SPACE VECTOR MODULATION BASED FEED CONTROL USING THREE PHASE INDUCTION MOTOR

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Abstract—This paper proposes the advanced feed control technique using three phase induction motor. An SVM-based technique is suggested and a controller design using this strategy is presented. A system representing the controller is developed and verified victimisation MikroPro PIC. VF management victimisation the trigonometric function PWM algorithmic program could be a fashionable algorithmic program for AC induction motor control; but this algorithmic program has bound drawbacks that have an effect on the general system efficiency. An advanced switching algorithm, like space Vector Modulation (SVM), over-come the drawbacks of the sine PWM algorithm and increases the overall system efficiency.

Index Terms — Direct Torque Control; Space Vector Modulation; Induction Motor Control

I. INTRODUCTION

In process industry controlling the material flow, fall rate is one of the prime important task. Too many techniques are used for controlling the industrial feed control like Dozing belt system, Belt drive and Table feeders. Basically most of the times DC motor drives are used for these control techniques. But now a days DC motors are replaced by induction motors due to advanced speed control techniques and low cost solutions. An induction motor can run only at its rated speed when it is connected directly to the However several applications want variable speed operations. Driving and controlling the induction motor efficiently square measure prime considerations in todays energy aware world. With the advancement in the semiconductor fabrication technology, every the size and the value of semiconductors have gone down drastically, this implies that that the motor user can replace associate degree energy inefficient mechanical motor drive and management system with a Variable Frequency Drive (VFD). The VFD not solely exclusively controls the motor speed, however additionally improves the motors dynamic and steady state characteristics as well. VF management the PWM rule is a typical formula for AC induction motor rule ; however this formula has certain drawbacks that have a bearing on the system potency. This paper given extra advanced amendment rule, like house Vector Modulation (SVM) over - comes the drawbacks of the PWM rule and can increase the overall system potency.

II. SPACE VECTOR MODULATION (SVM)

The SVM is a sophisticated averaging algorithmic program that offers 15% additional voltage output compared to the PWM formula, thereby increasing the VDC utilization. It additionally minimizes the THD as well as switching loss. Like PWM, the SVM is also a scalar control. The direct controlled variables are the motor voltage and the motor frequency. There are various variations of SVM that result in several quality and computational needs. One active area of development is the reduction of total harmonic distortion (THD) created by the rapid switching inherent to these algorithm

III. WHY WE USE SVM WITH EMBEDDED CONTROL

Because input VDC utilization is more than PWM technique, also it gives at least 15% more output than conventional technique. This algorithm provides more advanced facilitates like vector control implementation. It also minimizes the THD as well as switching loss. The direct controlled variables are the motor voltage and the motor frequency.

The 3 - phase line to neutral sine waves required for driving the 3 -phase inverter can be represented as 120° phase shifted vectors (VRn, VYn, and VBn) in space, as shown in Figure 1. For a balanced 3-phase system these vectors sum to zero.

![Figure 1: Space Vector Modulation Based Feed Control Using Three Phase Induction Motor](Image)
requirements or the need for high accuracy of speed control. Examples of these applications embrace heating, air-con, fans and blowers. V/f control can be implemented by using low cost PIC microcontrollers, rather than using costly digital signal processors (DSPs). Many PIC microcontrollers have two hardware PWMs, one less than the three required to control a 3-phase induction motor. In this application note, we tend to can generate a third PWM in software system, exploitation a general purpose timer associate degree an I/O pin resource that are readily offered on the PIC microcontroller.

**PIC18 PWM Module**

The system contains the PIC18 microcontroller as main controlling device. PIC18 microcontroller is suitable for proposed system because of following reasons.

The controller Power Control PWM (PCPWM) module may be a serial interface, helpful for human action with different peripherals or microcontroller devices. This module contains up to 8 output channels also having complimentary PWM outputs. It’s PWM resolution is up to 14 bits. Similarly this module update has duty cycle period.

**IV. OVERVIEW OF THE SYSTEM**

The system consists of PIC18 microcontroller from PIC 8-bit family is used. PIC18 is having up to 32 Kbytes program flash memory, 10 bit ADC with up to 8 channels and Enhanced PWM module with more channels. Hardware implementation of system is as below.

![Architecture of proposed system](image)

The above system consists of various blocks i.e PIC, Driver Circuit, Inverter, Bridge rectifier and 3-ph. Induction motor. PIC will generate pwm output, as per SVM algorithm. Controller sends these outputs to driver circuit. Driver circuit will drive the inverter bridge circuit, then finally output is fed to motor. PIC Microcontroller reads the input periodically to get the new speed or frequency reference based on this result, it determines the scaling factor for PWM duty cycle. The output of this PWM are given to the higher and lower input pins of driver circuits. The driver circuit is used to drive/control switching of inverter circuits. Generally IGBTs or MOSFET are used as driver circuit. Three phase bridge rectifier circuit used to convert AC to DC & DC ripple is filtered by using capacitor, this dc bus is connected to inverter for inverting it to a V/F supply. We can use the induction motor for controlling the speed of Feeder.

**V. RESULT AND DISCUSSIONS**

The SVM algorithm designed for controlling the higher speed and voltage of three phase induction motor, which is a real time application. Various ways to control the speed of induction motor but SVM is significantly improves the efficiency and having lower THD (Total harmonic distortion) SVM is compared to Sine PWM in the linear operating region. The reason for the higher line-to-line voltage in SVM can be explained with the help of Figure 3. It shows the phase voltage (line-to-virtual neutral point) generated by Sine PWM and SVM. For clarity, only two phase voltages (RO and YO) and their resultant line-to-line voltage (RY) are shown in each figure.

The Sine PWM generated phase voltages are sine waves. With 120° phase shift between them, the resultant line-to-line voltage is approximately 86.6% of VDC. But, the SVM generated phase voltages have a third harmonic component superimposed on the fundamental component. The addition of this harmonic element is due to the effective usage of inactive states that isn’t attainable within the circular function PWM. With 120° part shift between them, the third harmonic component is cancelled out in the resultant line-to-line voltage in such a way that the resultant line-to-line voltage is boosted to VDC (100%). Thus, SVM generates line-to-line voltage with higher amplitude (about 15% more) compared to Sine PWM.
A) Sine PWM Generated Waveforms

B) SVM Generated Waveforms

VI. ADVANTAGES OF SVM

The advantages of SVM vis-à-vis Sine PWM are as follows:

1. Line-to-line voltage amplitude can be as high as VDC. Thus, 100% VDC utilization is possible in the linear operating region.

2. In the linear operating range, modulation index range is 0.0 to 1.0 in the Sine PWM; whereas in the SVM, it is 0 to 0.866. Line-to-line voltage amplitude is 15% more in the SVM with the modulation index = 0.866, compared to the Sine PWM with the modulation index = 1. Hence, it has the better usage of the modulation index depth.

3. With the increased output voltage, the user can design the motor control system with reduced current rating, keeping the horsepower rating the same. The reduced current helps to reduce inherent conduction loss of the VSI.

CONCLUSION

The proposed SPACE VECTOR MODULATION technique provides efficient Speed control of motor. It gives adjacent voltage vector switching and fast dynamic response. In addition, it eliminates switching frequency variations, on-chip resources, such as the ADC and the multiple timers and allow users to implement other con-trol (acceleration and deceleration) and protection (over current, overvoltage, over temperature) features. Finally, we can easily control the speed of table feeder.

Future Scope

The future work includes experiments with more complex embedded systems. So in future, increase the numbers of applications using dsPIC controller.

REFERENCES


