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Modeling of PWM Technique for Three Phase Voltage Source Inverter

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Abstract

This paper deal with 3rd harmonic-based pulse width modulation techniques for 3 phase voltage source inverters. In this work DC voltage is converted in AC voltage with the help of inverter. 3rd harmonic is generated with the help of fundamental component in power supply, that is used for generating the pulse for inverter. Three phase inverters have been adopted in this work, that having the capability to generate the pure sinusoidal output voltage for load. 3Phase LC filter also proposed in this work to getting the voltage for load without any harmonics. This study have been carried out with the help of modeling and simulation with MATLAB.
Keywords: PWM, Voltage source inverter, Load, Supply.

1.1 Introduction

Harmonics definition changes to way we see the harmonics in the nature. In the harmonics for the power system say "positive integer multiples of the fundamental frequency. Harmonics are sometime these harmonics are destruction and distraction in transmission lines. Those harmonics produced

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by the components of power electronic such as rectifiers, transistors, or but the electrical motor with unbalanced loads. Those frequently affects power quality problems in the equipment which cause the conductor heating, variable speed drives get misfired. In fundamental frequency is also 50Hz, then the second harmonics will be in 120Hz, The third will be in the range of 150Hz. In generally to know the nth harmonics then nth harmonics will be (n*50) Hz. Majorly the harmonics are classified as follows of single-phase system: (1) Current harmonics; (2) Voltage harmonics Harmonics of three phase systems can be found in following parts for current and voltage:

- Even harmonics
- Odd harmonics
- Triplen harmonics
- Non triplen odd harmonics

Basis of sequence harmonics are categorized in three major parts

- Positive sequence harmonics
- Negative sequence harmonics
- Zeros sequence harmonics

Level of harmonic distortion present in power system are measured in total harmonics distortion (THD). THD methods are either to related to current or voltage harmonics. That can be defined as ratio of RMS value of all harmonics to the RMS value of the fundamental element times 100%. Then DC component is not considered for calculating the THD in power system. The effects of harmonics on motor and communication (Telephones lines majorly effects by increasing the current in the system, In that area harmonics are always exhibits based third harmonics majorly, those will increase the harmonics in neutral lines of transmission lines. Motors will experience losses due to eddy currents and hysteresis set in the iron core of motor[1, 2, 3, 4]. If there is more harmonics then results in higher core losses in motor core. Counter electromotive force (CEMF) from 5th harmonics in larger motor which acts in opposite direction of rotation. Those CEMF is not large enough to counteract the rotation So, it does play role in rotation speed of motor Now a days telephones are become old due to evolution of wireless communication evolved. Usually, those transmitted frequency 300 and 3400Hz.It normally does not interfere with telephone communications because its frequency to low so. Inverters are widely used now a days to fulfill the need of day to day requirements of industries, offices and home appliances. AC power cannot be stored But DC can be stored using battery . Appliances we use are mostly

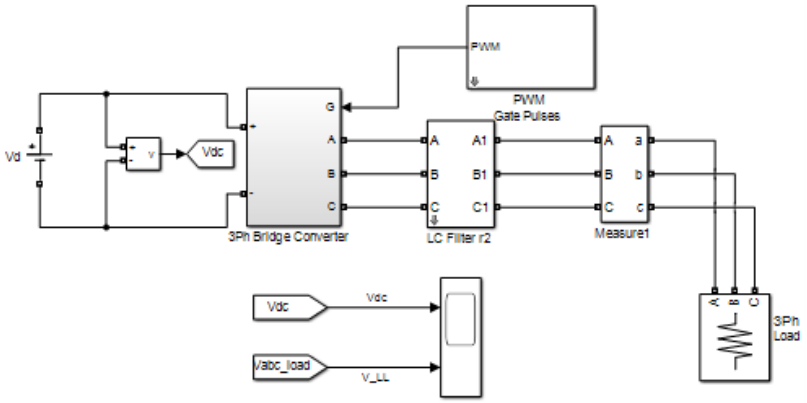

Figure 1.1 Proposed work with simulink diagram

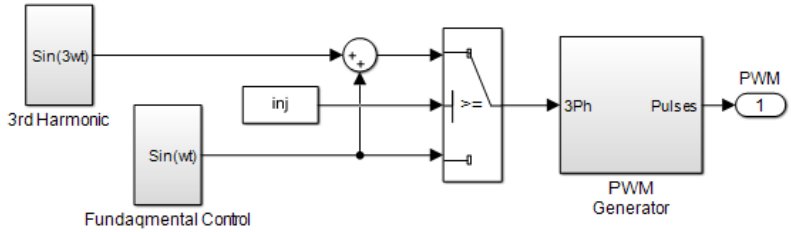

Figure 1.2 3rd harmonics generation using simulink

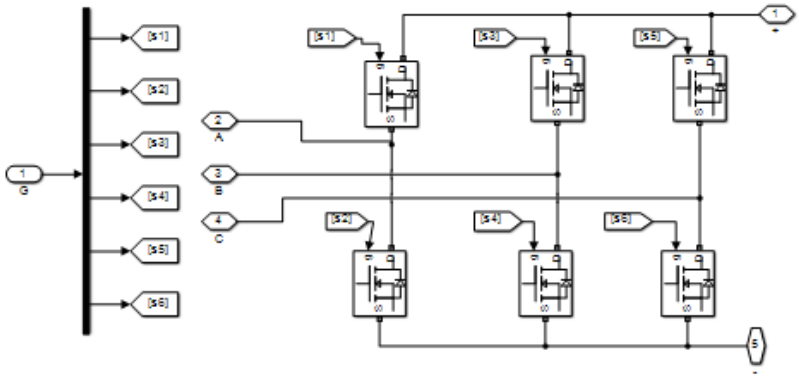

Figure 1.3 Inverter modeling in MATLAB Simulink.

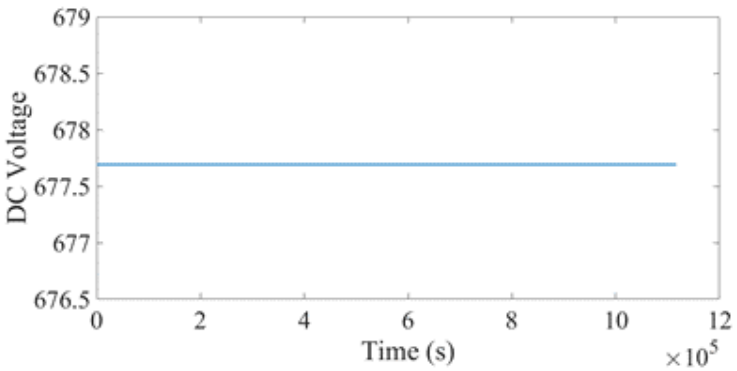

Figure 1.4 DC voltage supplied to inverter for conversion

of AC in nature. So DC is converted to AC by inverter. In the processes of converting DC to AC and depending up on the converter technology , control, type of load harmonics are introduced in the inverter[5, 6, 7, 8]. Harmonics are unwanted components which leads to distortion of current and voltage waves leading to increased power losses, hence reduced efficiency. Also reduces life of the device, components[9, 10, 11]. Harmonies are positive integer multiple of fundamental frequency like third harmonics, fifth harmonics, seventh harmonics etc. when fundamental frequency is 50hz, frequency of third fifth harmonics is 3*50=150 hz , 250hz respectively. In this proposed work, third harmonics is modeled for three phase voltage inverter using MATLAB which keeps the HD value less than the acceptable value by novel Mathematical modeling strategical control algorithm. Harmonics is an important phenomena in power system, healthy signal having the minimum total harmonics distortionḢarmonics in single phase transformer in divided in three several cases [12, 13, 14, 15]. when flux is sinusoidal and linear (B = H). In this case EMF is in sinusoidal as well as the current will also be sinusoidal, that is an ideal case.

1.2 Methodology

The proposed work consisting of the structure of three-page voltage source inverter with six pulse width modulation. The proposed work consisting of the DC voltage as input to voltage source inverter, three phase bridge converter, LC filter, PWM gate pulse and the three-phase load is discuss in the next paragraph. Figure 1.1 represents the proposed work. Primary prime application of the VSI is converting the DC input to AC output. In this work DC voltage is taken as 415*2*sqrt (2). Here 415 is considered as line-to-line voltage, the output of the voltage source inverter to feed the load that is showing in Figure 1.4. 3 Phase Bridge converter: 6 MOSFET have been used for this configuration with internal diode resistances 0.01 ohms and R on equal to 0.1 ohm, Snubber resistance is taken 1e5 for the proposed circuit that is mentioned in Figure 1.3.

1.2.1 Pulse Width Modulation

PWM pulse width modulation is the important part of the proposed work switching frequency is taken as 20 kilo hertz and control signal frequency is taken as 50 hertz for generating the gate pulse. Three inputs are considered that is showing in Figure 1.2.

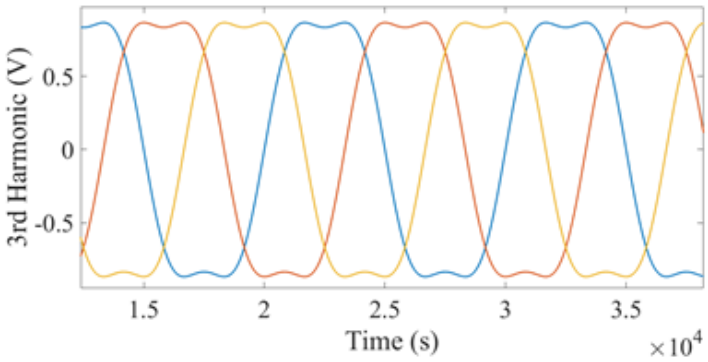

Figure 1.5 Distorted power supply with 3rd harmonics

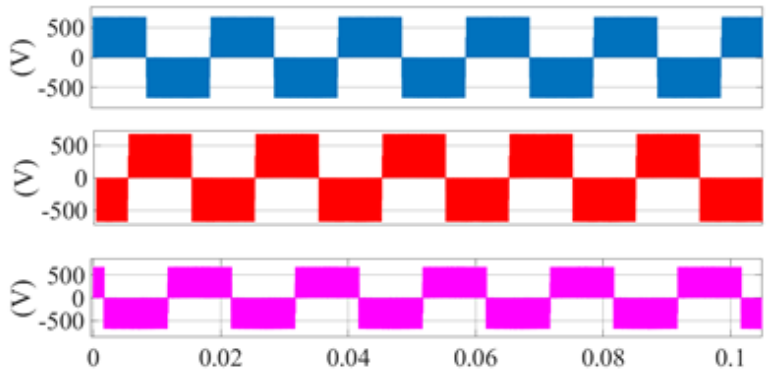

Figure 1.6 Inverter output voltage without filter.

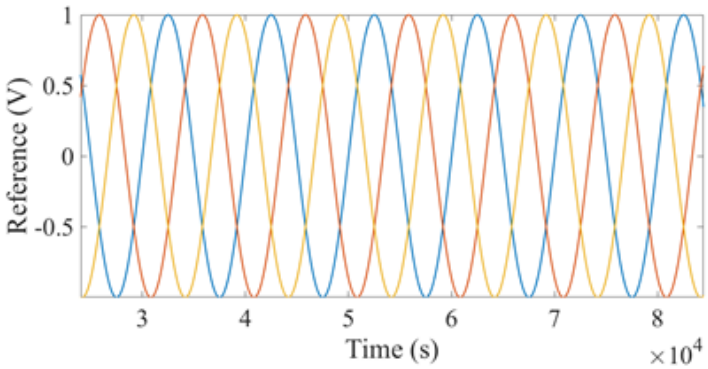

Figure 1.7 Results for reference voltage input to 3rd harmonics generation

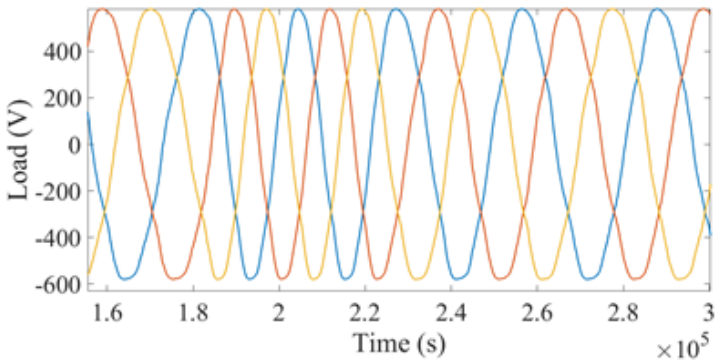

Figure 1.8 Load voltage for with pure sinusoidal condition.

- 3rd harmonic $sin(3\omega t)$
- Injection (constant value)
- Fundamental control $sin(\omega t)$

LC filter: The parameters values of the LC filter is taken as L= 10e-3 and C = 20micro farad. Three phase parallel RLC load has been applied for the purposed work. Nominal phase two phase voltage is 415 V and nominal frequency is considered as the 50 Hertz.

1.3 Results and Discussion

This paragraph representing the output obtained from the proposed work. Figure 1.5 showing that distorted power supply with third harmonics, Figure 1.6 represents the VSI output without Filter. Figure 1.7 is about the reference voltage is taken during the PWM generation. Load voltage is mentioned in Figure 1.8. Here load voltage is 415 volts with pure sinusoidal wave form. Total harmonics distortion is obtained minimum as per IEEE standard. The overall output of the proposed work is to maintain the load voltage. Novelty of the research is generating the PWM gate pulse with the distorted reference input.

1.4 Conclusion

This research intends to modeling of voltage source inverter by following the proposed PWM method. 3rd harmonics-based pulse width modulation investigated. All results obtained from this research is showing the good agreement with published results in same domain. The research has been carried out is based on the MATLAB and Simulink. The outcomes of the proposed work can be applied in inverter (DC to AC) based applications.

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