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HIGH PERFORMANCE Z-SOURCE THREE PHASE INVERTER BASED ON MOTOR DRIVE

Nagarajan.M [1], Gurumoorthi.M[2], Kanakaraj.P[3],Rajesh.E[4] ,Vignesh.S[5]
[1]Assistant professor,[2,3,4,5] Students
Department of Electrical and Electronics Engineering,
Kathir College of Engineering, Coimbatore.

Abstract- Z – source inverters have been recently proposed as an alternative power conversion concept as they have both voltage buck and Boost capabilities. These inverters use a unique impedance network, coupled between the power source and converter circuit, to provide both voltage buck and boost properties, which cannot be achieved with conventional voltage source and current source inverters. This paper deals with sensor less control of Z-source inverter under direct torque control to get an instantaneous torque control. Sliding mode observer is a parameter for estimating the phase to phase trapezoidal back-EMF in sensor less mode. Z-source inverter is used to boost up the voltage.
Keywords: Z-source network, PWM, ATMEL 89C51 microcontroller.

I. INTRODUCTION

BLDC motors are becoming so popular in industrial applications. Because of its High efficiency, High torque, Low acoustic noise, less maintenance, longer life time and large inertia ratio when compared to brushless AC motors. BLDC motor is also known as electronically commutated motors are synchronous motors. A BLDC motor is an inside out DC commutator motor with mechanical commutator replaced by an electronic switching converters. The existing two converters are voltage source inverter and current source inverters. In voltage source inverter and current source inverter the reliability is low, complexity is high and the power factor is low with decreasing speed. To overcome these limitations z-source inverter is used.

The power electronics literature focuses the level and characteristics of the source voltage have been changed using different converter topologies. Each converter topology has its own restrictions regarding different aspects like number of components used, stress on semiconductor switches and converter efficiency. Some of these converters have found places in industry for a variety of applications. Today, efficient power conversion is more important than before because of the alternative energy sources like fuel cells, solar energy, wind energy and ocean wave energy that require proper power conditioning to adapt to different loads. Also hybrid vehicles are very promising new applications of power converters.

A common way of varying the AC voltage parameters is to introduce a third state which is called the zero state. The zero state can be obtained by closing either the upper leg switches (S1 and S3) or lower leg switches (S2 and S4). Shows the output AC voltage of the single phase inverter in when the zero state is used to change the AC voltage parameters. Different methods of harmonic cancellation at the output by introducing this zero state are explained.

Pulse Width Modulation (PWM or wave-shaping) technique is also very common in DC/AC conversion. Using this high frequency switching technique, it is possible to eliminate the undesirable low frequency harmonics and high frequency switching harmonics are easy to filter. The output waveform of the single phase inverter in (a) is shown in (b) when PWM technique is used. Here two of the four switches (S1 and S2) are switched at high frequency and the other two (S3 and S4) are switched at low frequency. Low frequency variation of the fundamental component can be observed after proper filtering.

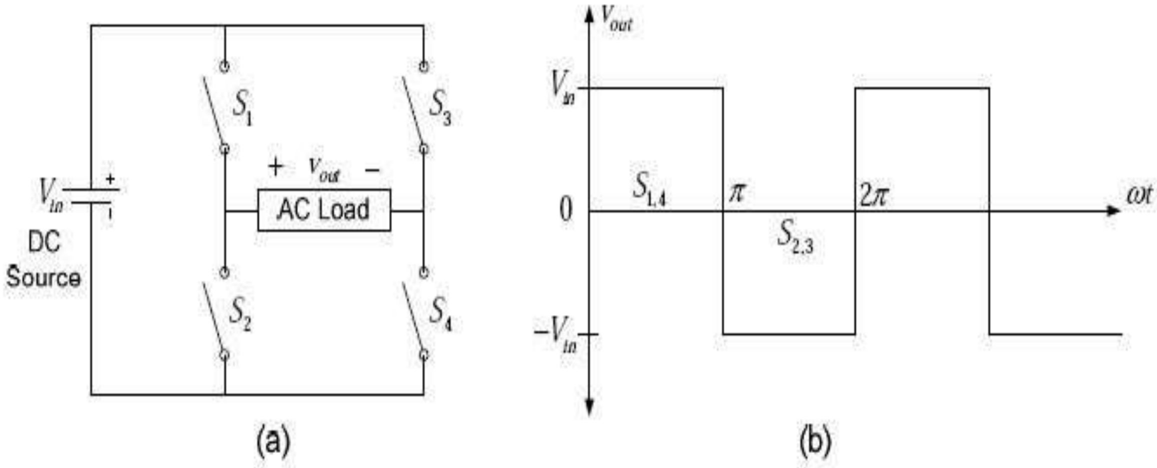

Figure 1 (a) Single phase bridge inverter (b) Wave form of the AC voltage

Z-Source inverter is a type of power inverter that converts direct current into alternating current. It works as Buck-boost inverter. Z-source inverter eliminates the problems of voltage source inverter and current source inverter. Z-source inverter is a two-port network that consists of inductance and capacitance which are connected in x-shape to provide an impedance source. With the unique LC network, we can intentionally add the shoot through state to boost the output voltage. Z-source inverters has some advantages when compared to voltage source inverters and current source inverters. By using z-source inverter the switching losses can be reduced. The z-source inverter is applied to all DC-AC, AC-DC, AC-C and DC-DC power conversion.

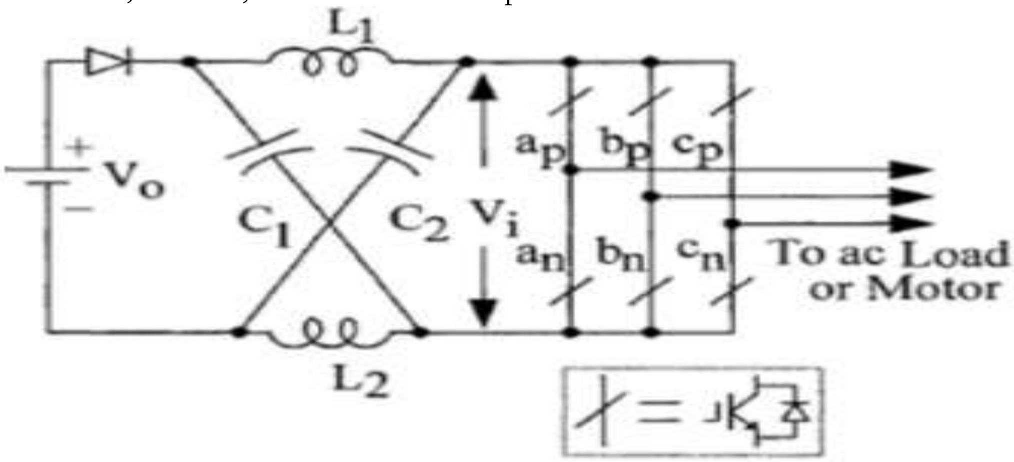

Figure 2 Z-Source inverter

II. EQUIVALENT CIRCUIT OF VOLTAGE SOURCE BASED Z-SOURCE CONVERTER

Figure 3 shows a simplified equivalent circuit for voltage source based ZSC. In the simplified circuit, the VSI inverter bridge is viewed as an equivalent current source or drain in parallel with an active switch S2. Unlike a conventional VSI, the shoot-through state is not harmful and actually has been utilized in ZSI. The analysis in shows how the shoot-through state over the non-shoot-through state controls the buck-boost factor of the system. Through the boost factor in combination with the conventional modulation index M of VSI, the DC-AC buck-boost factor can be obtained as indicated in figure 3.

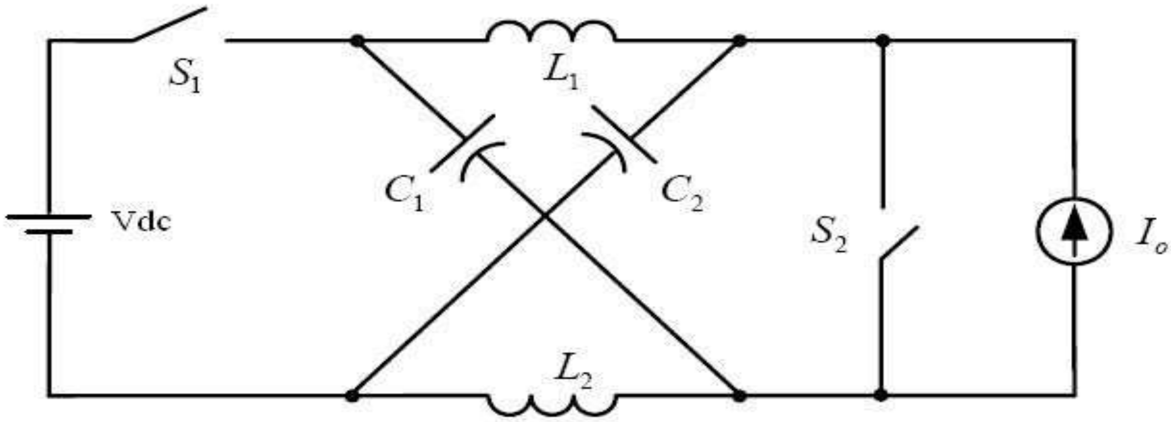

Figure 3 Equivalent circuit of Z-Source converter

It is important to note that the process of energy transfer between DC and AC overlaps the process of energy transfer from DC source to the Z-network. The overlap process seems very demanding on Switch "S1**".** Therefore, for both motoring and generating operation, S1 is subject to substantial current stresses. In particular, for a high starting current application, the total current will impose a tremendous stress on S1 (the starting current plus the current needed to store energy in the Z-network). The ripple current through C is higher than that through the dc bus capacitor used in a conventional VSI. In terms of voltage, the boosted dc voltage is the voltage across the capacitor in ZSI. Additionally, for starting and generating operation, S1 need to handle bi-directional current and, thus, a diode with an anti-parallel transistor should be used. The selection of inductors and capacitors for Z-network is also of great importance. Firstly the reactive components selection should be guaranteed that no resonance would occur. In addition, the inductance and capacitance should be large enough to make the inductor current and capacitor voltage ripple as small as possible. With the shoot-through states evenly distributed among the pulse width modulation (PWM) cycles, the equivalent switching frequency seen by the Z-network will be several times of that used in VSI part, implying that minimization of reactive components is possible

III. PROPOSED SYSTEM

1. To overcome the problems of existing system Z-source concept is introduced.
2. 15 switching states.
3. Buck- Boost Inverter.
4. Wide range of output is obtained.
5. No extra commutation circuits.
6. Network consist of 2 inductors and 2 capacitors.

IV. EXISTING SYSTEM

1. Extensively used in past decades for most applications.
2. It has many limitations such as:
3. Either Buck or Boost Inverter.
4. Electro Magnetic Interference.
5. Output voltage range limited.
6. 8 Switching states.
7. Extra commutation circuits req.
8. Main circuits cannot be interchangeable.

V. HARDWARE DESCRIPTION

The amplitude of the phase voltage is dependent on the duty cycle of the PWM signals given to the inverter switches. At any instant of time, 2 switches (2 upper, 2 lower) are gated and the remaining 3 are turned OFF. The switching produces a rectangular shaped output waveform that is rich in harmonics. The supplied current with harmonics is made to produce 3-phase sine wave with negligible harmonics by the inductive nature of the motor's stator windings. The inductive nature of the windings oppose any sudden change in the reverse direction of flow of current until all of the energy stored in the windings are dissipated, when the switches are turned off.

Figure 4 Hardware Trainer Kit

This is accomplished using fast recovery diodes, known as freewheeling diodes across every Insulated-Gate Bipolar Transistor (IGBT) switch. PWM inverters can be classified such as single phase and three-phase. These inverter share capable of producing AC voltages of variable magnitude as well as variable frequency. The PWM inverters are very commonly used in adjustable speed AC motor drive where one needs to feed the motor with variable voltage, variable frequency supply. For wide variation in drive speed, the frequency of the applied AC voltage needs to be varied over a wide range. The applied voltage also needs to be varied almost linearly with the frequency. There are two possibilities in deriving the modulation signals. The first and obvious method is to modulate the two inverters from a common carrier signal with careful insertion of shoot-through time with simple boost or minimum switching methods proposed in references for a single Z-source inverter. This pulse is used to switch ON or OFF the power switches. The width of the pulse or duty cycle can be varied by varying the frequency of the reference wave.

VI. SOFTWARE DESCRIPTION

Simulations have been performed to confirm the above analysis. Fig shows the circuit configuration and simulation waveforms when the fuel-cell stack voltage is V and the Z-source network parameters are H and F. The purpose of the system is to produce a three-phase 208-Vrms power from the fuel-cell stack whose voltage changes 150-340 V dc depending on load current. From the simulation waveforms of it is clear that the capacitor voltage was boosted to V and the output line-to-line was 208-Vrms or 294 V peak. In this case, the modulation index was set to and the shoot-through duty cycle was set to and switching frequency was 10 kHz. The shoot-through zero state was populated evenly among the three phase legs, achieving an equivalent switching frequency of 60 kHz viewed from the Z-source network. Therefore, the required dc inductance is minimized. From the above analysis, we have the following

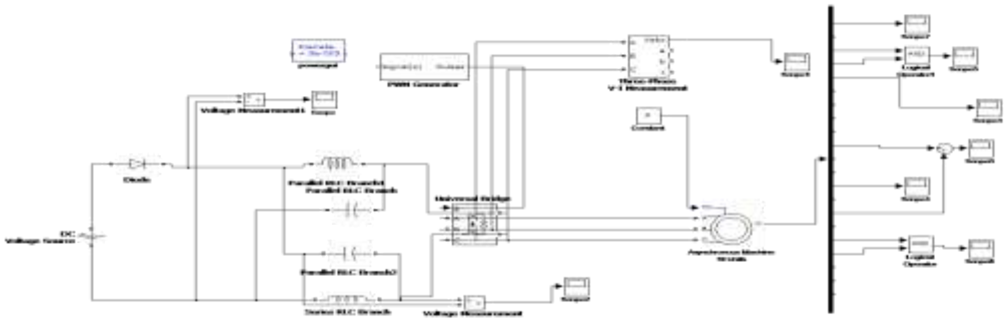

Figure 5 Simulation circuit diagram

Source circuit bi-directional in nature. Also, PID controller can be included for capacitor voltage control with an excellent transient performance which enhances the rejection of disturbance, including the input voltage ripple and load current variation, and have good ride-through for voltage-sags

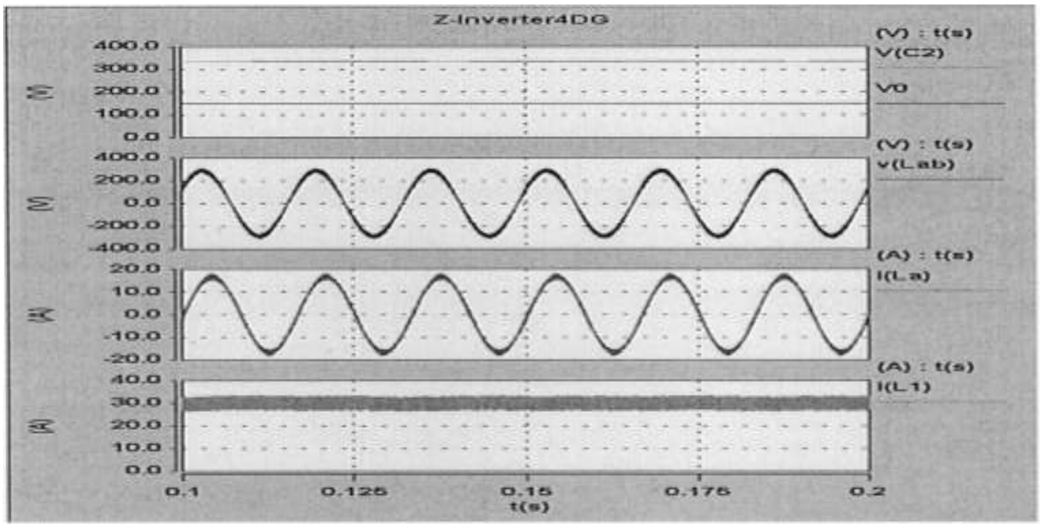

Figure 6 Simulation voltage when fuel cell voltage shoot through duty cycle

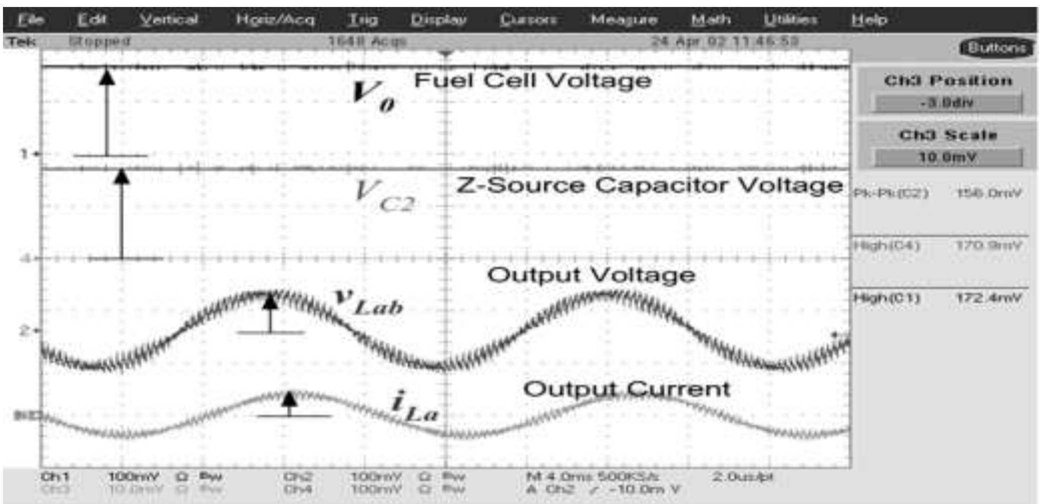

Figure 7 Experimental waveforms for fuel cell voltage is high, without shoot through

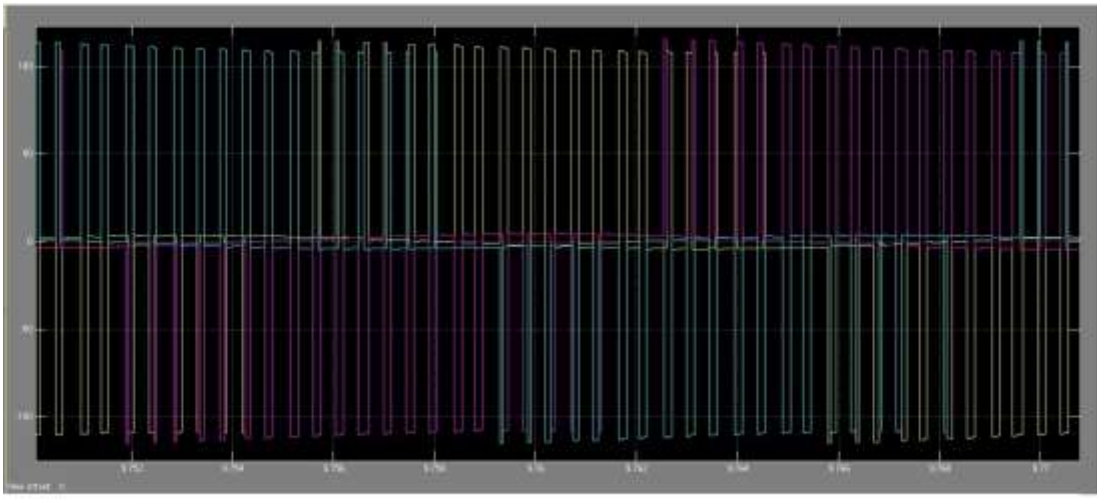

Figure 8 Simulation three phase output

VII. CONCLUTION

This paper presents a Z-source inverter system for controlling the speed of the without Permanent Magnet Brushless DC motor. This inverter regulates the input voltage that can be increased. It also reduced the torque ripple. The minimum components are used in this scheme, which decreases the switching loss and stress across the switches, so the harmonic generation can be reduced in the output. These inverters use a unique impedance network, coupled between the power source and inverter circuit, to provide both voltage buck and boost properties, which cannot be achieved with conventional voltage-source and current-source inverters. As a result, the new Z-source inverter system provides ride-through capability during voltage sags, reduces line harmonics, and extends output voltage range. Implementing Z-source inverter has many advantages that have been described in this paper such as:

1. It can generate demanded DC voltage, even greater or lower than the output voltage
2. It provides greater operation speed range for BLDC motors
3. It can store energy without any additional circuits and energy storage
4. It reduces the output torque motors ripple

REFERENCES

1. Hyun Lee and Jangmyung Lee, "Design of iterative sliding mode observer for sensorless PMSM control," *IEEE Trans. on Control Syst. Technol*., vol. 21,no. 4, pp. 1394-1399, Jul. 2013.
2. Salih Baris Ozturk and Hamid A. Toliyat, "Direct torque control of brushless dc motor with non-sinusoidal back-EMF,"*IEEE Int. Electric machines and Drives Conf*., vol. 1, pp. 165-171, 2007.
3. Salih Baris Ozturk and Hamid A. Toliyat, "Direct torque and indirect flux control of brushless dc motor," *IEEE/ASME Trans. on Mechatronics*, vol. 16, no. 2, Apr. 2011.
4. A. Deenadayalan and G. Saravana Ilango, "Modified sliding mode observer for position and speed estimations in brushless dc motor," *IEEE Annu. India Conf. (INDICON),* pp. 1-4, 2011.
5. Chen Wei, Chen Yankun, Li Hongfeng and Song Zhanfeng, "Sensorless control of permanent magnet synchronous motor based on sliding mode observer,"*IEEE 7th Int. Power Electron. and Motion Control Conf*., Jun. 2012.
6. Vidya Sojan, and Mrs. Lekshmi A "Performance Analysis of Z-Source Inverter fed PM BLDC Motor Drive" R.
7. Krishnan, Electric Motor Drives-Modeling Analysis and Control" Prentice Hall, 2005.
8. Poh Chiang Loh, D. M. Vilathgamuwa, Y. S. Lai, G. T. Chua and Y.W.Li, "PWM of Z-Source Inverter",