Unipolar and Bipolar PWM Inverter Fed Induction Motor

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Abstract: Sinusoidal pulse width modulation or SPWM is widely used in power electronics. To digitize the power so that a sequence of voltage pulses is generated by ON or OFF of the power switches the pulse width modulation inverter has been the main alternative in power electronic for many years as a result of its circuit simplicity and rugged control scheme SPWM switching technique utilized in used in industrial applications SPWM techniques are characterized by constant amplitude pulses is completely different dutycycle for each period the width of this pulses are modulated to obtain inverter output voltage control to diminished its harmonic content, Sinusoidal pulse width modulation or SPWM is that technique to used in motor control and Inverter application in this thesis development a unipolar and bipolar SPWM voltage modulation type is given as a result of this method offers the advantage of effectively doubling the changed frequency of the Inverter voltage making the output filter smaller cheaper and easier to generate with this signal triangle wave as a carrier signal is compared to the sinusoidal wave whose frequency is the desired frequency. In this thesis single-phase inverters and there in operation principles are analyzed very well the concept of sinusoidal Pulse Width Modulation or PWM for inverters is explain with analyses extended to different kinds of SPWM strategies.

Key words: Unipolar, Bipolar, Inverter, Over PWM Modulation, Induction Motor drive

I INTRODUCTION
An inverter is basically a device that converts electrical energy of DC form into that of AC. The aim of DC-AC inverter is to require DC power from a source and converts it to AC.

II PWM TECHNIQUES
Pulse-width modulation (PWM) is the basis for control in power electronics theoretically zero rise and fall time of an ideal PWM waveform offer a most popular way of driving modern semiconductor power devices. The exception of resonant converters the vast majority of power electronic circuits. They controlled by PWM signals of various forms the fast rising and falling edges ensure that the semiconductor power devices. The turned ON or OFF as quick as practically probable to minimize the switching transition time. The upper limit on the turn-ON or OFF speed in practical situations the resulting finite rise and fall time can be ignored in the analysis of PWM signals.

A.SPWM with Bipolar Voltage Switching
The sampling of SPWM bipolar switching is as shown in figure 2 in that the reference voltage waveform having magnitude Vr are compare with carrier signal having amplitude Vc sinusoidal waveform is used as reference signal and triangular waveform as carrier signal.
In this technique all switch are on at same time and the output voltage magnitude depends on \( V_r \) and \( V_c \).

**Fig. 3:** Waveform of bipolar switching pulse.

In this technique two power switch (S11 and S21) are on at same time in single phase full bridge inverter with other two (S12 and S22) are remain in OFF state condition in next state S12 and S22 are ON and S11 and S21 are OFF state condition. The output waveforms are as shown in figure 3.6.

**B. SPWM with Unipolar Voltage Switching**

In this technology one carrier signal is compare with two reference signal in which one of them is positive and other one is negative signal the basic idea of Unipolar switching is shown in figure 4 the basic of Unipolar switching is as shown in figure 5. the switching output waveform are as shown in figure 3.8.

The output voltage in Unipolar switching is vary within a limit of 0 to \( V_{dc} \) and if the switching frequency is increase in that case the harmonic level is raise and frequency increase with load so the harmonic level is low as compared to Bipolar switching. This technology power switch is turn ON or OFF according to the comparison of two reference and carrier signal as shown in figure 4. In this technology output voltage is varies within a0 to +\( V_{dc} \) or 0 to -\( V_{dc} \) so the switching frequency is twice and the harmonic level is reduce. The output signal is as shown in figure 5.

**Fig. 4:** Unipolar SPWM generator

**III BIPOLAR PWM INVERTER**

The upper and the lower switches in the same inverter legwork in a corresponding manner with one switch turned on and other turned off. Thus we need to consider only two independent gating signals \( V_{g1} \) and \( V_{g3} \) they are generated by comparing sinusoidal modulating wave \( V_m \) and triangular carrier wave \( V_{cr} \).

**Fig. 5:** Unipolar switching signal Waveform.

**IV.UNIPOLAR PWM INVERTER**

The unipolar modulation normally requires two sinusoidal modulating waves \( V_m \) and \( V_m - \) which are of same magnitude and frequency but 180 out of phase. The two modulating wave are compared through a common triangular carrier wave \( V_{cr} \) generating two gating signals \( V_{g1} \) and \( V_{g3} \) for the upper two switches S1 and S3 can be observed that the upper two devices do not switch simultaneously, which is well-known from the bipolar PWM where all the four devices are switched at the same time. The inverter output voltage switches either between zero and +\( V_d \) during positive half cycle or between zero and \( V_d \) during negative half cycle of the fundamental frequency this is called unipolar modulation.

**Fig. 6:** Simulink modal of Bipolar PWM inverter
V. BLOCK MODEL OF PWM INVERTER FED THREE PHASE INDUCTION MOTOR

A. Pulse Generator

The first block is used as pulse generator where we have used the PWM techniques in this we have used the unipolar and bipolar switching techniques.

B. Single Phase Inverter

In this block we have drawn the single phase inverter and the switch we in the inverter circuit is the MOSFET switches and the gate pulse which is given to it is the PWM switching technique and the output of inverter is to be taken.

C. Bridge Rectifier

In this block we can convert the output of single phase inverter which is AC and the bridge rectifiers will convert it to DC.

D. Filter

The sum of ripples which is in DC will be eliminated and the desired DC will get from this block.

E. Three Phase Inverter

The output of filters has been given to this block the given filtered DC is converted into AC. As PWM generator pulse is given to it which is 12 pulses these 12 pulse is given as gate pulse of a three phase inverter.

F. Three Phase Induction Motor

The output of three phase inverter block is given to induction motor internal block of induction motor is taken it from the Simulink library and the desired internal parameter are given to it for the outcome of the induction motor.

VI. RESULT AND DISCUSSION

A. Bipolar PWM inverter

The following waveform is the output of fig : -6 simulink modal of bipolar PWM inverter the AC output is taken it.

Fig : -4.1 output waveform of Bipolar PWM inverter (simulation)
Conclusion

The bipolar PWM inverter is it consists of two components, the generator unit and control unit. The generator unit merely includes a PWM waveform computed by comparator action of generator. The control unit establishes the bipolar switching and having simple circuitry, the control unit creates a half bridge topology. Henceforth, the inverter works, we have verified the input and output waveforms of each components. On the generator unit, we must be capable to generate a 50Hz sinusoidal control signal, 15 kHz triangular carrier signal and a pulse width modulated square output signal. On the control unit, we could obtain a PWM square signal that is a bipolar switching. And after filtering PWM signal, we were able to obtain a 50Hz AC output signal that is sinusoidal.

Reference


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