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Performance Comparison of Switched Inductor Based Quasi Impedance Source Inverter Using Different PWM Technique

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Abstract

PWM technique is mainly used for reducing the current harmonic and controls the speed of the motor in industries. Many PWM techniques are developed for harmonic reduction. In this paper Trapezoidal PWM (TPWM), Sine PWM (SPWM) and third harmonic injection pulse width modulation (Third HI PWM) methods are proposed for control the switched inductor based quasi impedance source inverter (SL-QZSI). The proposed circuit is simulated using three PWM techniques in MATLAB environment. The circuit performance is compared with simulation results. Third harmonic Injection method has less THD and high voltage gain compare than other two methods. The circuit results and operation is present.

Keywords: PWM technique, voltage gain, harmonic and inverter.

INTRODUCTION

Pulse Width Modulation technique produces variable ac output voltage where the input of the inverter is supplied with fixed dc voltage. It is achieved by adjusting the duty ratio of the inverter switching pulses. It gives the best results compared to any other external control method [1]. These techniques affect the system performance directly [2]. Different PWM method is used to control the output voltage and current harmonic [3-4]. Each method has advantages as well as disadvantages compare than other method. Single PWM is a basic control method and produce even pulse width for all pulses. SPWM is the best control method compare than single PWM method because SPWM produce variable pulse width in each pulse [5]. But this method has some draw backs such as more total harmonic distortion (THD) lower effective utilization of DC value [6]. Trapezoidal PWM method is used to improve the system performance such as reduce the current harmonic and improve the power quality [7].

Many research works is going on continuously to improve the impedance source inverter voltage gain and reduce the current harmonic compare than previous version [8-9]. PWM method with shoot through concept is applied for increase the voltage gain and reduces the harmonic of the impedance source inverter [9-10]. The switched inductor based quasi impedance source inverter using third harmonic injection is proposed in this paper. Different PWM method is applied for improving the system performance. The circuit performance is compared using simulation results. The following section describes the simulation results and discussion.

CIRCUIT DESCRIPTION

The switched inductor based quasi impedance source inverter system is as shown in fig 1. This circuit consists Solar input; switched inductor based quasi impedance source (Sl-Qzi) inverter and load. The solar cells produce the dc voltage based on light intensity. This dc supply is fed to Sl-Qzi for converting dc to ac with voltage boosting. **Impedance network** consists of three inductors (*L*1, *L*2, and *L3*), two capacitors (*C* and *C*2), and four diodes (*D*1, *D2*, *D3* and *D5*). The combination of *L*1–*L*3–*D*1–*D2*–*D3* performs the function of the SL cell This SL cells are used to store and transfer the energy from the capacitors and dc source to the dc bus under the switching action of the main circuit. The impedance network with inverter produces the constant voltage with fixed frequency output. This ac voltage is given to the motor load. The circuit operation is explained in detail [11&12].

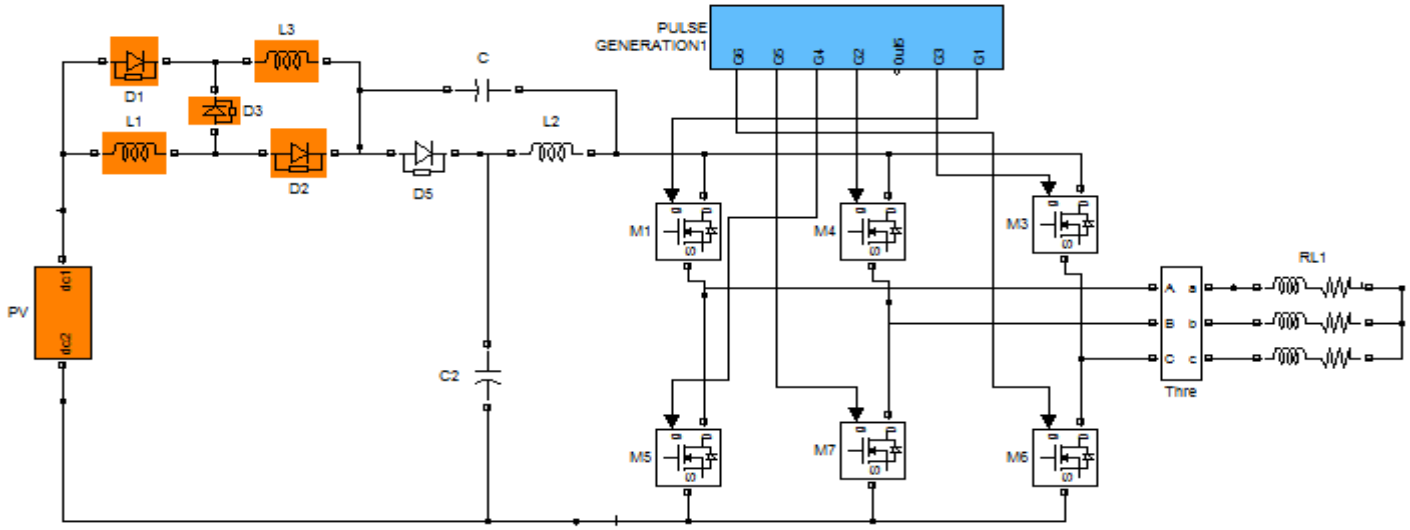

Figure 1: Switched inductor based quasi impedance source (Sl-Qzi) inverter

PWM TECHNIQUE

Figure 2 shows the trapezoidal PWM pulse generation method and pulse pattern. In this method trapezoidal reference signal is compared with triangle carrier signal. Each pulse having different pulse width in each half cycle. Figure 3 shows the Sine PWM pulse generation method and pulse pattern. In this method sine reference is compared with triangular carrier signal. Each pulse having different pulse width in one half cycles. it is giving better voltage regulation and harmonic reduction. Figure 4 shows the third harmonic injection PWM pulse generation method and pulse pattern. Lower order harmonic are the dangerous one for the electrical apparatus. When the output voltage has more THD that increase the system loss and reduce the equipment life. Third harmonic injection is used to eliminate the third order harmonic. In this method third harmonic injected signal is compared with triangular carrier signal. Each pulse having different pulse width in one half cycles. It is giving better voltage regulation and harmonic reduction.

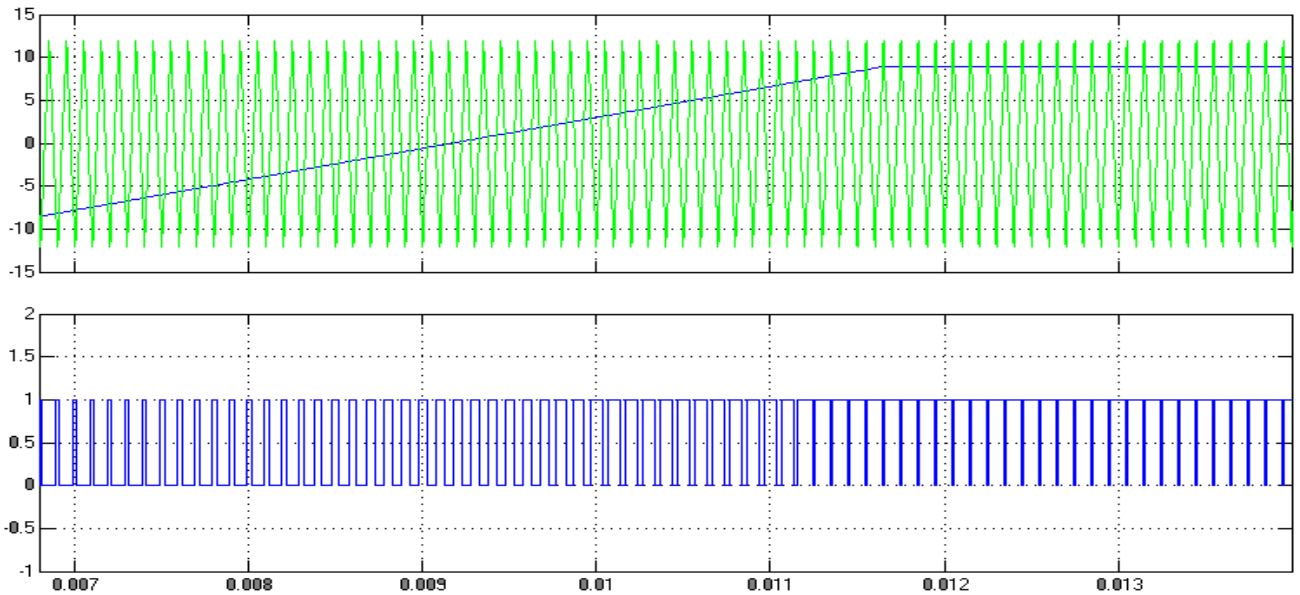

Figure 2: Trapziodal Pwm Generation Method and Pulse Pattern

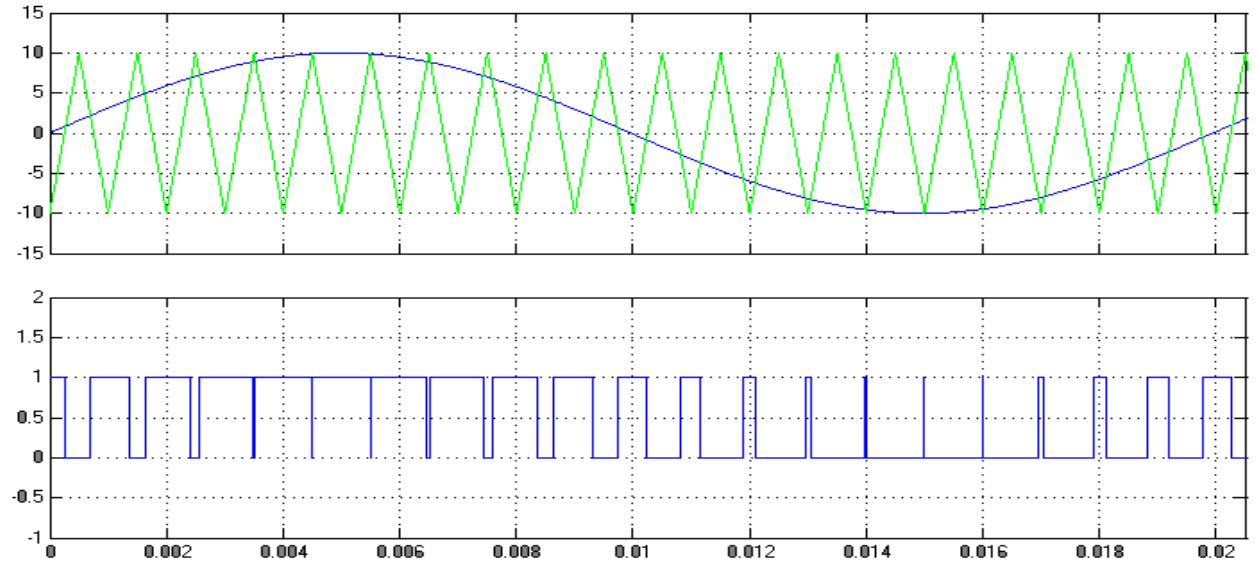

Figure 3: Sine Pwm Generation Method and Pulse Pattern

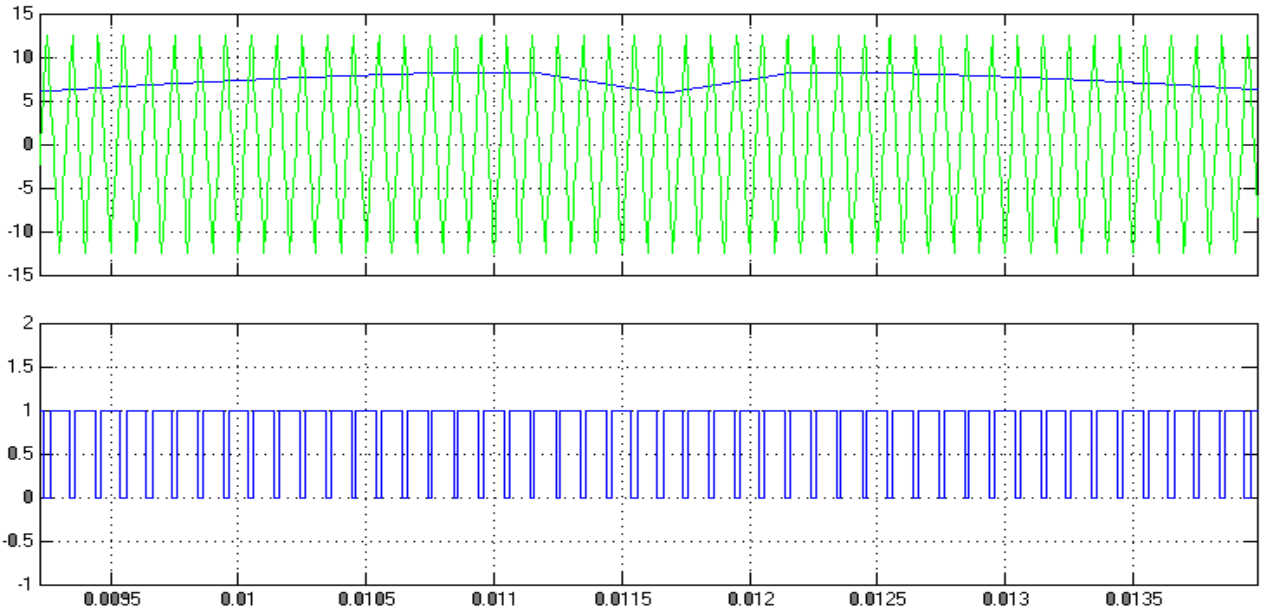

Figure 4: Third harmonic injection Method and Pulse Pattern

SIMULATION AND DISCUSSION:

The switched inductor based quasi impedance source inverter circuit is simulated using different PWM technique to compare the system performance. First trapezoidal PWM method is used to control the inverter switch and output voltage. Figure 5 shows the Inverter output voltage wave form using Trapezoidal PWM technique. Figure 6 shows the inverter output current. Figure 7 shows the FFT spectrum to measure the current harmonic. Second Sine PWM method is used to control the inverter switch and output voltage. Figure 8 shows the Inverter output voltage wave form using Sine PWM technique. Figure 9 shows the inverter output current. Figure 10 shows the FFT spectrum to measure the current harmonic. Finally Third harmonic injection PWM method is used to control the inverter switch and output voltage. Figure 11 shows the Inverter output voltage wave form using Third harmonic injection PWM technique. Figure 12 shows the inverter output current. Figure 13 shows the FFT spectrum to measure the current harmonic.

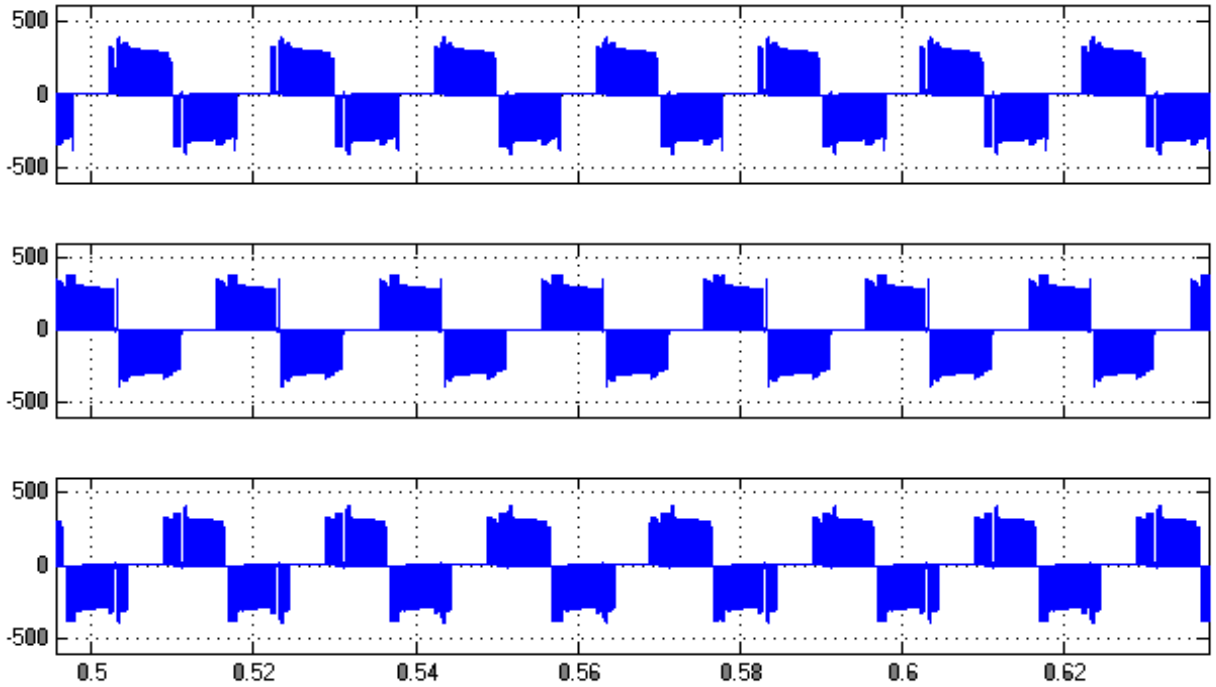

Figure 5: Inverter output voltage using Trapezoidal PWM technique

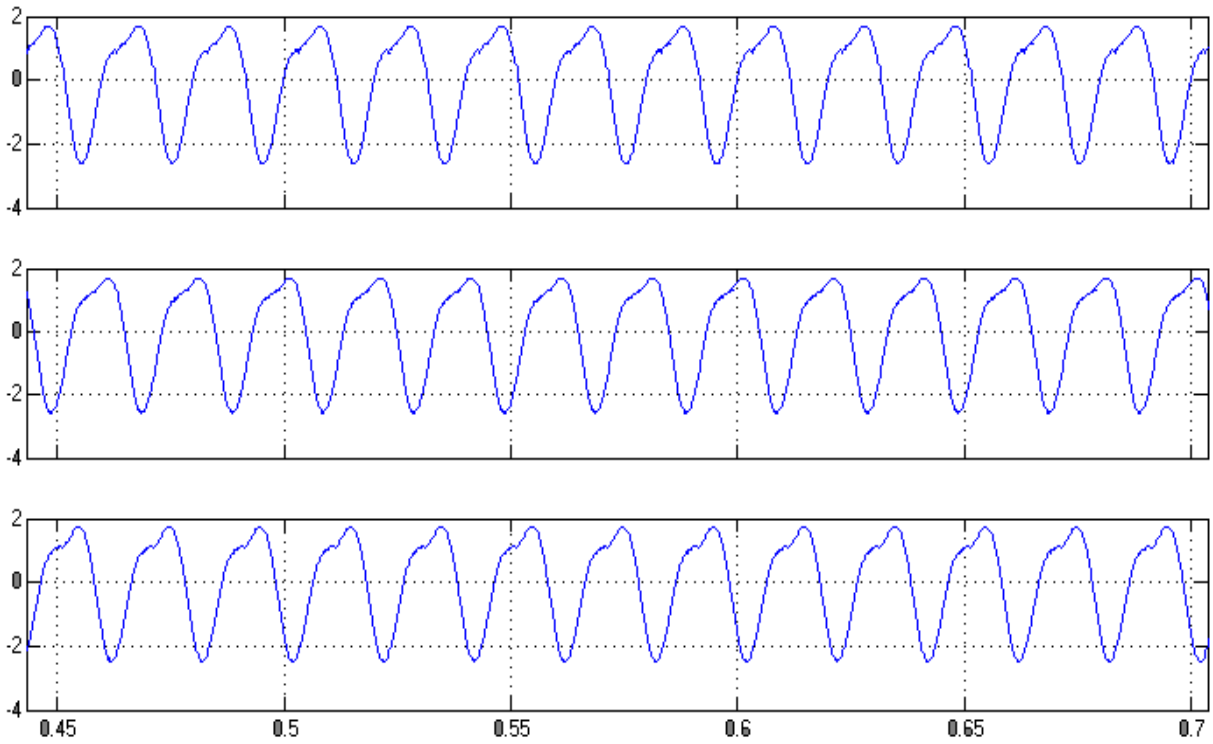

Figure 6: Inverter output current using Trapezoidal PWM technique

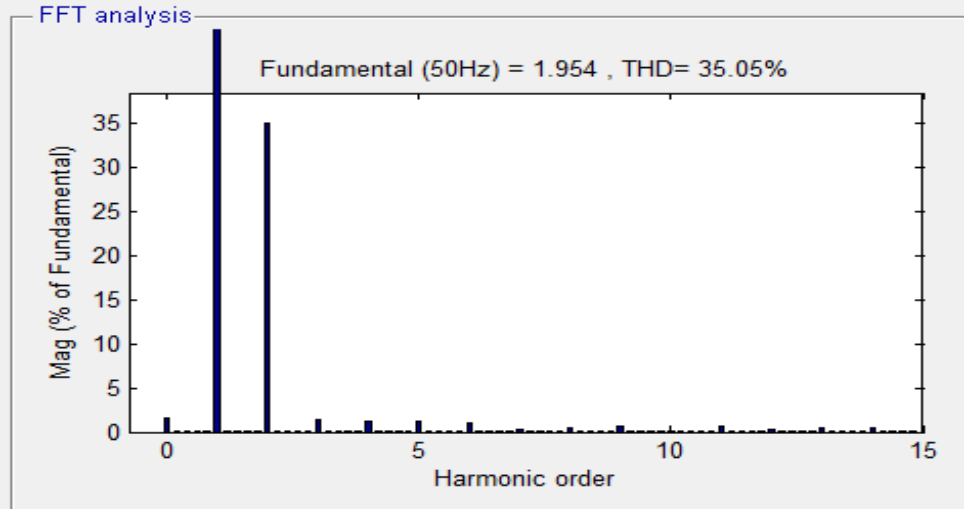

Figure 7: FFT ANALYSIS for current using Trapezoidal PWM technique

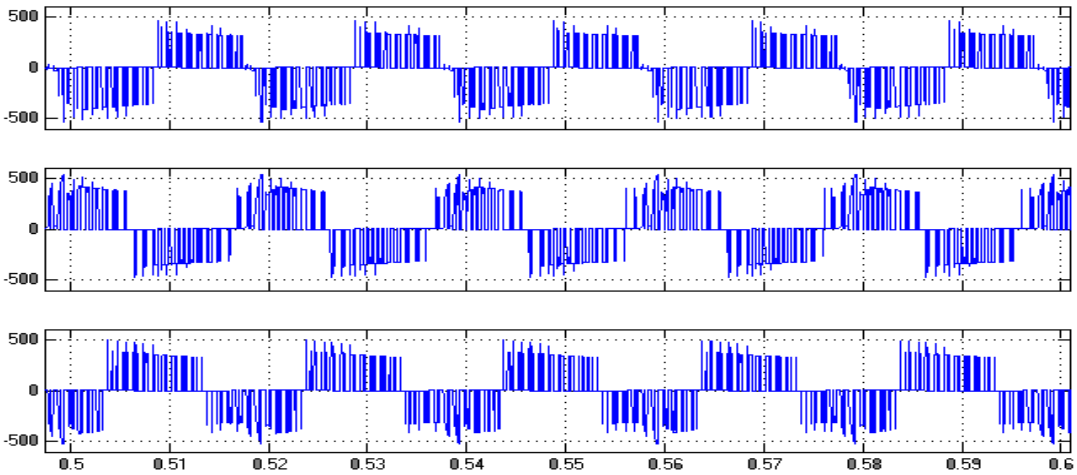

Figure 8: Inverter output voltage using Sine PWM technique

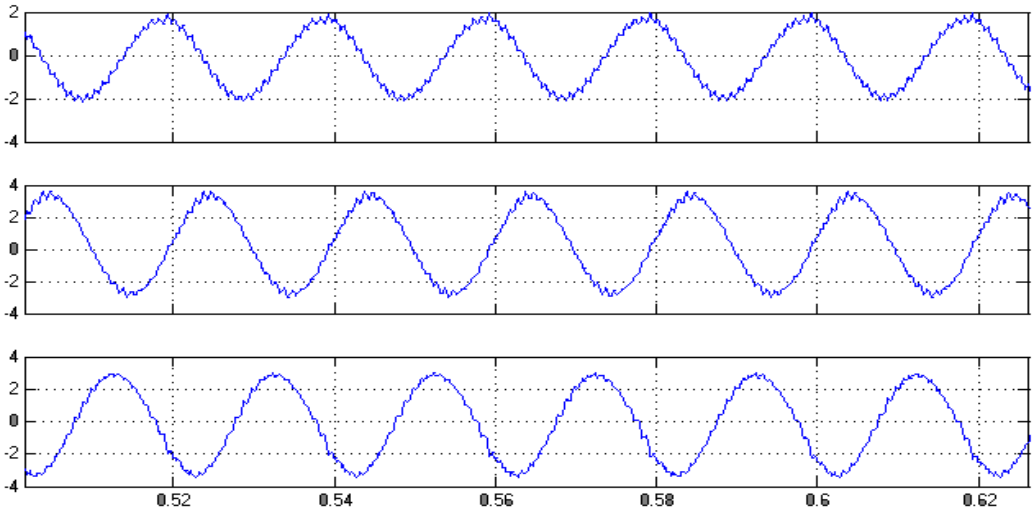

Figure 9: Inverter output current using Sine PWM technique

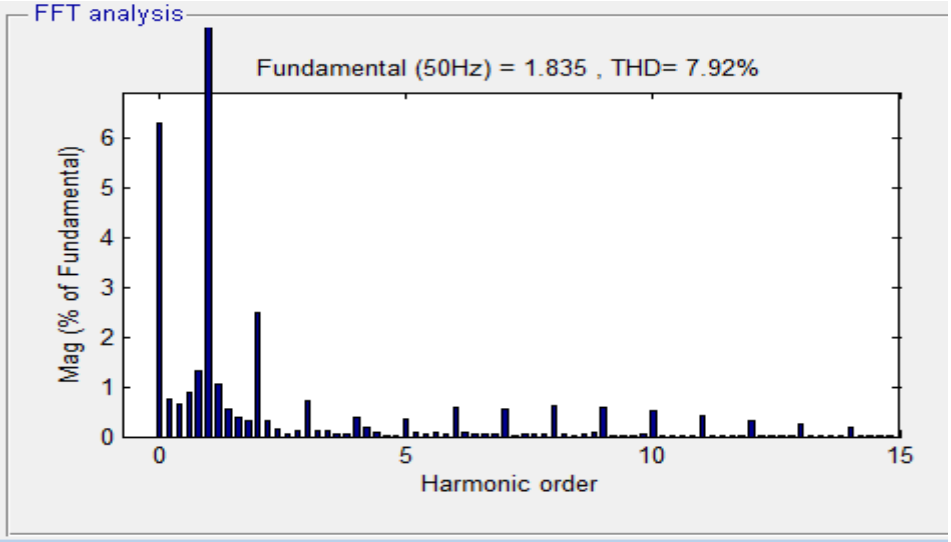

Figure 10: FFT ANALYSIS for current using Sine PWM technique

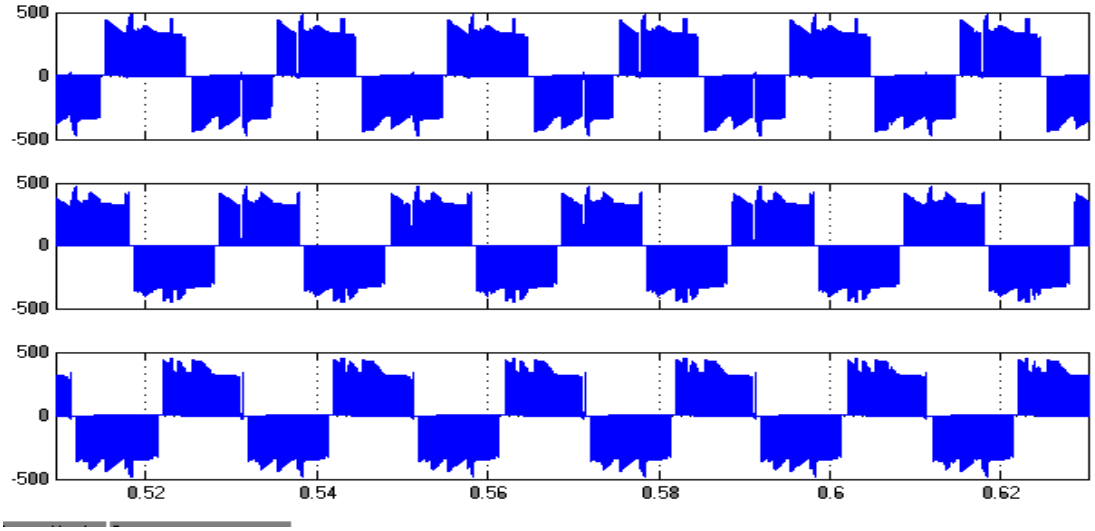

Figure 11: Inverter output voltages using Third harmonic injection PWM technique

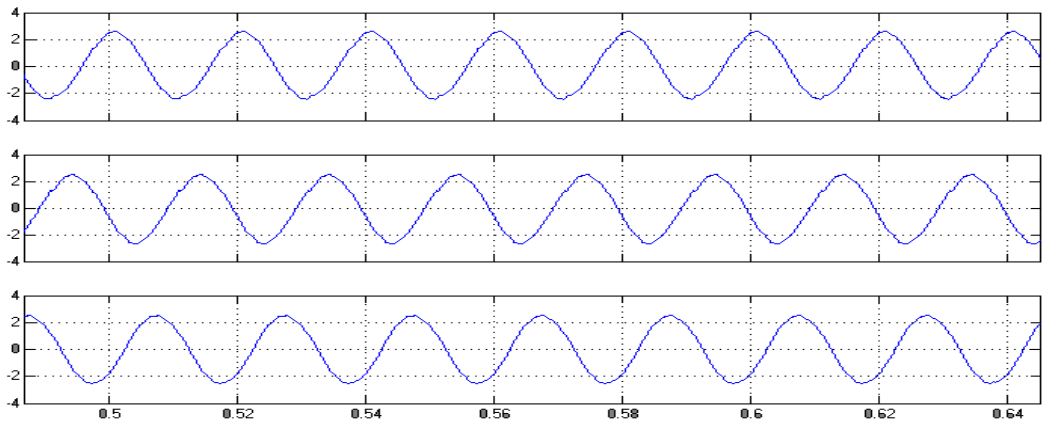

Figure 12: Inverter output current using Third harmonic injection PWM technique

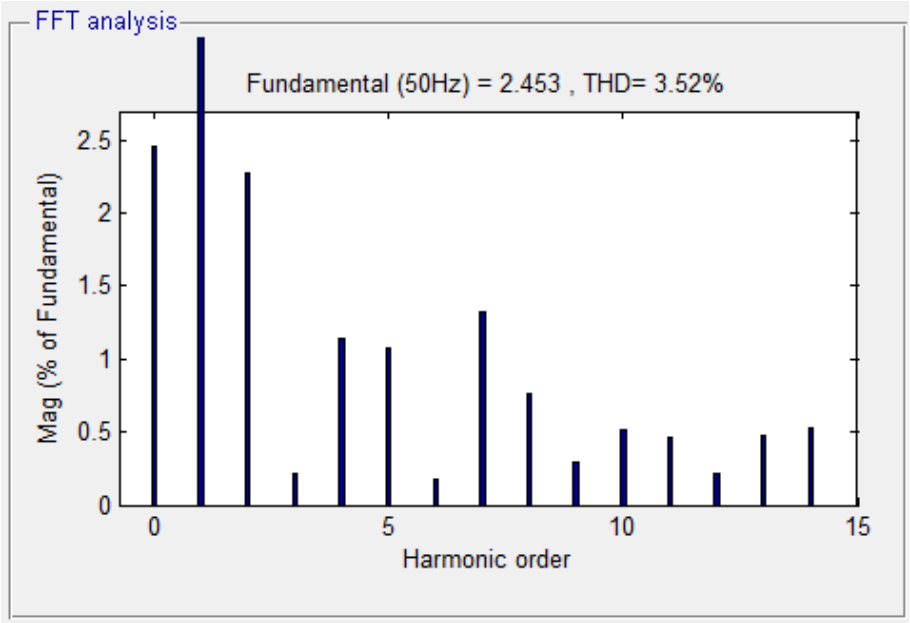

Figure 13: FFT ANALYSIS for current using Third harmonic injection PWM technique

Comparative analysis:

Table 1: Performance comparison for different PWM technique

PARAMETER	Trapezoidal method	Sine PWM method	Third harmonic injection method
%THD	34.98	7.92	3.52
DC LINK VOLATGE (V)	310	320	345

The circuit performances are analyzed based on simulation results. The input voltage, shoot through period, switching frequency and load values are taken common for all PWM methods.

The sine PWM technique has better voltage gain compare than Trapezoidal PWM technique. It is shown from table 1. The Sine PWM technique has less harmonic 7.92% compare than Trapezoida**l** PWM technique 34.98%. It is shown that from figure 7 and 10. Third harmonic Injection PWM method has less harmonic 3.52% comparable than Sine PWM technique 7.92%. It is shown that figure 13.

CONCLUSION

The proposed inverter is simulated using Third harmonic Injection PWM, Sine PWM and Trapezoidal PWM method in this paper. The voltage gain is more in Third harmonic Injection PWM technique compare than Sine PWM and Trapezoidal method. The trapezoidal PWM technique has more harmonic compare than third harmonic Injection and Sine PWM method. From this result the Third harmonic Injection method has better voltage gain and lower harmonic compare than other two techniques.

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