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Z-Source Inverter Fed Asynchronous Motor Drive

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ABSTRACT

In this project, an impedance-source power converter (or impedance-fed power converter) and its control method are presented to implement DC to DC, AC to DC, AC power conversion. The Z source inverter uses a single impedance network (or a single impedance circuit) to couple the main circuit of the converter to the power source, using respectively a capacitor and an inductor in the voltage source and the converter. of current source. Implementation of the crossing zero state as a switching state in a switching cycle of the inverter in which the output voltage is zero, because the output terminals are short-circuited by both the switching over and through the lower switching device, thanks to which the Z-source conceptual inverter and the theoretical barriers and limitations of the conventional inverter and inverter. By controlling the duty cycle (ie, by increasing the initial state of the duty cycle), the state in which two switches of one branch or four switches of two branches or six switches of all branches are activated simultaneously, which allows to generate a renewed state signal, called zero crossing state, which increasingly charges the capacitor, thus improving the performance of the source inverter Z.

This project also highlights the ASD system powered by a Z-Source inverter and proposes a new concept of power conversion. The control for general purpose motor drives by Z source inverters is also presented in detail in this project. The behavior of a three-phase induction motor powered by an impedance inverter (AC drive) is analyzed with the results of the simulation.

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KEYWORDS: *Line harmonics, ZSI- Z-Source Inverter, VSI-Voltage Source Inverter Z-Source Inverter fed Induction Motor*

I. INTRODUCTION

Traditional traditional frequency converter (ASD) system (based on the voltage source inverter (V-type inverter)), which consists of a diode rectifier front block, a DC link capacitor and an inverter bridge, as shown in Fig. 1. In order to improve the power factor, an alternating or continuous inductor is normally used.

The DC link voltage is approximately 1.35 times the line voltage, and the inverter V is a buck converter (or buck converter) that can only produce an AC voltage limited by the DC link voltage.

Due to this nature, the ASD system based on a source V inverter suffers from the following general limitations and problems.

1) The achievable output voltage is limited far below the mains voltage. Figure 1 shows the voltages of a three-phase 230V drive system. The diode rectifier powered by the 230 VAC line generates approximately 310 VDC at the DC link, which is approximately equal to the value of 1.35-fold line-to-line input voltage assuming a high load and a continuous "bump" input current for large drives (50 kW) whose inductance on the AC side is typically about 3% or continuous. When operating under light load or small drives without significant inductance, the mains current becomes a discontinuous "double pulse" and the DC voltage is closer to 1.41 times the grid input voltage (ie, 325 VDC for a 230 VAC - Entrance). The inverter can only produce up to 190 V AC in the linear modulation range, since the DC 310 V is subjected to a high load where the voltage is most needed. For a 230 V engine the lowest possible.

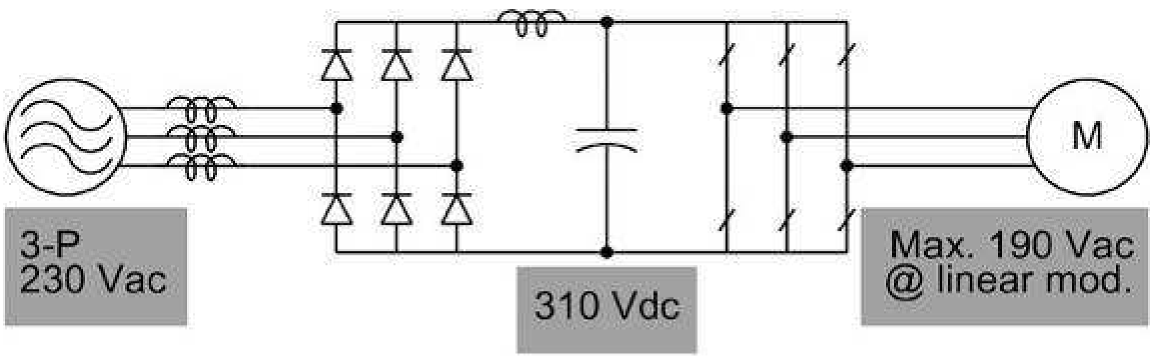

Fig1: traditional V-source inverter fed drive

1) Voltage dips can interrupt an ASD system and stop critical loads and processes. More than 90% of the power quality problems are due to short-term voltage drops (usually 0.1-2 s) 10 to 50% lower than the nominal voltage (Figure 2 shows the brownouts) . The DC capacitor in an ASD keeps the DC voltage above this voltage drops below the operating level. A lack of passage capacity is a serious problem for sensitive loads powered by ASD. Details of the vulnerability of an ASD and DC voltage under three-phase and two-phase voltage drops. Solutions have been sought to speed up transit.

2) Inrush current and harmonic current from the diode rectifier can pollute the line. The low power factor is another problem of the traditional ASD system.

INVERTER Z-SOURCE

This article presents an impedance-source (or impedance-powered) power converter (abbreviated Z-source inverter) and its control methodology for AC, DC-DC, AC-DC, and AC-DC power conversion. The z-source converter uses a single impedance network (or a single-impedance circuit) to couple the main circuit to the power supply, thereby providing the unique features that can be provided by the power source and power source converters. conventional current, comprising a capacitor and a power supply. The inductor can be used. The Z-Source inverter overcomes the conceptual and theoretical barriers and limitations of traditional voltage and current transformers and offers a new concept of power conversion. The Z-Source concept can be applied to all types of energy conversion. To describe the principle and control, this article is based on an example: a Z inverter to convert DC to AC, which is needed in fuel cell applications.

II. HARMONIC STUDY AND COMPARISON OF Z-SOURCE INVERTER WITH TRADITIONAL INVERTERS

This document presents an impedance inverter for electric drives. The impedance source inverter uses a single line torque with one inverter main circuit and one rectifier. By controlling the charging cycle, the Z-source inverter system using MOSFETs provides voltage breakdown enforcement capabilities, reduces line harmonics, improves power factor and reliability, and extends the voltage range.

III. Z-SOURCE ASYNCHRONOUS DRIVE SYSTEM

Similar to the conventional ASD system, the main circuit of the ASD Z-Source system consists of three parts: a diode rectifier, a DC link and an inverter bridge. The differences are that the DC link circuit is implemented by the source array Z (C1, C2, L1 and L2) and that small input capacitors (Ca, Cb and Cc) are connected to the diode rectifier. These changes can easily be integrated and implemented by traditional ASD systems. Since the source inverter bridge Z can increase the voltage of the DC capacitor (C1 and C2) to a value greater than the average DC value of the rectifier, a desired output voltage is always available, regardless of the mains voltage. Using the example of the ASD 230 V system, the voltage of the DC capacitor can be increased to 350 V or more to generate a 230 V AC voltage regardless of the mains voltage. Theoretically, the voltage of the DC capacitor can be increased to a value higher than the inherent average DC voltage (310-325V for a 230V line) of the rectifier by using zero crossing switching states when a higher output voltage Voltage dips are necessary. However, the voltage of the DC capacitor is limited in practice by the voltage of the apparatus.

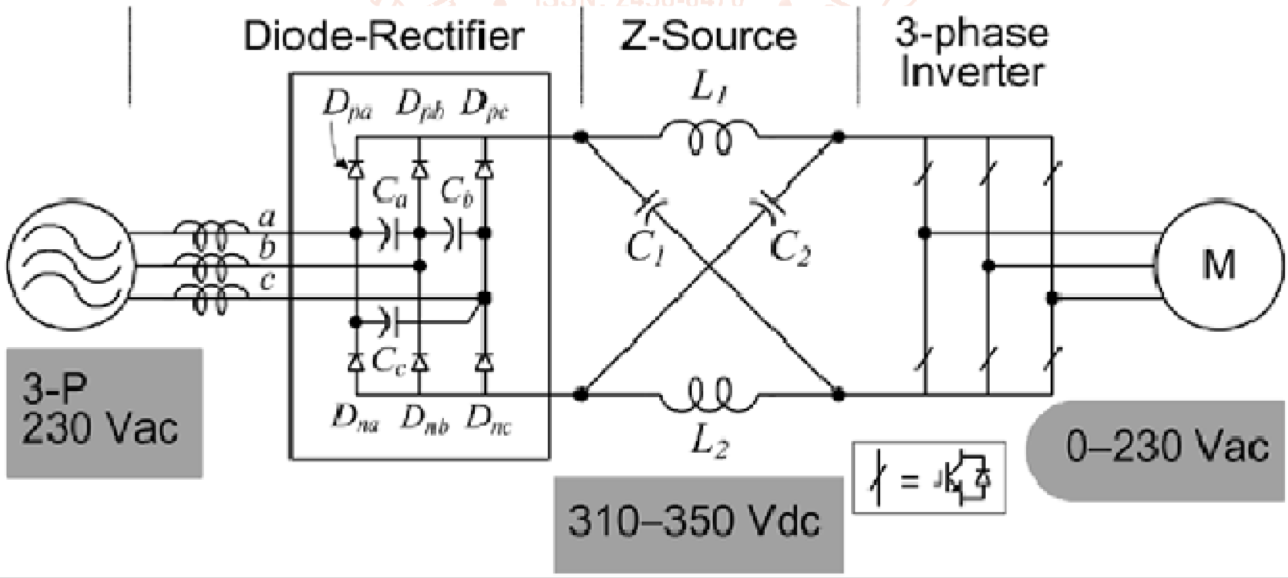

Fig2. Main circuit configuration of proposed Z-source inverter ASD system

IV. SIMULATION RESULTS

The Z-well inverter was invented to solve the problems associated with the conventional power source inverter and the power source inverter. The results of simulation of the Z-source inverter for induction motors have proven to be very effective compared to the conventional motorized drive converter.

By implementing a new concept, it is possible in the new Z-Source inverter to vary the AC output voltage Vac (0-310) even more than the rated voltage of the grid. By performing a Forrier analysis for the AC output, an additional zero State ignition in the three phases and even a 210 V AC base voltage component can be generated.

In order to confirm the operating principle of the new ASD system, simulations must be performed on a 20 kW three-phase induction motor.

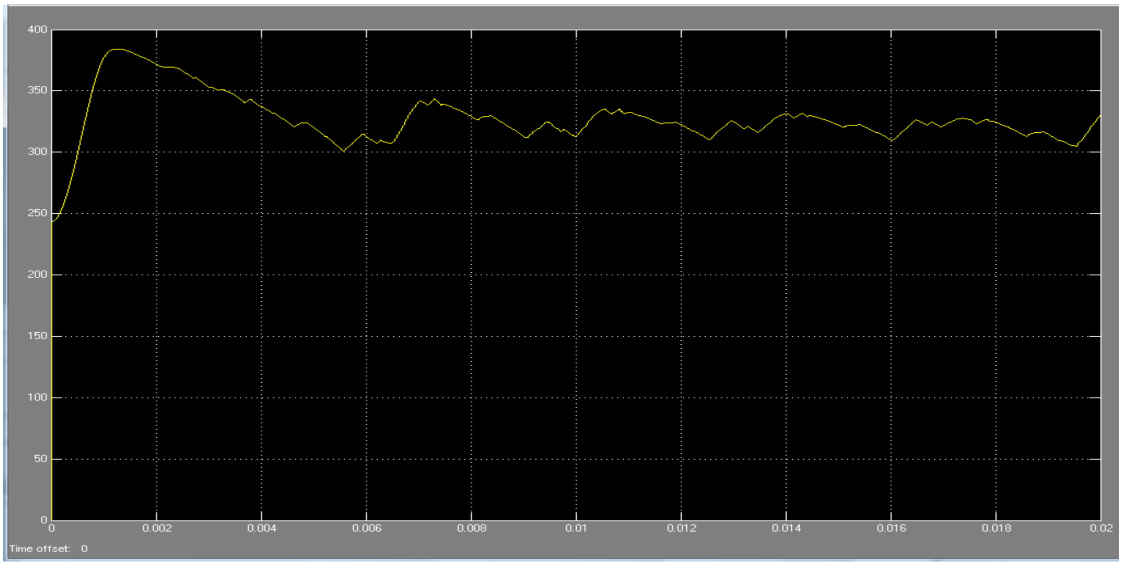

Fig3. Capacitor voltages Vc1, Vc2

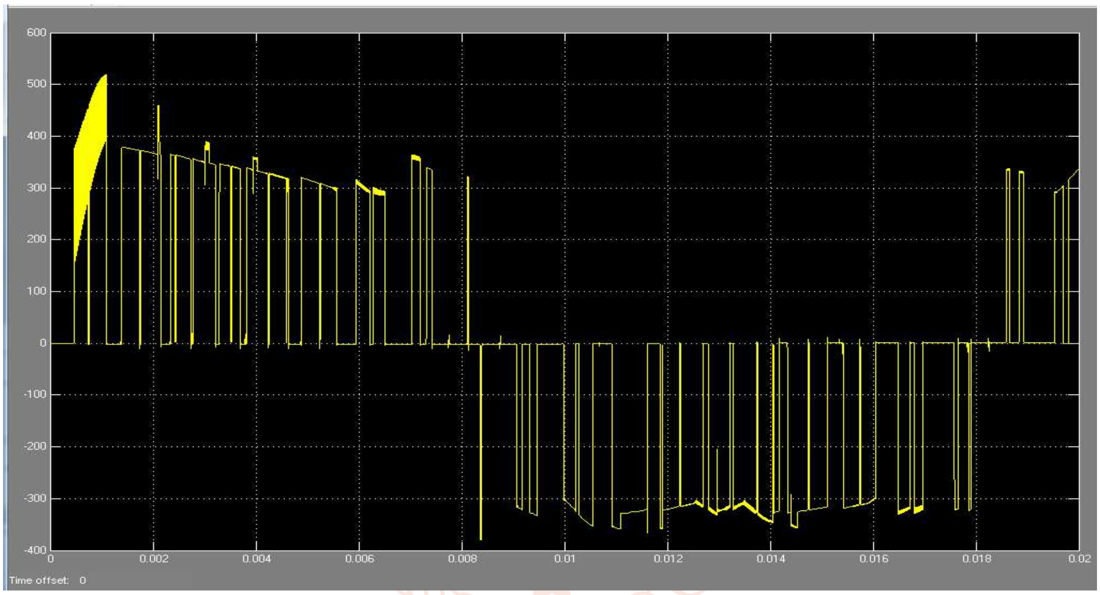

Fig4 Ac output voltage of the ZSI

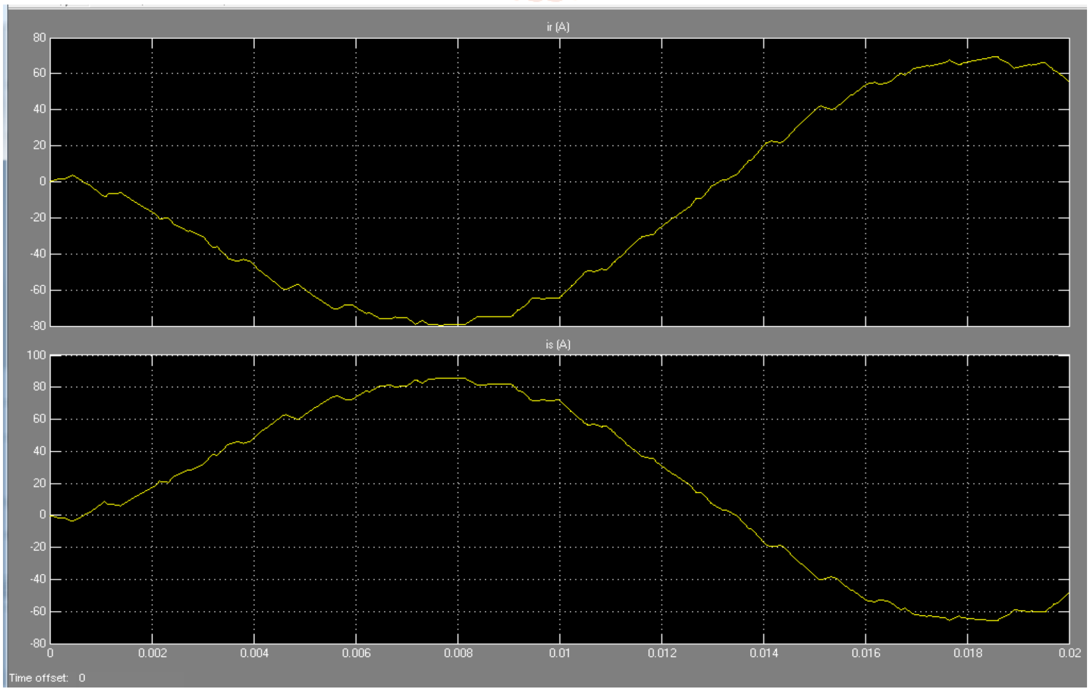

Fig5 Ir,Is rotor and stator Currents

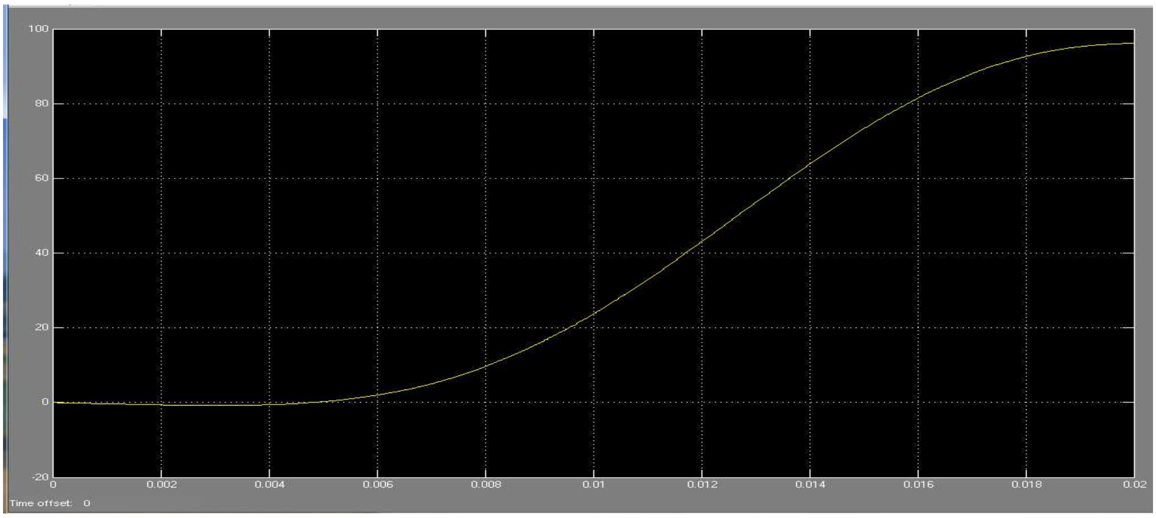

Fig6 Nr speed of the induction motor.

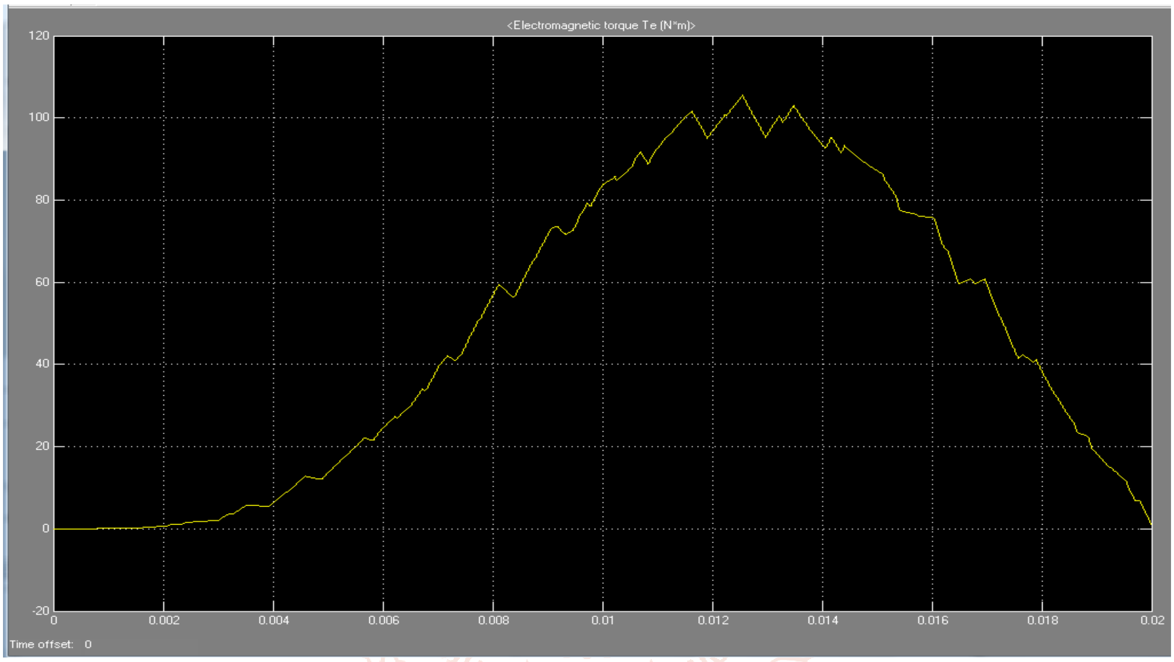

Fig7. Electromagnetic torque

V. CONCLUSION:

This document introduces a new ASD system based on the Z-Source inverter. The principle of operation and the analysis were given. The simulation and the experimental results confirmed the functionality and showed the promising properties. Summarizing the Z-Source Inverter Waveforms The ASD system offers several unique benefits that are highly desirable for many ASD applications. The control of the three-phase asynchronous motor with ZSI supply with PI controller and PID controller is successfully simulated. The results of the simulation show that the PID controlled system performs better than the PI controller because the PID controlled system reduces the rise time, settling time of the controlled system and the error. The stationary speed is reduced to 3.2 rpm. The contribution of this work is to achieve the best dynamics of the ZSIIM control loop. The fuzzy logic-based closed-loop system will be simulated in the future.

References

[1] D. J. Arent, A. Wisel, and R.Gelman, "The status and prospects of renewable energy for combating global warming," *Elseiver Energy Economics, Vol. 33, No. 4, pp.584-593, Jul. 2011*.

[2] F. Blaabjerg, Z. Chen, and S. B. Kjaer, "Power electronics as efficient interface in dispersed power generation systems," *IEEE Trans. Power Electron, Vol. 19, No. 5, pp. 1184-1194, Sep.2014.*

[3] L. Zhang, K. Sun, Y. Xing , and M. Xing, "H6 Transformer less full -bridge PV grid-tied inverters," *IEEE Trans. Power Electron, Vol. 29, No.3, pp. 1229-1238,Mar.2014.*

[4] Rong-Jong Wai and Wen-Hung Wang, "Grid-connected photovoltaic generation systems," IEEE Trans. Circuits and systems. Vol.55. No.3. Apr. 2008.

[5] J. A. Gow and C. D. Manning , "Photovoltaic converter systems suitable for use in small scale stand-alone or grid connected applications," *Proc.IEE Electric. Power Appl. Vol. 147, No. 6, pp. 535-543, Jun.2000*.

[6] N. Vazquez, J. Almanan, J. Alvarez , C. Aguilar, and J. Arau, "A comparison between the buck, boost and buck- boost inverters, " in *Proc. IEEE 30th Annu. Power Electron. Spec. Conf., Vol. 2. Pp.801-806, 1999.*

[7] F. Z. Peng, Z-Source Inverter, *IEEE Tran .Ind. Tran. Appl., Vol. 39, no.2. pp, pp.504-510, Mar/Apr.2003*.

[8] M. S. Shen, J. Wang, A. Joseph, F. Z. Peng, L. M. Tolbert, and D. J. Adams, "Constant boost control of the Z-source inverter to minimize current ripple and voltage stress," *IEEE Trans. Ind. Appl., vol. 42, no.3, pp. 770-777, May/Jun.2006.*

[9] F. Z. Peng, M. S. Shen, and Z. Qian, "Maximum boost control of the Z-source inverter," *IEEE Trans. Power Electron, vol. 20, no. 4, pp. 833-838, Jul. 2005.*

[10] P. C. Loh, D. M. Vilathgamuva, Y. S. Lai, G. T. Chua, and Y.W. Li, "Pulse-width modulation of Z-source inverters," *IEEE Trans. Power Electron., vol. 20, no 6, pp. 1346-1355, Nov.2005.*

[11] P. C. Loh , Feng Gao , Frede Blaabjerg, Shi Yun Charmaine Feng, Kong Ngai Jamies Soon, " Pulse width –Modulated Z-Source Neutral-point- clamped inverter," *IEEE Trans. On Industry Applications, vol. 43, no 5, pp. 1295-1308, 2007.*

[12] Miao Zhu, Kun Yu, Fang Lin Luo, "Topology analysis of a switched- inductor Z-source inverter," *5th IEEE Conference on Industrial Electronics and Applications, pp. 364-369, 2010.*

[13] Minh-Khai Nguyen, Young-Cheol Lim, Geum- Bae Cho, " Switched inductor Quasi Z-source inverter," *IEEE Trans. Power Electron., vol. 26, no 11, pp. 3183-3191, 2011.*

[14] Joel Anderson; F. Z. Peng, "Four quasi-Z-Source inverters, " *2008 IEEE Power Electronics Specialists Conference , pp. 2743 – 2749 , 2008.*

[15] Yi Huang; Miaosen Shen; Fang Z. Peng Jin Jin Wang, " Z-Source inverter for Residential Photovoltaic Systems," *IEEE Transactions on Power Electronics, vol.21, no.6, pp 1776-1782, 2006.*

[16] Fang Z. Peng, Xiaoming Yuan, Xupeng Fang, and Zhaoming Qian, " Z-Source inverter for adjustable speed drives," *IEEE Power Electronics Letter.*, vol. 1, no.2, pp. 33-35, June.2003.

[17] Zhi Jian Zhou, Xing Zhang, Po Xu and Weixiang X. Shen, "Single-phase uninterruptible power supply based on Z-Source inverter," *IEEE Trans. Ind. Electron*., vol. 55, no. 8, PP. 2297-3004, Aug.2008.

[18] P. C. Loh, D. Mahinda Vilathgamuwa, Chandana Jayampathi Gajanayake, Yih Rong Lim and Chern Wern Teo, "Transient Modeling and Analysis of Pulse-Width modulated Z-Source Inverter," *IEEE Trans. Power Electron., vol* .22 , no .2 , March 2007.

[19] Veda Prakash Galigekere and Marian K. Kazimierczuk, "Small Signal Modeling of PWM Z-Source Converter by Circuit-Averaging Technique," *IEEE Conf. 2011.*

[20] Chiang, Loh, "Embedded EZ-source inverters," *IEEE Trans. Ind. Appl*. vol. 46, no. 1, PP. 256-267, Jan/Feb.2010.

[21] F. Gao, P. C. Loh, D. Li, and F. Blaabjerg, "Asymmetric and Symmetric Embedded EZ-source inverters," *IET Power Electron*.vol.4, no.2, pp. 181-193, 2011.

[22] Sengoden Thangaprakash and Ammasai Krishnan, "Current mode integrated control technique for Z-Source inverter fed induction motor drives," *Journal of Power Electronics, vol.10. no.3, May 2010.*

[23] Minh-Khai Nguyen, Young-Cheol Lim, Yong-Hak Chang , Chae-Joo Moon, "Embedded switched –inductor Z-Source inverters, " *Journal of Power Electronics, vol.13, no.1, January 2013*.

[24] A. Radhika and A. Shunmugalatha, "A novel photovoltaic power harvesting system using a transformer less H6 single-phase inverter with improved grid current quality," *Journal of Power Electronics, vol.16, no.2, pp.654-655, March 2016.*