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## ANALYSIS AND CONTROL OF HARMONICS OF THREE PHASE INDUCTION MACHINE BY SPACE VECTOR DECOMPOSITION USING MATLAB SIMULATION

SHARDA PATWA

*Electrical Engineering Department, Jabalpur Engineering College, shardapatwa@gmail.com*

HEMANT AMHIA

*Electrical Engineering Department, Jabalpur Engineering College, hemant.amiha@gmail.com*

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# ANALYSIS AND CONTROL OF HARMONICS OF THREE PHASE INDUCTION MACHINE BY SPACE VECTOR DECOMPOSITION USING MATLAB SIMULATION

SHARDA PATWA<sup>1</sup> & HEMANT AMHIA<sup>2</sup>

<sup>1,2</sup>Jabalpur Engineering College, Electrical Engineering Department  
Email:- shardapatwa@gmail.com

**Abstract** - The technique of vector space decomposition control of three phase induction machine is presented in this paper. By vector space decomposition the analytical modeling and control of machine are accomplished. The space vector decomposition technique limits the 5<sup>th</sup>, 7<sup>th</sup>, 17<sup>th</sup>, 19<sup>th</sup>...harmonic currents, which in such a system is otherwise difficult to control. This synopsis present harmonic analysis of motor current of medium and high power Variable Frequency Drive (VFD) Systems. Computer simulation of an IGBT fed induction motor based on constant voltage/frequency (V/f) operation is implemented using simulation software.

**Keywords**- Induction Motor, Space vector decomposition, Harmonic Analysis, PWM Inverter, Frequency Response, IGBT inverter.

## I. INTRODUCTION

The induction motor, which is the most widely used motor type in the industry, has been used because of its good self-starting capability, simple and rugged structure, low cost and reliability etc. Along with variable frequency AC inverters, induction motors are used in many adjustable speed applications which do not require fast dynamic response. The concept of vector control has opened up a new possibility that induction motors can be controlled to achieve dynamic performance good.

Induction motor for many years has been regarded as the workhorse in industrial applications. In the last few decades, the induction motor has evolved from being a constant speed motor to a variable speed, variable torque machine. When applications required large amounts of power and torque, the induction motor became more efficient to use. With the invention of variable voltage, variable frequency drives (VVVF), the use of an induction motor has increased. Variable frequency IGBT Inverters fed space vector control method is widely used to control the harmonics of 3-phase squirrel cage induction Motors (IM) over a wide range by varying the stator frequency. In particular the IGBT fed space vector control are widely preferred in industries for individual medium to high power variable speed drive systems, driving a group of motors connected in parallel at economic costs. The “Insulated Gate Bipolar Transistor” (IGBT) is a common choice in modern VFDs. The IGBT can switch on and off several thousand times per second and precisely control the power delivered to the motor. The IGBT uses “pulse width modulation” (PWM) technique to simulate a sine wave current at the desired frequency to the motor.

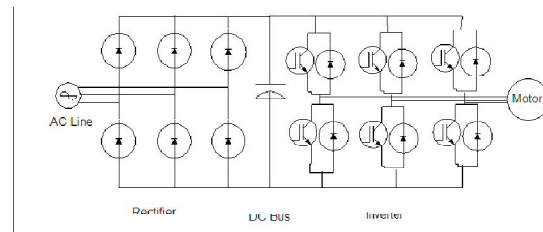


FIG 1- IGBT fed Three Phase Induction Machine.

## II. METHODOLOGY OF WORK

A simulation model of such induction motor drive system is developed and its dynamic response is verified by observing harmonic analysis and control to establish acceptability of the model. Then a series of simulations are carried out for three different post fault conditions which are:

1. Open circuiting of one of the six IGBTs gate signal,
2. Blowing off one IGBT in the inverter module.
3. Space vector control method.

Computer simulation is the discipline of designing a model of an actual or theoretical physical system, executing the model on a digital computer, and analyzing the execution output. Simulation model of the motor drive system developed in Power SIM (PSIM) has been used for this study.

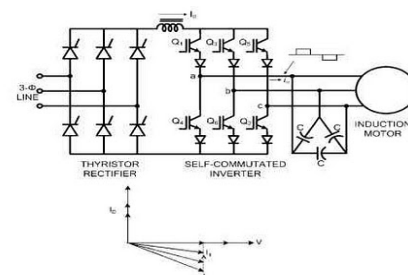
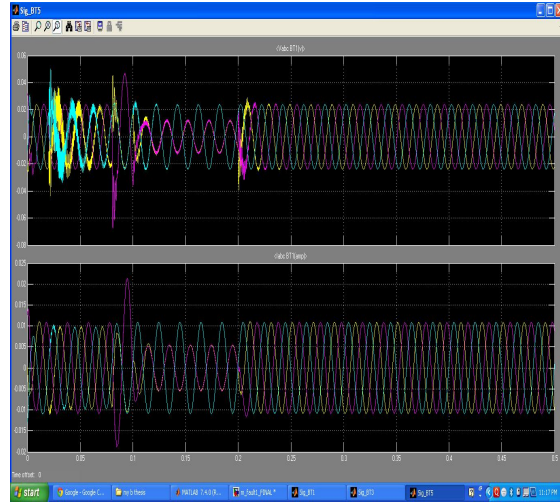


FIG 2- IGBT fed Three Phase Induction Machine.

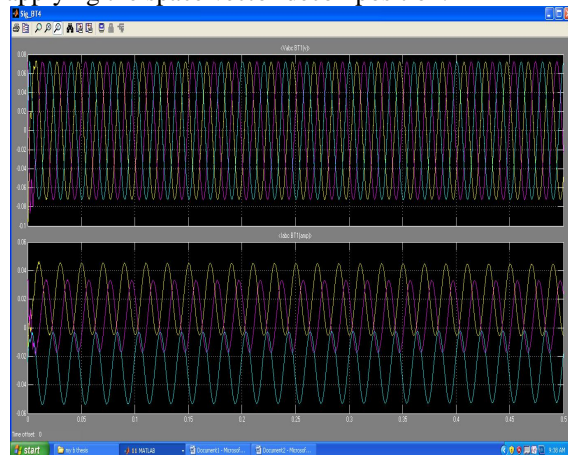
### III. RESULT AND DISCUSSION

In Figure 3, the results about harmonics present in voltage and current has been given. By this we can see the waveform of voltage and current in induction machine.



**Fig.3- voltage and current waveform in induction machine with harmonics.**

In Figure 4, the results of voltage and current has been given. By this we can see the waveform of voltage and current in induction machine after applying the space vector decomposition.



**fig. 4- voltage and current waveform in induction machine without harmonics and application of space vector decomposition.**

In future this controlling method can be used as-

1. The extension of work can be done on a high level for industrial purpose.
2. This process can analyses and control the harmonics of 3 phase induction motor.
3. Simulation method of harmonic analysis and control can be done on a big scale.

### IV. CONCLUSION

The presented paper introduced scheme for induction motor drive harmonic control based on space vector modulation. The induction motor drive controlled by the proposed harmonic control techniques was simulated using MATLAB SIMULINK package programs. Moreover, its experimental setup was build.

To validate the effectiveness of the proposed harmonic control methods, the induction motor drive was subjected to starting and reference motor speed disturbances. Simulation in terms of motor stator current, speed, and torque responses will be plotted and obtained. The results prove the powerfulness and effectiveness of the proposed control approach in sense of fast response with less settling time and less over-shoot/undershoot.

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