

Speed Control of Induction Motor Using Lab View Simulation

Y.Rama Mohan, V. Ananthalakshmi, G.Sateesh, Abid Nayeemuddin

ABSTRACT: VSI fed asynchronous machines are extensively used in adjustable speed control applications. The effective wave of controlling of the speed of the asynchronous machines is Pulse width modulation (PWM) technique. In this paper, design and implementation of scalar control of IM is done using Lab VIEW. The scalar control of the induction motor means that to maintain the ratio of voltage at stator terminal to frequency should be constant, which is also called as v/f control of IM drive. Lab VIEW is the practical software that can be used for enaming and managing the systems in present day industries. It is a HMI design software which is user friendly and can easily interface hardware components linked to the industrial controller system. In this project Simulation is done using Lab VIEW software.

Key words: SVPWM, V/f control, Lab VIEW, DAQ card.

I. INTRODUCTION

IM drives are extensively used for commercial purposes. Compare to dc machines, AC machines have been comprehensively used in variety of applications because of its lucidity and low cost [1]. VFD techniques of Induction Motor can be divided into two major types: v/f control and vector control methods. v/f control can also be called as Scalar control[2]. In this particular scalar control method to maintain a constant magnetizing flux the ratio of v/f is kept constant. All the industrial drive applications are now using the PWM methods for variable speed drive uses demands better achievement.

II. LAB VIEW

In the present days coding become easy because of the graphical user interface. One such a coding environment is Lab VIEW. This is a graphical programming code for acquisition of required data, analysis of the acquainted data and presentation of the processed data. The components of Lab VIEW are first one is front panel, is used to build controls and indicators and second one is block diagram contains pictorial representation of code. Dynamic characteristics of electrical machines are learnt using simulation tools available in Lab VIEW. The LabVIEW can

be effectively employ the engineers, with the extensive control of the induction motor using the virtual instrumentation (VI) [3]. The major part of the virtual instrumentation involves gathering signals, store the signal, analyze the signal and present them on the PC. This is also called as data acquisition. This data acquisition offers much flexibility in the VI.

III. MODELING OF INDUCTION MOTOR

The mathematical model of a three-phase, squirrel-cage induction motor is given in [4]. The electromagnetic torque of an induction motor in stator reference frame is given by

$$T_e = \frac{3}{2} * \frac{p}{2} (\varphi_{ds}i_{qs} - \varphi_{qs}i_{ds})$$

IV. SPACE VECTOR PULSE WIDTH MODULATION

Space vector modulation (SVM) technique was initially developed as a vector approach to PWM technology for three-phase inverter. SVPWM has better-quality performance due to less voltage and current THDs, considerable PF and reduced switching losses compared to sine PWM because of SVPWM utilize advance computational switching technique to lessen the THD. The SVPWM gives superior results in comparison to SPWM at the higher switching frequencies. Therefore SVPWM technique is the preferred PWM technique for various three-phase converter applications [5]. A 3-phase VSI produces eight switching states as shown in Fig 1.

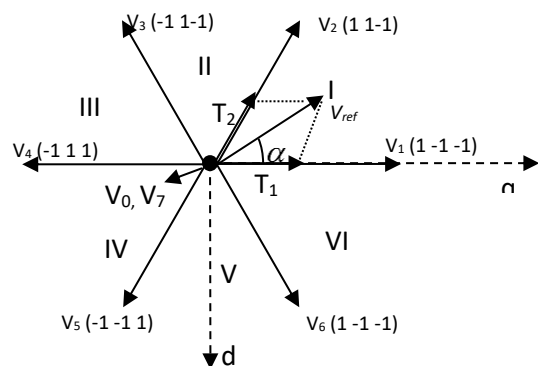


Fig 1: Six- Sector and basic switching vectors (6 –Active and 2 Zero vectors)

Time duration for active vectors in each sector can be calculated as follows

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$$T_1 = \frac{V_{ref} T_z}{V_{dc}} \left[\frac{\sin(60 - \alpha)}{\sin 60} \right]$$

$$T_2 = \frac{T_z \sin \alpha V_{ref}}{V_{dc} \sin 60}$$

$$T_0 = T_z - (T_1 - T_2)$$

V. BLOCK DIAGRAM:

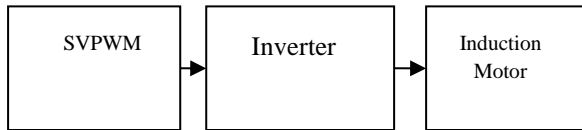


Fig 2: Block Diagram

PWM techniques are used to control the output voltage. In this paper SVPWM technique is used. SVPWM algorithm is used to generate the pulses and these are given to the 2-level inverter. A constant DC source is used for as input voltage source for the inverter and by turning on and off of the switches of the inverter a controlled ac output voltage is obtained. The speed and torque output of the induction motor are used for the analysis of the performance of the both PWM technique and induction motor. The block diagram of simulation study is shown in Fig 2.

VI. SIMULATION AND RESULTS

The reason for this using Lab VIEW environment is of its strong and good user interface, effective and ease of its graphical programming user interface code combined with built in application tools designed especially for testing the data, measuring the data and controlling the industrial equipment. With PWM techniques it is component of supplying high frequency to run the induction motor at accurate speed. The SVPWM algorithm pulses are given to the input of inverter. The output of the inverter is fed to the induction motor. Speed can be controlled by using scalar method. PWM was programmed using Lab VIEW to control the motor speed. With PWM through DAQ signals is acquired and system is controlled.

The results for Lab VIEW Simulation is shown in Fig. 3 to Fig.12 and the experimental results are shown in Fig.14. The simulink model of IM is shown in Fig.3. Fig. 5 shows the output of IM without PWM. The outputs of inverter and PWM pulses are shown in Fig.4, Fig.7 and Fig.8. Fig.6 shows the simulink model of SVPWM fed Induction motor. Fig 10 - Fig.12 shows the torque and speed characteristics of IM at different frequencies. Experimental results including setup are shown in Fig.13 and Fig.14.

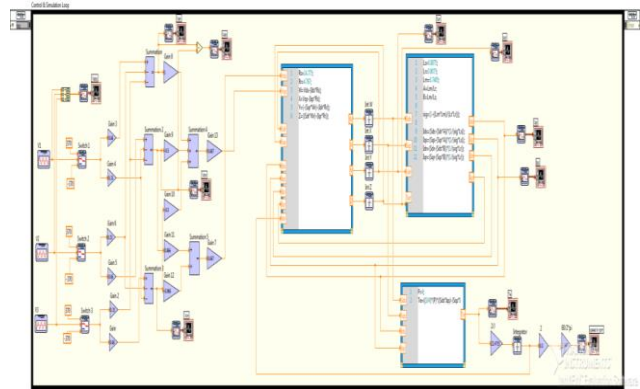


Fig 3: Simulink model of Induction motor

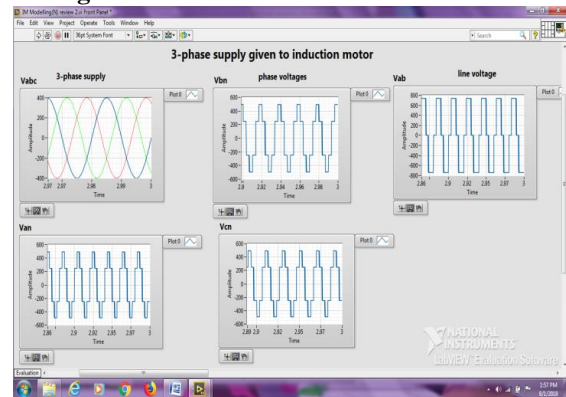


Fig 4: Supply voltage, phase voltages and line voltages waveforms.

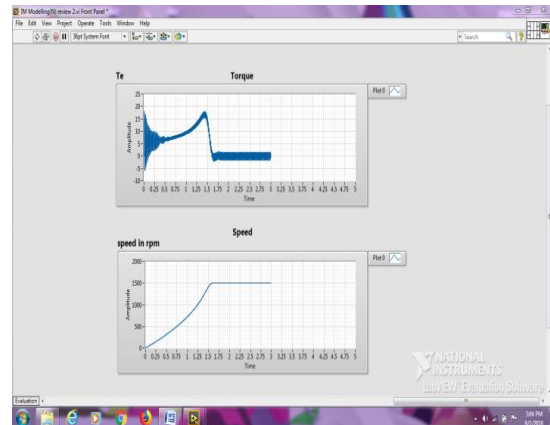


Fig 5: Torque and speed characteristics of Induction motor

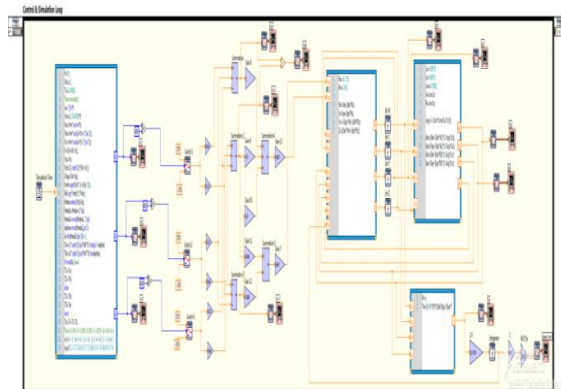


Fig 6: Simulink model of SVPWM fed Induction motor



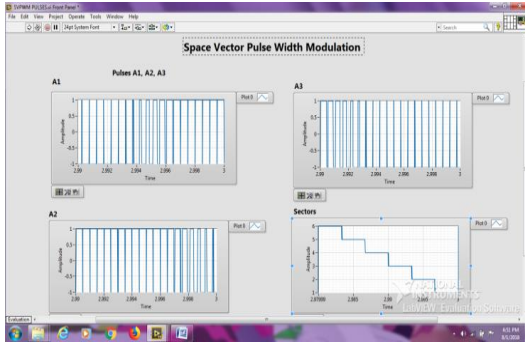


Fig 7: SVPWM pulses and sectors

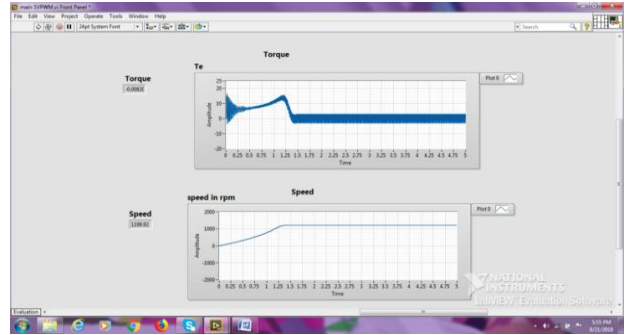


Fig 11: Torque and speed characteristics of Induction motor at $f=40\text{Hz}$

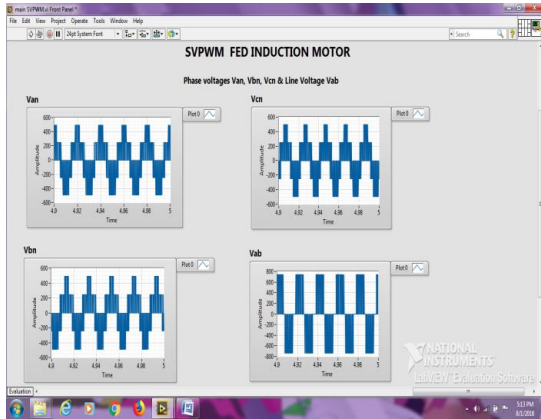


Fig 8: Phase voltages and line voltage of SVPWM fed Induction motor

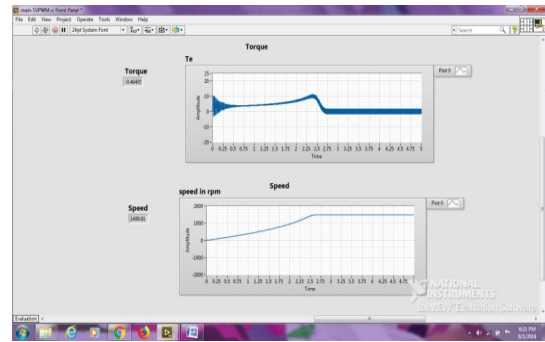


Fig 12: Torque and speed characteristics of Induction motor at $f=50\text{Hz}$

Hardware implementation:

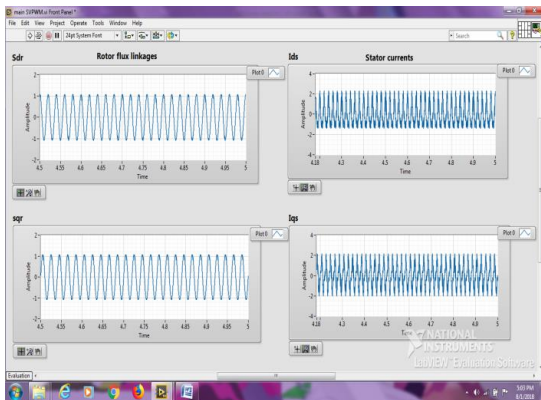


Fig 9: Rotor flux linkages and stator current wave forms

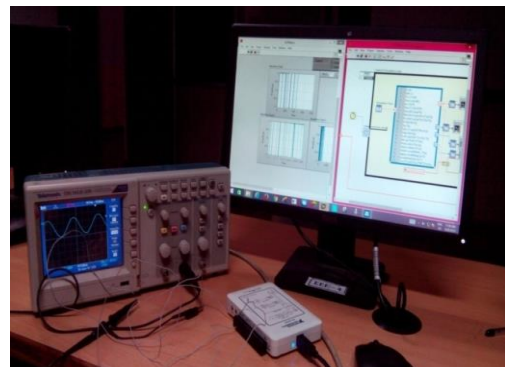


Fig 13: PC, DAQ and CRO connection

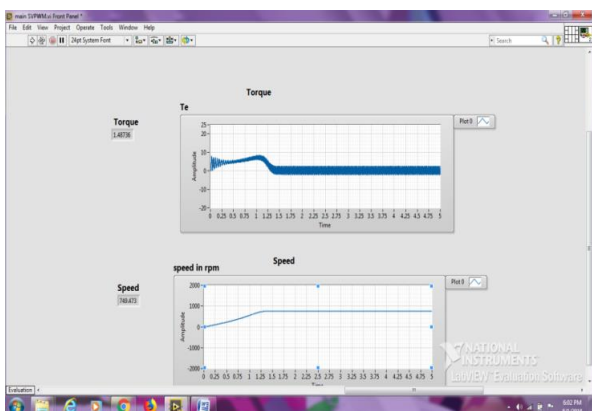
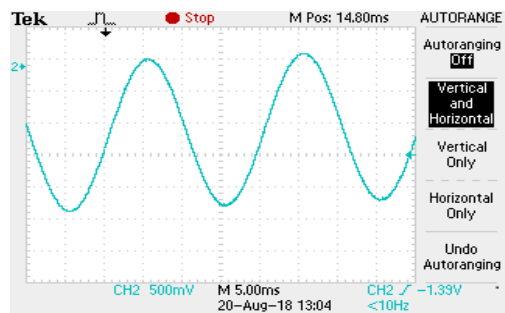


Fig 10: Torque and speed characteristics of Induction motor at $f=25\text{Hz}$

DAQ card, programmed as a digital output device by using Lab VIEW software, was operated to control the system. Fig 13 indicates the front panel and block diagram of Lab VIEW in running condition of the induction motor. It gives DAQ digital output. Variation of speed with respect to frequency is controlled by PWM techniques.



Sinusoidal signal



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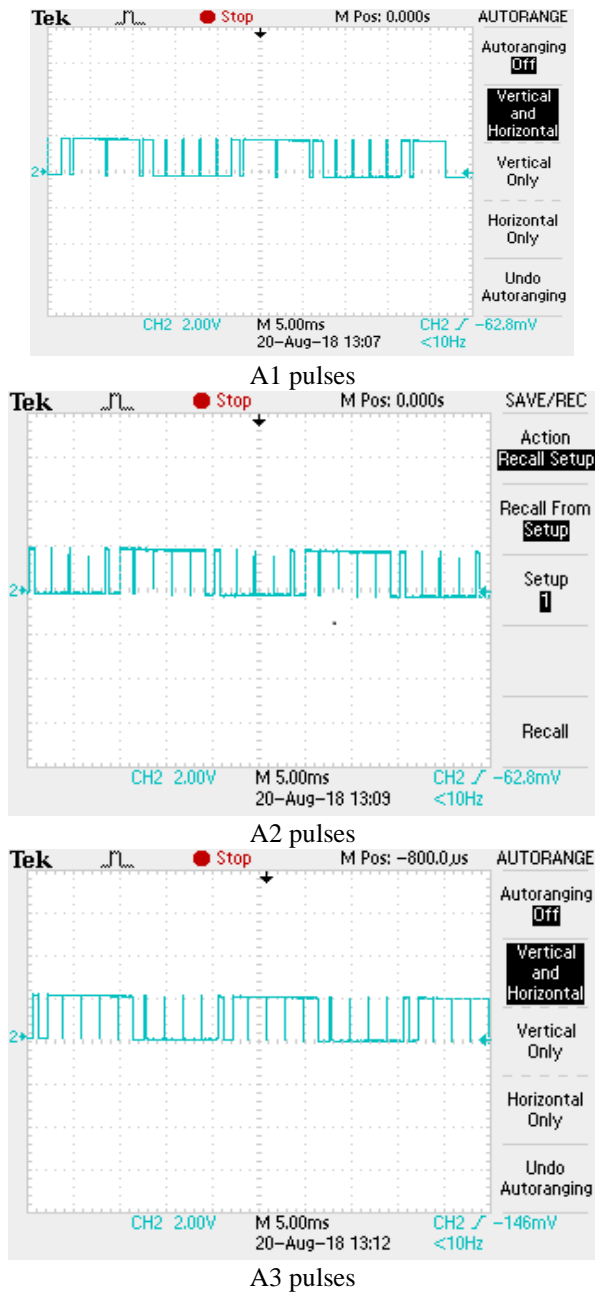


Fig 14: Results obtained from CRO

VII. CONCLUSION

In this work, by using Lab VIEW software both the inverter and induction motor are modeled and simulated. Lab VIEW based three-phase induction motor speed control is done by using scalar method at different frequencies. These models were with the use of simple VIs and math script node. SVPWM algorithm is used to generate the pulses and these are given to the 2-level inverter. A constant DC source is used for as input voltage source for the inverter and by turning on and off of the switches of the inverter a controlled ac output voltage is obtained. The speed and torque output of the induction motor are used for the analysis of the performance of the both PWM technique and induction motor

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