

Optimization of Multi Carrier Phase Opposition Disposition with Absolute Sine Wave in Quasi Z Source Cascaded H Bridge Multi Level Inverter

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Abstract

Multi carrier phase opposition disposition pulse width modulation is used for the control of cascaded H bridge multilevel inverter and its different types. Quasi Z source cascaded H bridge multilevel inverter is one type of cascaded H bridge multilevel inverter with boosting of voltage is done across each bridge. The different voltage levels are obtained using switching pulses generated using sinusoidal PODPWM. The voltage boost and inversion are integrated in a single stage. Simulations of the circuit using simple boost control method have been performed in MATLAB/Simulink and the results are verified.

Keywords: THD, Quasi_ Z source, Phase opposition disposition, Pulse width modulation

I. INTRODUCTION

The multilevel inverters offer several advantages over a conventional two level inverters such as lower semiconductor voltage stress, better harmonic performance, low Electro Magnetic Interference (EMI) and lower switching losses. But the drawback of MLI is that its output Voltage is limited to the sum of the dc input sources. Therefore, to boost up the voltage, a DC-DC converter is required as a intermediate converter. To overcome this drawback, a Z-source and quasi z source based multi-level inverter can be used which can perform boost or buck operation.

Cascaded H Bridge multilevel inverter with Quasi Z network can be implemented to obtain both inversion and boost capability in a single stage. The output voltage can be controlled using modulation index and shoot through state

II. OPTIMIZATION OF MULTICARRIER PODPWM WITH ABSOLUTE SINE WAVE

The multi carrier sinusoidal PWM method is used for the control of the quasi Z source multilevel inverter. Phase opposition disposition method is used for the modulation. The absolute or positive value of the modulating reference sine wave is taken. This method of optimization reduces the number of carriers required for n level inverter into $\frac{(n-1)}{2}$. The seven level inverter requires only 3 carrier waves. Modulation index $M = \frac{A_{ref}}{\frac{n-1}{2} * A_{tri}}$

Where n is the number of levels of inverter and A_{tri} is amplitude of triangular carrier wave and A_{ref} is amplitude of reference sine wave.

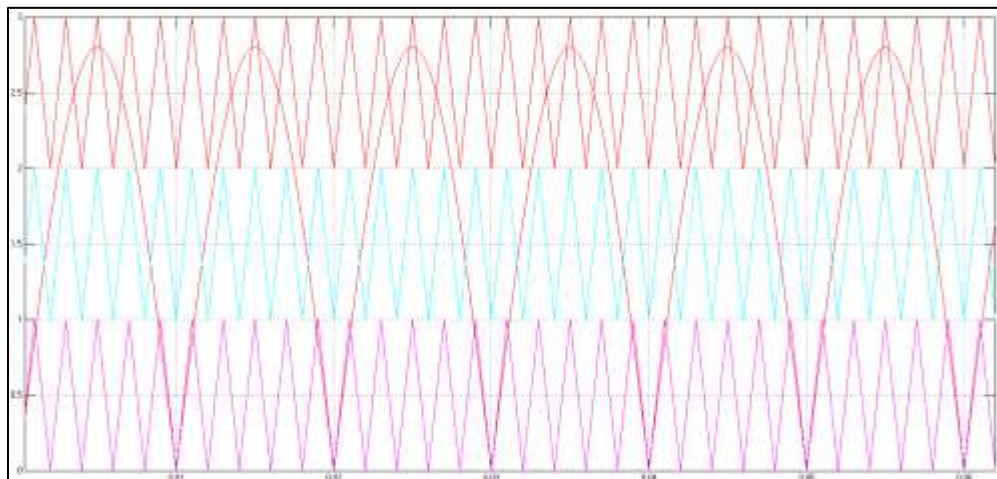


Fig. 1: Optimization of multicarrier PODPWM with absolute sine wave

III. OPTIMIZED PODPWM IN QUASI Z SOURCE MULTILEVEL INVERTER

The quasi z-source inverter has the capability of boosting and inverting the dc voltage in a single-stage, with less no of switches in comparison with a combination of dc booster and multi-level inverter which has two stages. The output voltage of the quasi z source multilevel inverter can be controlled using modulation index and shoot through state. Cascaded quasi Z–Source Multilevel inverter is analyzed with simple boost control modulation strategy. The control technique have been proposed to insert the shoot-through periods in the traditional switching waveform of power switching devices. Multilevel inverter output is summation of DC inputs. Quasi z source inverter can realize buck or boost and inversion in a single stage. QZSI has advantages of continuous input current, reduced source stress, and lower component ratings when compared to ZSI.

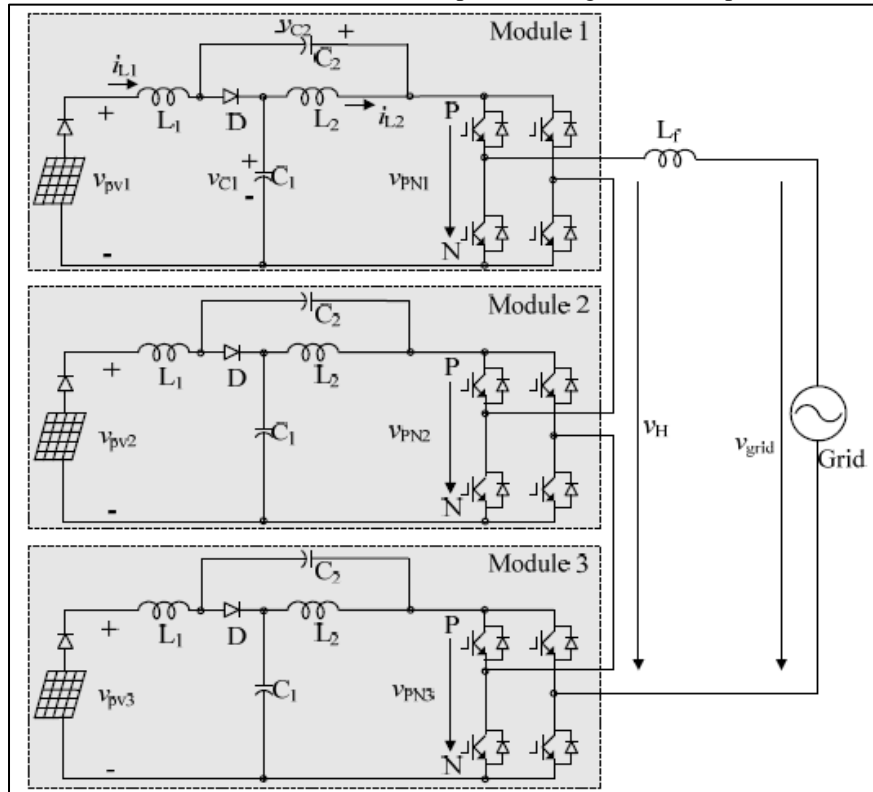


Fig. 2: Quasi Z source Cascaded H bridge multi-level inverter

- Quasi z source multilevel inverter works in two modes.
 - 1) Non shoot through state.
 - 2) Shoot through state.

$$\text{Shoot through duty ratio } D = 1 - M$$

$$\text{Boost factor } B = \frac{1}{1 - 2D}$$

$$\text{Voltage Gain } G = MB = \frac{M}{2M - 1}$$

Simple boost technique is used. In shoot through states, the inductors in the impedance networks are charged by the capacitors while in the non-shoot-through states these inductors along with input DC source discharge through the load. Hence the output voltage is boosted. In Simple Boost technique, the triangular carrier wave will be compared with a constant DC line to produce shoot through. The shoot through states will be produced if the carrier wave amplitude is greater than the DC line.

IV. SIMULATION RESULTS

The quasi Z source cascaded h bridge multilevel inverter is simulated with multi carrier phase disposition method Modulation index is taken as 0.8 and shoot trough duty ratio as 0.2.the figure shows simulation circuit diagram of quasi Z source cascaded h bridge multilevel inverter.

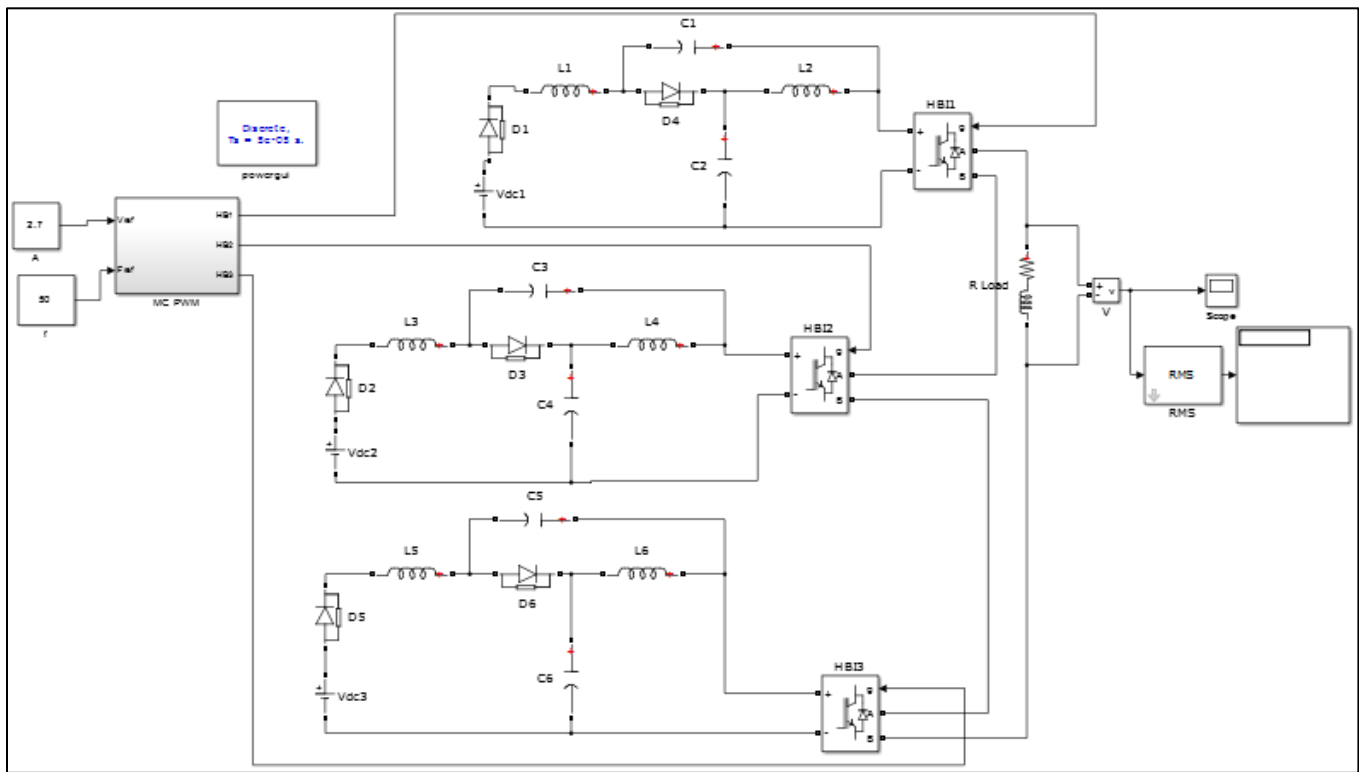


Fig. 3: Simulation circuit diagram

Multicarrier phase disposition sinusoidal PWM is used for the control of quasi Z source multilevel inverter and is given in the figure below. The absolute value of sine is taken so instead of six carrier only three carriers are used.

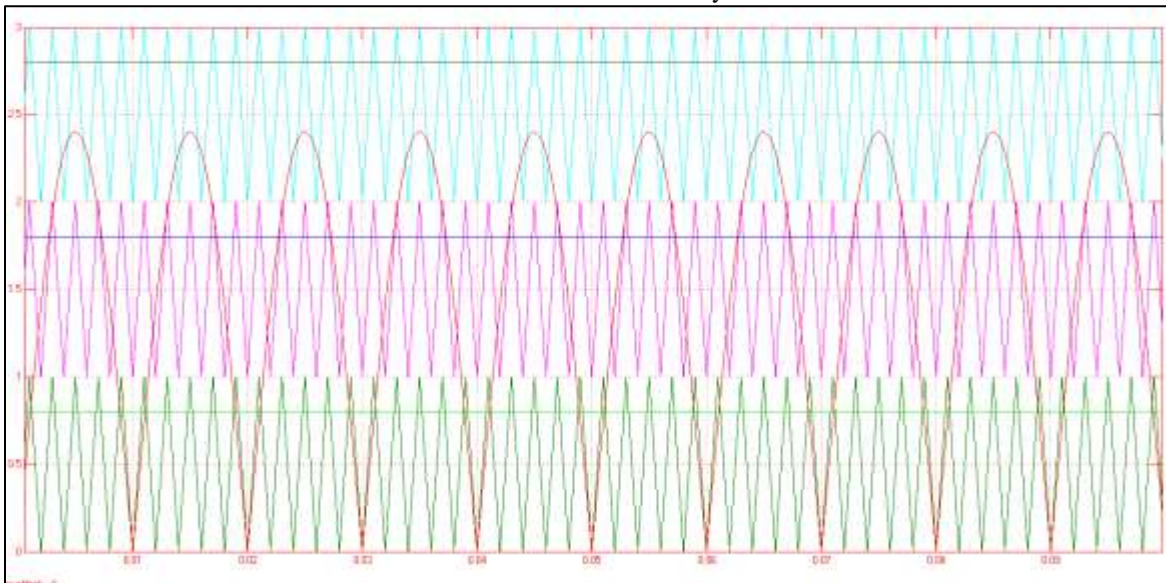


Fig. 4: Multicarrier phase disposition PWM with shoot through

The figure below shows the output of the quasi Z source cascaded h bridge multilevel inverter with 6V input across each bridge. The RMS value of output voltage is obtained as 24 V.

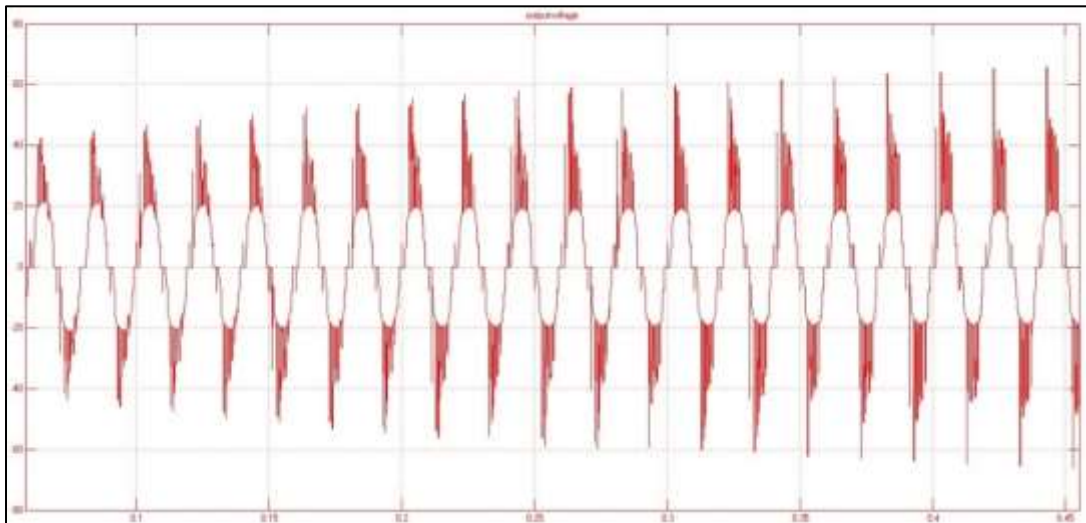


Fig. 5: Output voltage across the load

V. CONCLUSION

The control techniques such as Simple Boost Control (SBC) are applied to for the seven level Quasi Z-source inverter. Optimized PODPWM modulation strategy have been used the simulations have been developed in Matlab/Simulink environment for seven level Quasi Z-source inverter with R L load. Boosting of the output voltage is obtained. QZSI inherits all the advantages of the ZSI. It can buck or boost a voltage with a given boost factor. It is able to handle a shoot through state, and therefore it is more reliable than the traditional voltage source inverter

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