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ANALYSIS AND MODELING INDUCTION MACHINE FED BY PWM INVERTER

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ABSTRACT
In this paper are presented and analysed techniques for modelling of Induction Machine which fed by PWM Inverter. Also there are presented the basic parameters for Induction Machine and proposed Simulink model with PWM Inverter. In the paper are include the limitations of Induction machine Blok. As results we have find out waveform of time vs armature current, waveform of time vs rotor current, waveform of time vs speed and waveform of time vs torque for the different frequency. The simulations are done using the MATLab software.
Keywords: Induction Machine, PWM Inverter, PWM Inverter.

1. INTRODUCTION

Today the number of industry applications in which induction motors are fed by PWM inverters is growing fast and, although much has already been done within this field, there is still a lot to be studied regarding such applications [1]. Then the theoretical basis and simulation model of speed variation on induction machines feed by PWM inverter is presented. Induction machine are the major electromechanical conversion devices in industry. Many different models available for squirrel cage induction motors are successfully used for drive design and control. Once the basics of adjustable speed drives are known, the behavior of the whole power system is analyzed. Each component of the power system (frequency inverter, induction motor, load) is focused, as well as the overall interactions between them, resulting from speed variation. In this manner the whole drive system can be well understood [2]. A voltage source inverter is commonly used to supply a variable frequency variable voltage to a three phase induction motor in a variable speed application. PWM drives are more efficient and typically provide higher levels of performance [3]. A suitable pulse width modulation technique is employed to obtain the required output voltage in the line side of the inverter.

2. MODELLING OF INDUCTION MOTOR

PWM voltage source static frequency inverters presently comprehend the most used equipments to feed low voltage industrial motors in applications that involve speed variation. They work as an interface between the energy source and the induction motor. Many variable speed drives require a constant torque output and this can be achieved if the air-gap flux in the motor is maintained constant [4]. In practice, all electric motors usually operate near saturation in order to fully utilize the core materiel.

Figure 1 shows a simplified circuit illustrating the essential of our control system. This system consists of a PWM Block, a voltage source inverter, an induction motor, and same circuit of control system. Transistors are being used as switching devices along. The two control parameters required are frequency and voltage, the frequency command also generates the voltage command through inverter. PWM is used to control the voltage and reduce the harmonic contents in the inverter output. In particular, sinusoidal PWM has been show to give minimum harmonic contents in the inverter output voltage. However, the relative complexity of control makes this modulation strategy difficult to implement. In this article a voltage source inverter is developed for use in pulse width modulation speed control systems for three phase a.c motor. The modulation of the output waveform is achieved by opening and closing the upper and lower switching element in each phase of the inverter. Closing the upper element gives a high output voltage, and closing the lower element gives low output voltage.

3. MODEL IN SIMULINK

The induction motor, when under PWM voltage coming from the inverter, is subjected to voltage harmonics. Depending on the type of PWM strategy, the switching frequency and other peculiarities of the control, the motor may present efficiency decrease and losses, temperature, noise and vibration levels increase. Furthermore other effects may appear when induction motors are fed by inverters. Although not produced specifically by harmonics but by other matters that will soon be approached, these are important effects and should not be neglected. The motor current and voltage waveforms when under PWM supply are illustrated below.

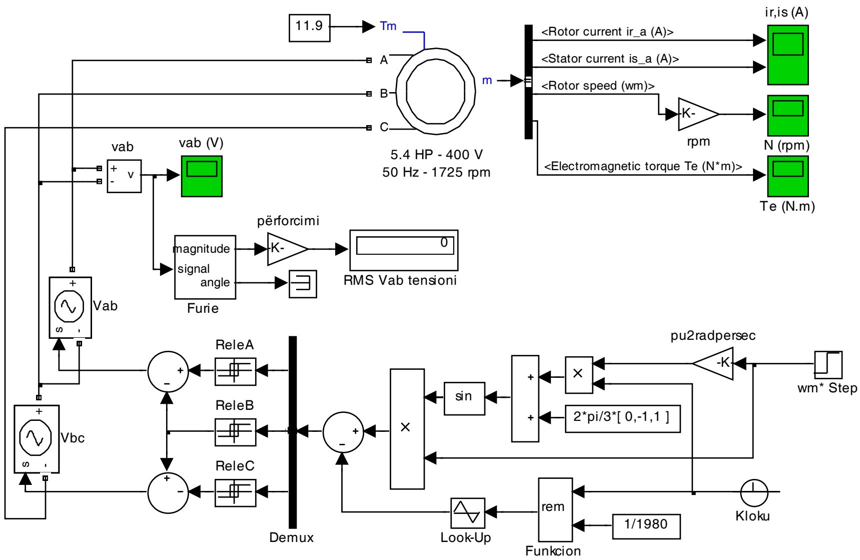


Figure 1. Simulink model

This circuit uses the block of SimPower library. The induction motor is fed by a PWM voltage source inverter. The speed control loop uses a proportional-integral controller to produce the flux and torque references for the direct torque control block. The direct torque control block computes the motor torque and flux estimates and compares them to their respective reference.

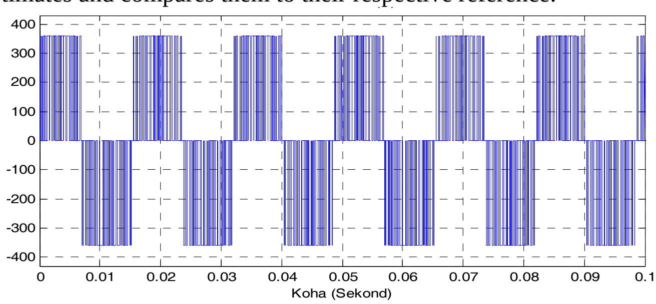
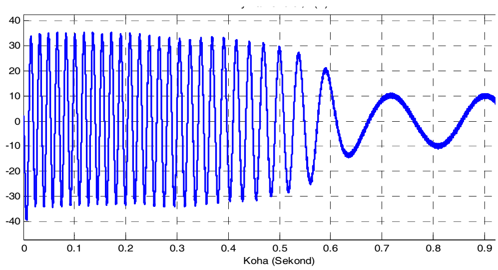


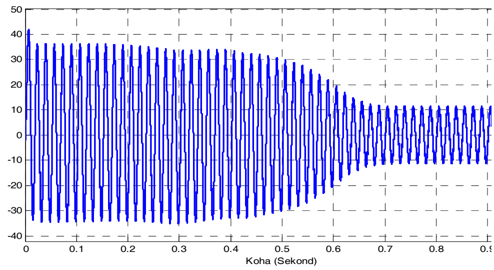
Figure 2. a) 0utput of pulse width modulator

The comparators outputs are then used by an optimal switching table which generates the inverter switching pulses. Motor current, speed, and torque signals are available at the output of the block.

We can observe the motor stator current, the rotor speed, the electromagnetic torque on the scope. The output frequency varies from 0 to 100 Hz and the maximum switching frequency is fixed at 2 kHz and 5 kHz. Simulation control system is modulate and tested for four pole squirrel cage induction motor drives (1KW, 220V, 50Hz, 10A). The more sinusoidal current output produced by the PWM inverter reduces the torque pulsations, low speed motor cogging, and motor losses noticeable.

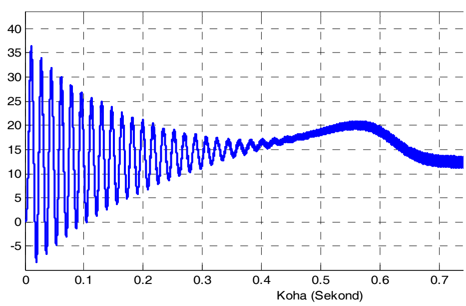


b) *waveform of time vs rotor current Ir(A)*

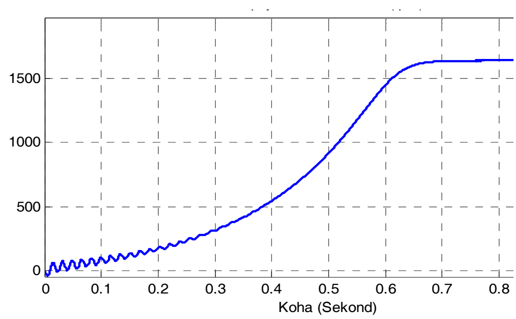


c) waveform of time vs stator current Is(A)

The rotor speed evolution of a loaded motor at 50 Hz is presented in figure 3(e).

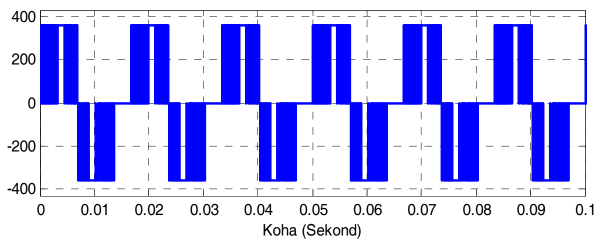


d) Waveform of time vs torque

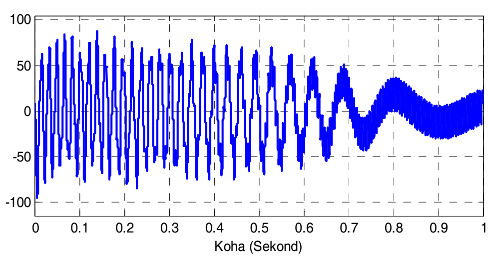


e) Waveform of time vs Speed

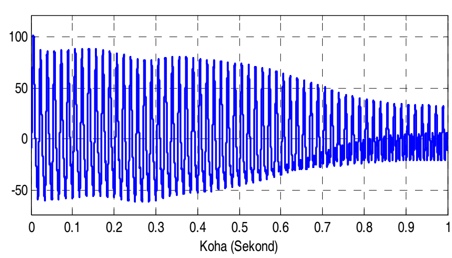
Figure 3. Waveforms with frequency 2 kHz



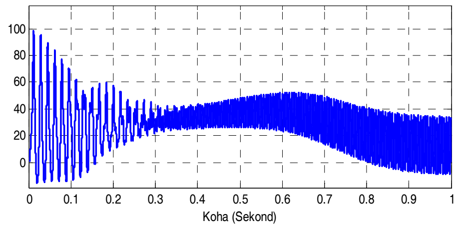
a) 0utput of pulse width modulator



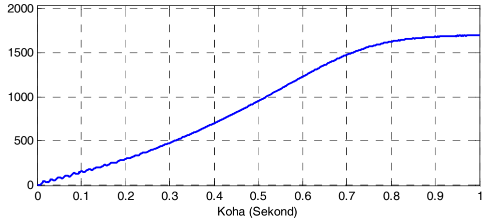
b) *waveform of time vs rotor current Ir(A)*



c) waveform of time vs stator current Is(A)



d) Waveform of time vs torque



e) Waveform of time vs Speed

Figure 4. Waveforms with frequency 5 kHz

4. CONCLUSION

PWM inverters are the most preferred for these applications since control of voltage, frequency, and harmonics are all achieved within the inverter itself. In this paper a voltage PWM inverter was realized. The increasing number of applications with induction motors fed by PWM inverters operating in variable speed duty thus requires a good understanding of the whole power system as well as the interactions among its parts one another. The inverter uses sinusoidal pulse-width modulation. The base frequency of the sinusoidal reference wave is set at 50 Hz and the triangular carrier wave's frequency is set at 2 kHz and 5 kHz. On the basis of waveforms presented, easily note the advantages of inverter with harmonic control PWM signal at the load (especially if we refer to the current waveform) with different frequencies.

5. REFERENCES

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