Analysis and Desin of Improved Trans-Z-Source Inverter with Continuous Input Current and Boost Inversion Capability

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***Abstract*— This paper deals With a new family of high boost Voltage inverters that improve upon the conventional trans-Z-source and trans-quasi-Z-source inverter.[1] The Improved Trans-Z-source Inverter(ITZI) provides continuous input current and a high boost voltage inversion capability. In addition, the improved inverter can suppress resonant Current at startup, which might destroy the device. In comparison to the conventional trans-Z-source/-trans-quasi-z-source inverters, for the same transformer turn ratio and input and output voltages, the improved inverter has a higher modulation index with reduced voltage stress on the dc link,[5] lower current stress flow on the transformer windings and diode, and lower input current ripple. The results are validated by simulating (ITZI) in matlab/simulink.**

Keywords-Trans-Z-source inverter(TZI),voltage source inverter(VSI),current source inverter(CSI).

I. INTRODUCTION

The Z-source converter employs a unique impedance network(or circuit)to couple the converter main circuit to the power source, thus providing unique features that cannot be obtained in the traditional voltage-source and current-source converters where a capacitor and inductor are used, respectively. The Z-source converter overcomes the conceptual and theoretical and provides a novel power conversion concept[4]. The Z-source inverter was proposed in order to accomplish single-stage power conversion with buck-boostabilities.The improved Z source inverter used to control the speed of an induction motor. The proposed Z source inverter(ZSI) can effectively reduce the voltage stress across the capacitors in the impedance network. this reduces the voltage range of the capacitors used, and also the cost of the proposed topology which is in turn used to control the speed of an induction motor which is used in many valuable application. the three-phase voltage-source inverter structural DC voltage source supported by a relatively large capacitor feeds the 3-phase inverter circuit. The DC voltage source can be a battery, fuel cell stack, diode rectifier, and/or capacitor. Six switches are used in the main circuit each is traditionally composed of a power transistor and an anti parallel (or freewheeling)diode to provide bidirectional current flow and unidirectional voltage blocking capability.

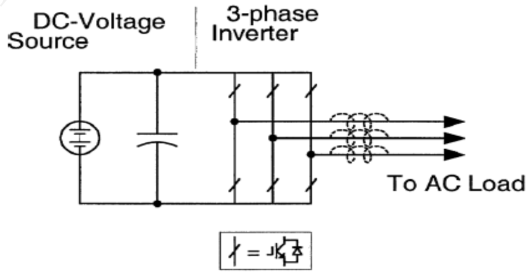

Fig.1.1 voltage source inverter

DC voltage source supported by a relatively large capacitor feeds the 3-phase inverter circuit. The DC voltage source can be a battery, fuel cell stack, diode rectifier, and/or capacitor. Six switches are used in the main circuit each is traditionally composed of a power transistor and an anti parallel (or freewheeling)diode to provide bidirectional current flow and unidirectional voltage blocking capability[2].

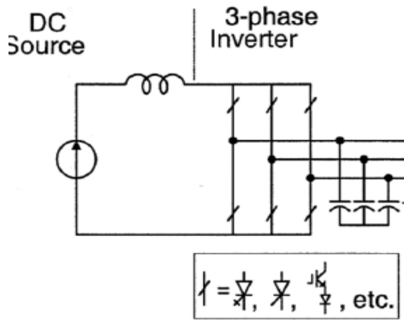

Fig.1.2 current source inverter

A DC current source feeds the 3 phase inverter circuit. The DC current source can be relatively large DC inductor fed by a voltage source such as a battery, fuel cell stack, diode rectifier, or thyristor converter. six switches are used in the main circuit each is traditionally[3].

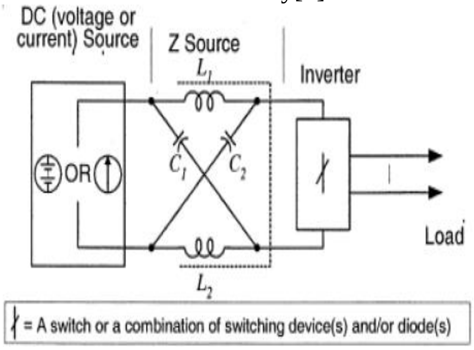

Fig.1.3 General Structure of the Z source inverter

Z-source inverter is the combination of voltage source inverter and current source inverter. A two port network that consists of a split-inductor L1and L2 and capacitors C1 and C2connected in X shape is employed to provide an impedance source(Z-source)coupling the inverter to load, or another converter. Switches used in the inverter can be a combination of switching devices and diodes as the anti parallel combination.

II PROPOSED IMPROVEDTRANS-Z-SOURCE INVERTER

The improved Z-source inverter was proposed in order accomplish single-stage power conversion with buck-boost abilities.in the improved Z-source inverter, both of the power the switches in a leg can be turned on at the same time, which eliminates dead time and significantly improves the reliability the while reducing the output waveform distortion.

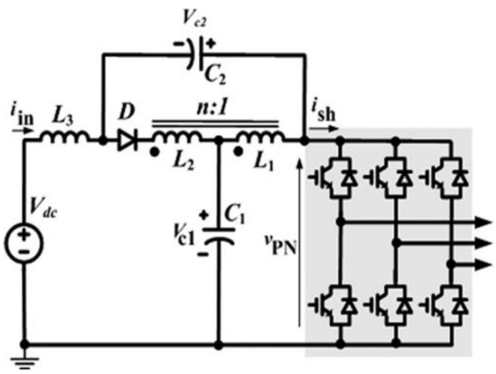

Fig.2.1 Improved trans-Z-source inverter with continuous input current and boost inversion capability.

The input dc current is continuous; it provides resonant current suppression, unlike the trans-Z-source inverter topology because no current flows to the main circuit at startup. Only one inductor and one capacitor are added, and a higher boost factor can be obtained with the same turn ratio and component count compared to the LCCT-Z-source inverters and the conventional trans-Z-source and trans-quasi-Z-source inverters with the *LC* input filter.

III OPERATION

The improved inverter has extra shoot-through zero states in additional to the traditional six active and two zero states in a classical Z-source inverter. Thus, the operating principal of the improved inverter are similar to those of the classical Z source inverters. For the purpose of analysis, the operating states are simplified into shoot-through and non shoot-through states. The equivalent circuits of the improved trans-Z source inverter, where the two windings are replaced by an ideal transformer and a mutual inductance (*Lm*).

In the shoot-through state, the inverter side is shorted by both the upper and lower switching devices of any phase leg.

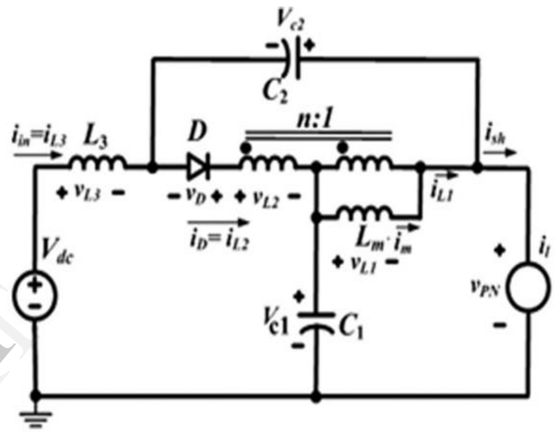

Fig.2.2 equivalent circuit of ITZI

The improved trans-Z-source inverter uses a lower transformer turn ratio than the trans-Z-source/-quasi-Z source inverter to produce the same boost factor. When $n = 0$, $B = 1/(1 - 2D)$, the improved inverter becomes the classical Z-source inverter. When $n \geq 1$, the boost ability of the improved trans-Z-source inverter is higher than that of the trans-Z-source, trans-quasi-Z-source, and classical Z-source inverters.

IV RESULTS AND DISCUSSION

A.PROPOSED TRANS Z SOURCE INVERTER IN OPEN LOOP

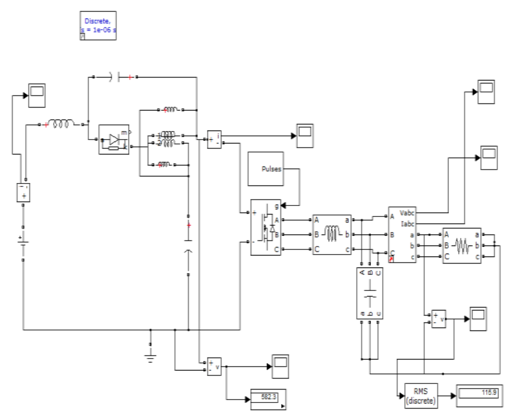

Fig.4.1 simulation diagram of the proposed Trans Z source inverter in open loop

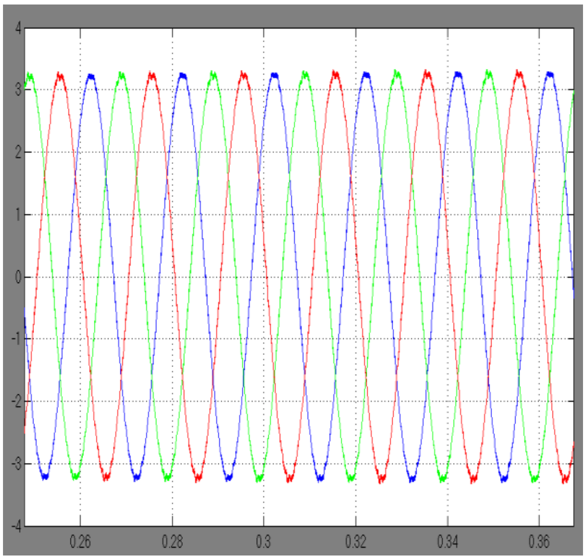

Fig.4.2 Simulation diagram of the output current wave form

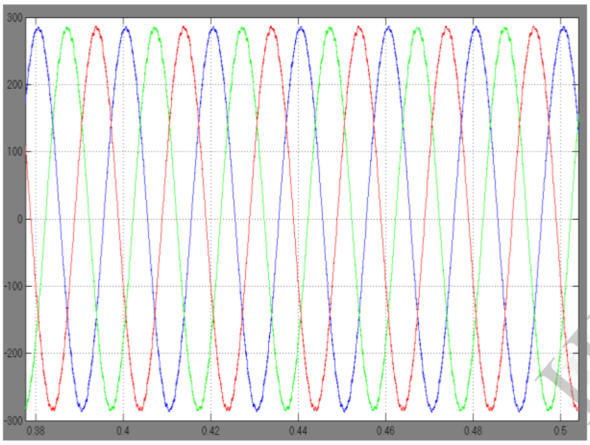

Fig.4.3.Simulation diagram of the output voltage waveform

B.SIMULATION DIAGRAM OF THE PROPOSED TRANS-Z-SOURCE INVERTER WITH ASYNCHRONOUS MOTOR

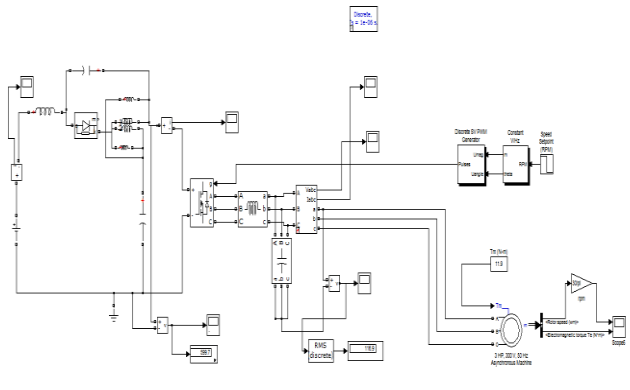

Fig .4.4. Simulation diagram of the proposed trans-z- source inverter with asynchoronous motor

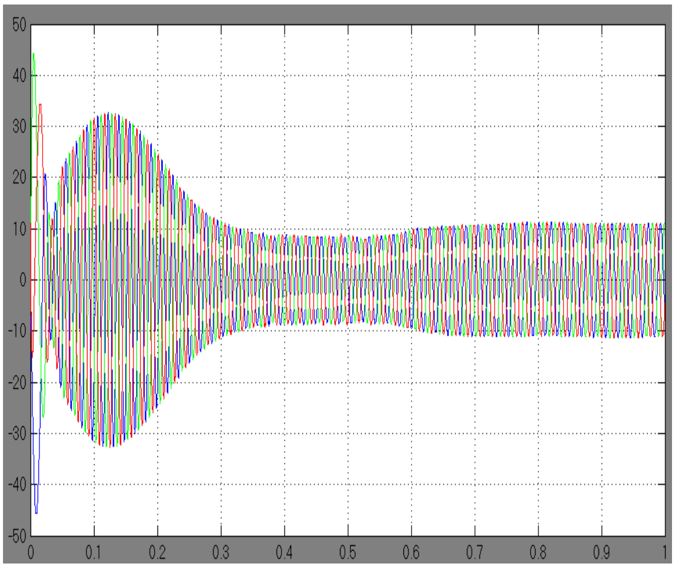

Fig.4.5. output voltage wave form of asynchronous motor

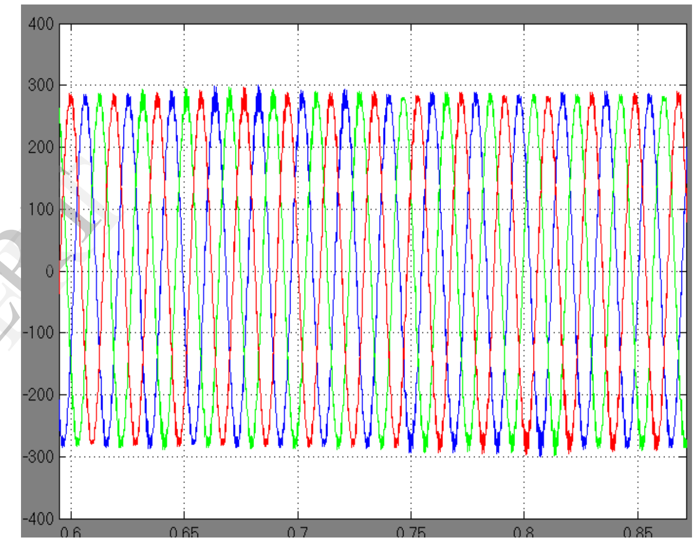

Fig .4.6. output current wave form of asynchronous motor

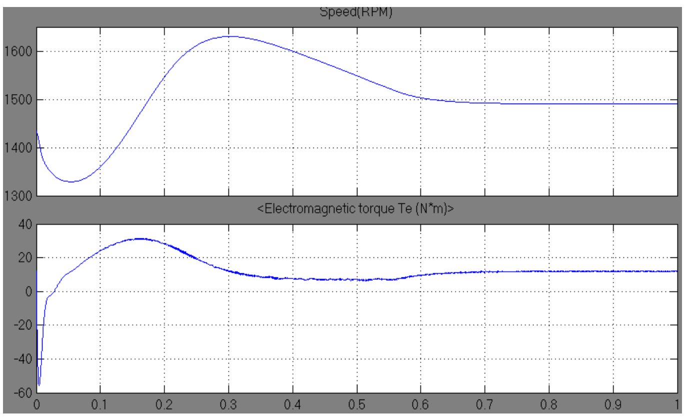

Fig .4.7. speed and torque of the asynchronous motor

V CONCLUSION

A new topology was proposed to improve the trans-Z-source inverter with the following main characteristics: high boost voltage inversion ability, continuous input current, and resonance suppression at startup. The conventional trans-Z-source and trans-quasi-Z-source inverters, for the same transformer turn ratio input and outputvoltage,the improved inverter has a higher modulation index with reduce voltage stress on the dc link, lower current stress flow to the transformer winding and diode and lower input current ripple. if the modulation index is kept fixed, the improved inverter uses a lower transformer turn ratio to produce the same input output voltage compared to the convectional trans-Z-source/-quasi-Z-source inverters. As a result, the size and weight of the transformer in the improved inverter can be reduced. The system can be improved to have application such as fuel cell EHV.

VI REFERENCES

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