained from the load is shown in Fig. 5.

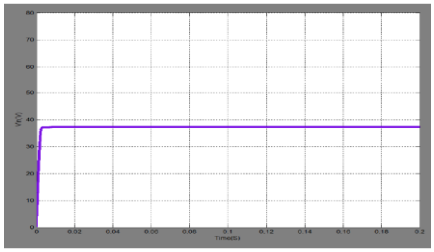

Fig1. Input voltage waveform

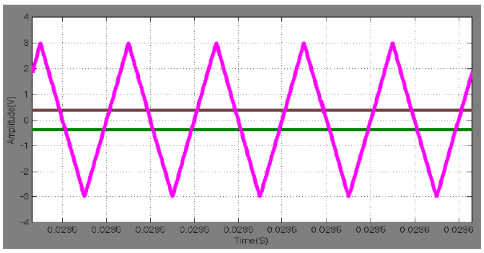

Fig.2. Sinusoidal PWM Waveform

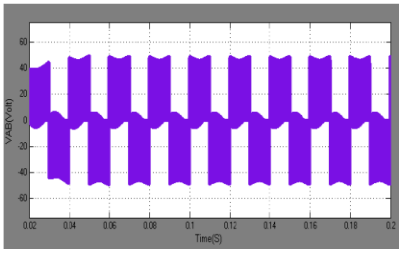

Fig.3. Output voltage waveform

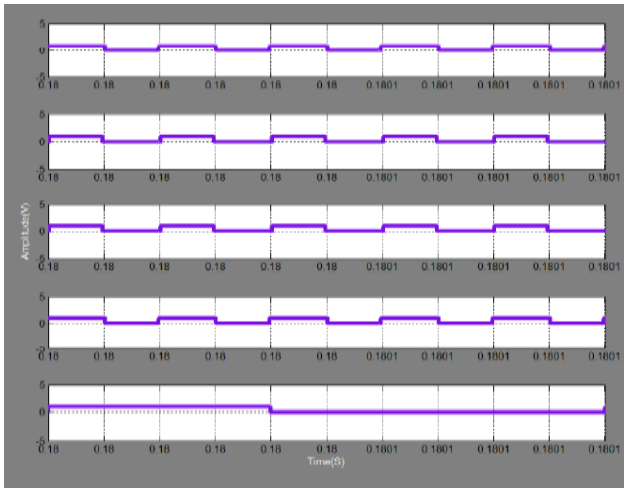

Fig. 4. Triggering pulses applied to the switches

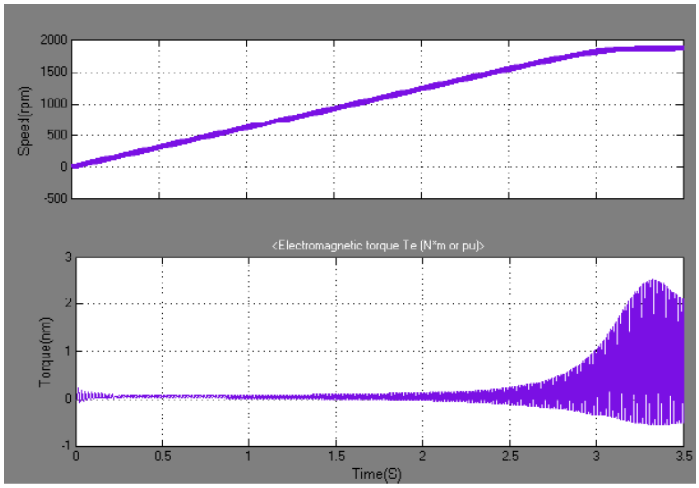

Fig. 5. Torque and Speed waveforms

Table.3.Electrical characterization of batteries

components	1	2	3	4	5	6	7	8	9	10
Cathode	**LFP (lithium iron phosphate)**	**LFP (lithium iron phosphate)**	**LFP (lithium iron phosphate)**	**NMC (lithium nick- el manganese cobalt oxide)**	**NMC (lithium nick- el manganese cobalt oxide)**	**NCA (lithium nickel cobalt aluminum oxide)**	**LFP (lithium iron phosphate)**	**LFP (lithium iron phosphate)**	**LFP (lithium iron phosphate)**	**LFP (lithium iron phosphate)**
Nominal capacity(Ah)	12	10	42	12	70	27	13	2.4	10.1	40.8
Shape	cylindrical	prismatic	pouch	cylindrical	pouch	prismatic	cylindrical	pouch	Pouch	prismatic
Nominal voltage	3.2	3.3	3.3	3.6	3.8	3.33	3.5	3.8	3.7	3.7

Table.4.Experimental specifications of ZSI

parameters	value
Input voltage	38V
inductance	5mH
Capacitance	200µF
AC load resistance	100Ω
Output current	0.5A
Output voltage	50V

For electricity vehicle production and transportation some energy are used (diesel, solar).

Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

Table.5.Useage of hybrid energy

parameters	Value
Land for PV panels	82%
DC generation	12%
DC/AC conversion	84%

Fig. 6. Output voltage waveform

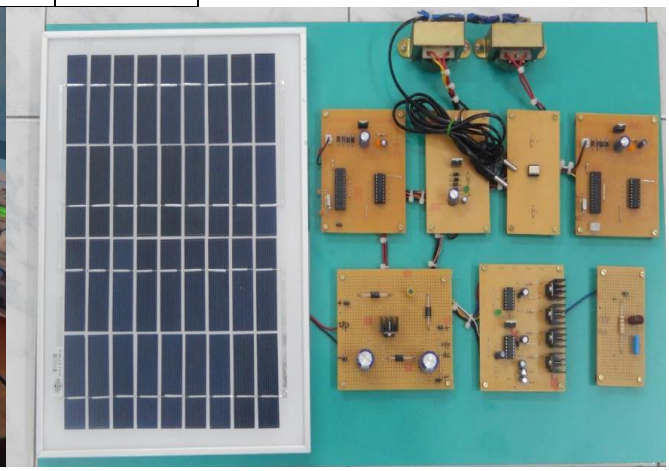

Fig. 7. Hardware diagram

The proposed experimental model is shown in Fig. 7. The output voltage of 33 volt measured using multi meter as well as CRO.

Table.6.Comparision between hybrid energy

PV cells	8.16%
Bio-methane	0.137%
Bio-hydrogen	0.074%

CONCLUSION

The simulation is carried out for both R load and motor load with SPWM technique. Results obtained are found to be more or less similar. The proposed inverter with hybrid systems is economic and feasible for electric traction system. Acceleration and deceleration frequency, traffic jams are reduced by using this method in the field of automobile applications. Electric vehicles are reduced ambient pollution, increase energy efficiency using additional supply of solar cells. Thus the annual energy is extracted from one hectare land is 3255000 km with electricity from solar cells. In this paper, electric vehicles are designed with z-source inverter and batteries for high efficiency and gentle to drive.

REFERENCES

Bodur H, Bakan AF, A New ZVT– ZCT–PWM DC–DC Converter, IEEE Transactions on Power Electronics, 19(3), 2004, 676–684.

Fang Zheng Peng, Fellow, Alan Joseph, Jin Wang, Miaosen Shen, Student Member, Lihua Chen, Zhiguo Pan, Eduardo Ortiz-Rivera, and Yi Huang, Z-source inverter for motor drives, IEEE Tranactions on power electronics, 20(4), 2005.

Hsieh YC, Hsueh TC, C Yen H, An Interleaved Boost Converter with Zero –Voltage Transition, IEEE Transactions on Power Electronics, 24(4), 2009, 973–978.

T. T. Song and N. Huang, A Novel Zero-Voltage And Zero-Current Switching Full Bridge PWM Converter, IEEE Transactions on Power Electronics, 20(2), 2005, 286–291.

Yao G, Chen A, He X, Soft Switching Circuit for Interleaved Boost Converters, IEEE Transactions on Power Electronics, 22(1), 2007, 80–86.