

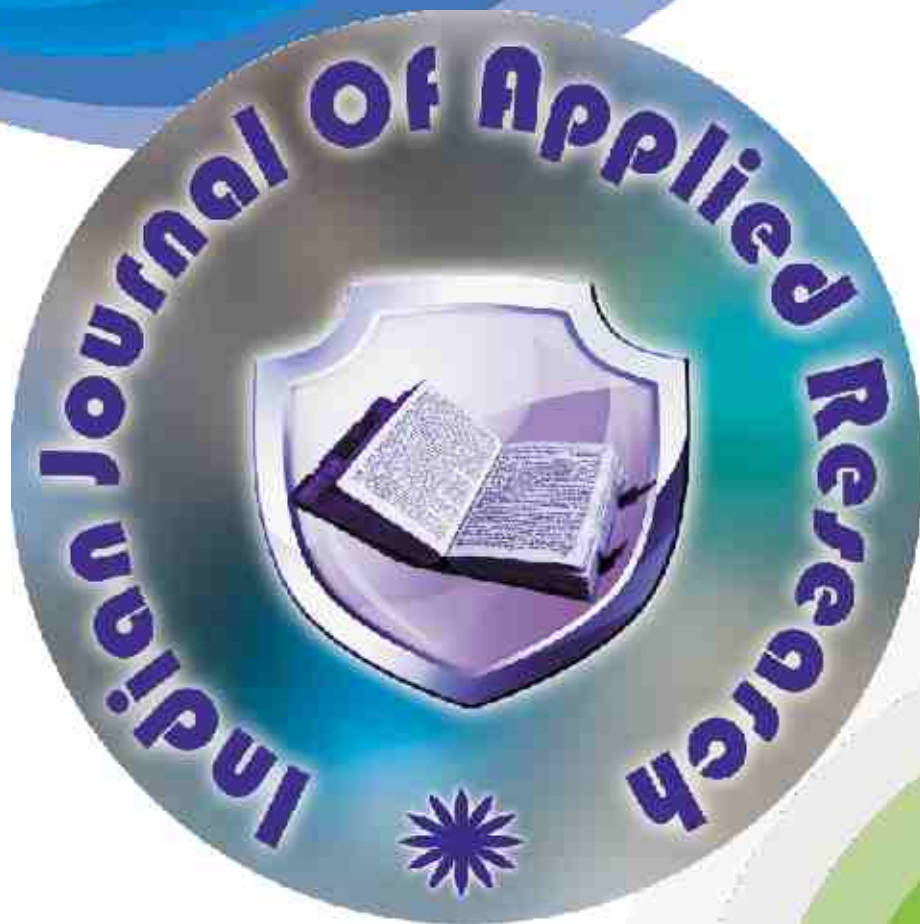
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# VECTOR CONTROL SIMULATION OF INDUCTION MOTOR USING PI CONTROLLER

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## ABSTRACT

This Paper is considered with the Vector control based speed control of an induction motor drive using P.I. controller. The vector control method has been optimized by using PI controller. The orientation control of an induction motor has permitted fast transient response by decoupled torque and flux. The conventional PI controller has been widely used in industrial due to the simple control algorithm and easy implementation. The present controller combines the benefits of P.I. controller and vector-control in a single system controller. High quality of the regulation process is achieved through utilization of P.I controller along with vector control method., while stability of the system during transient processes and a wide range of operation are assured through application of the vector-control. A PI controller of the motor speed is designed. With the help of Matlab/Simulink, block model of an induction motor drive is constructed and simulated. A superiority PI controller in handling nonlinearity such as an induction motor has been effectively demonstrated by comparing speed controller with conventional PI controller under varying operating conditions like step change in speed reference and torque reference. The result validates the robustness and effectiveness of the vector control based speed control of 3-phase induction motor using P.I. controller.

**Keywords :** Vector control, PI controller, Matlab/Simulink software , speed control.

## INTRODUCTION

AC Induction motors are being applied today to a wider range of applications requiring variable speed. Generally, variable speed drives for Induction Motor (IM) require both wide operating range of speed and fast torque response, regardless of load variations. This leads to more advanced Control methods to meet the real demand.

### 1 VETOR OR FIELD-ORIENTED CONTROL

#### 1.1 Introduction

Scalar control is somewhat simple to implement, but the inherent coupling effect (i.e., both torque and flux are function of voltage or current and frequency) gives sluggish response and the system is easily prone to instability. The foregoing problem can be solved by vector or field-oriented control. Vector control of an induction motor can be controlled like a separately excited dc motor. Because of dc machine-like performance, vector control is also known as decoupling, orthogonal, or transvector control. Vector control is applicable to both induction and synchronous motor drives.

#### 1.2 DC Drive Analogy

Ideally, a vector-controlled induction motor drive operates like a separately excited dc motor drive. Explain this analogy. In a dc machine, neglecting the armature reaction effect and field saturation, the developed torque is given by

$$T_e = K_t \cdot I_a I_f$$

The construction of a dc machine is such that the field flux  $\psi_f$  produced by the current  $I_f$  perpendicular to the armature flux  $\psi_a$ , which is produced by the armature current  $I_a$ . These space vectors, which are stationary in space, are orthogonal or decoupled in nature. This means that when torque is controlled by controlling the current  $I_a$ , the flux  $\psi_f$  is not affected and we get the fast transient response and high torque/ampere ratio with the rated  $\psi_f$ . Because of decoupling, when the field current  $I_f$  is controlled, it affects the field flux  $\psi_f$  only, but not the  $\psi_a$  flux. Because of the inherent coupling problem, an induction motor cannot generally give such fast response.

### 2. MATLAB Implementation of Vector Control Principle.

#### 2.1 Vector control principal

The construction of a DC machine is such that the field flux is perpendicular to the armature flux. Being orthogonal, these two fluxes produce no net interaction on one another. Adjusting the field current can therefore control the DC machine flux, and the torque can be controlled independently of flux by adjusting the armature current. An AC machine is not so simple because of the interactions between the stator and the rotor fields, whose orientations are not held at 90 degrees but vary with the operating conditions. You can obtain DC machine-like performance in holding a fixed and orthogonal orientation between the field and armature field and armature fields in an AC machine by orienting the stator current with respect to the rotor flux so as to attain independently controlled flux and torque. Such a control scheme is called flux-oriented control or vector control. Vector control is applicable to both induction and synchronous motors. We will see now how it applies to induction motors. Considering the d-q model of the induction machine in the reference frame rotating at synchronous speed  $\omega_s$ .

$$V_{qs} = R_s i_{qs} + \frac{d}{dt} \psi_{qs} + \omega_e \psi_{qs}$$

$$V_{ds} = R_s i_{ds} + \frac{d}{dt} \psi_{ds} - \omega_e \psi_{ds}$$

Where assume that  $v_{qr} = v_{dr} = 0$

$$0 = R_r i_{qr} + \frac{d}{dt} \psi_{qr} + (\omega_e - \omega_r) \psi_{dr}$$

$$0 = R_r i_{dr} + \frac{d}{dt} \psi_{dr} + (\omega_e - \omega_r) \psi_{qr}$$

$$T_e = 1.5 P \frac{L_m}{L_r} (\psi_{dr} i_{qs} - \psi_{qs} i_{dr})$$

From Equation

$$\psi_{qs} = L_s i_{qs} + L_m (i_{qs} + i_{qr})$$

$$\psi_{ds} = L_s i_{ds} + L_m (i_{ds} + i_{dr})$$

$$\psi_{qr} = L_l i_{qr} + L_m (i_{qs} + i_{qr})$$

$$\psi_{dr} = L_l i_{dr} + L_m (i_{ds} + i_{dr})$$

Now  $L_s = L_l + L_m$  and  $L_r = L_l + L_m$

$$\psi_{qs} = L_s i_{qs} + L_m i_{qr}$$

$$\psi_{qr} = L_s i_{qr} + L_m i_{qs}$$

$$\psi_{ds} = L_s i_{ds} + L_m i_{dr}$$

$$\psi_{dr} = L_s i_{dr} + L_m i_{ds}$$

The field-oriented control implies that the ids component of the stator current would be aligned with the rotor field and the iqS component would be perpendicular to ids. This can be accomplished by choosing we to be the speed of the rotor flux and locking the phase of the reference frame system such that the rotor flux is aligned precisely with the d axis, resulting in

$$\psi_{dr} = 0 \Rightarrow \frac{d}{dt} \psi_{dr} = 0$$

And  $\psi_{dr} = \psi_r$  which implies that

$$\omega_{sl} = (\omega_e - \omega_r) = \left( \frac{L_m R_r}{\psi_r L_r} \right) i_{qs}^*$$

$$T_e = 1.5 P \frac{L_m}{L_r} (\psi_r i_{qs}^*)$$

It also follows that

$$\frac{d}{dt} \psi_r = - \left( \frac{R_r}{L_r} \right) \psi_r + \left( \frac{L_m R_r}{L_r} \right) i_{ds}^*$$

The analogy with DC machine performance is now clear. The electric torque proportional to the  $i_{qs}$  component, whereas the relation between the flux  $\phi$  and  $i_{ds}$  component is given by a first-order linear transfer function with a time constant  $L_r/R_r$ .

You cannot directly measure the rotor flux orientation in a squirrel-cage rotor induction machine. It can only be estimated from terminal measurements. An alternative way is to use the slip relation derived above to estimate the flux position relative to the rotor, as shown. The latter control scheme is called indirect field-oriented control.

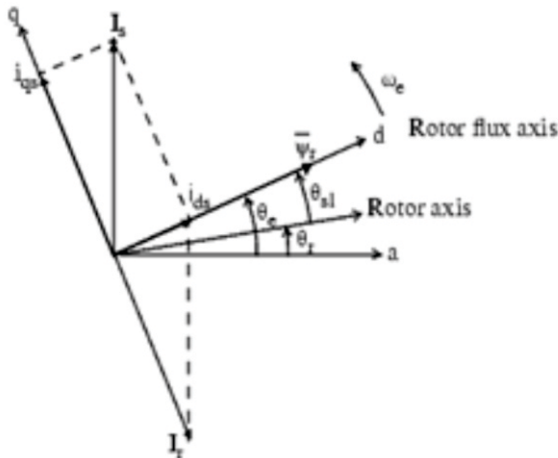


Figure.1. Indirect Flux- Oriented Control.

Here, we will only rewrite the basic equations. The stator quadrature-axis current reference  $i_{qs}^*$  is calculated from torque reference  $T_e^*$  as

$$i_{qs}^* = \frac{2 - 2}{3 P} \frac{L_r}{L_m} \frac{T_e^*}{|\psi_r|_{est}}$$

where  $L_r$  is the rotor inductance,  $L_m$  is the mutual inductance, and  $|\psi_r|_{est}$  is the estimated rotor flux linkage given by

$$|\psi_r|_{est} = \frac{L_m i_{ds}^*}{1 + \tau_r s}$$

where  $\tau_r = L_r/R_r$  is the rotor time constant. The stator direct-axis current reference  $i_{ds}^*$  is obtained from rotor flux reference input  $|\psi_r|_{est}$

$$i_{ds}^* = \frac{|\psi_r|_{est}}{L_m}$$

The rotor flux position  $\theta_e$  required for coordinates transformation is generated from the rotor speed  $\omega_m$  and slip frequency  $\omega_{sl}$ .

$$\theta_e = \int (\omega_m + \omega_{sl}) dt$$

The slip frequency is calculated from the stator reference current  $i_{qs}^*$  and the motor parameters.

$$\omega_{sl} = \frac{L_m}{|\psi_r|_{est}} \frac{R_r}{L_r} i_{qs}^*$$

The  $i_{qs}^*$  and  $i_{ds}^*$  current references are converted into phase references  $i_a^*, i_b^*, i_c^*$  for the current regulators. The regulators process the measured and reference currents to produce the inverter gating signals. From above equation vector control principle is implemented in MATLAB as follows:

**2.2 MATLAB Implementation Vector Control Principle Block**  
**2.2.1 MATLAB / SIMULINK Vector Control Block Sub-system**

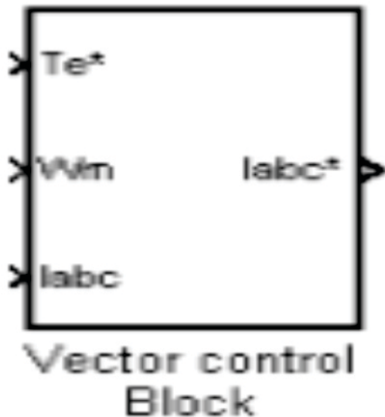


Figure 2: Vector control block sub-system.

**2.2.2 MATLAB / SIMULINK Vector Control Block**

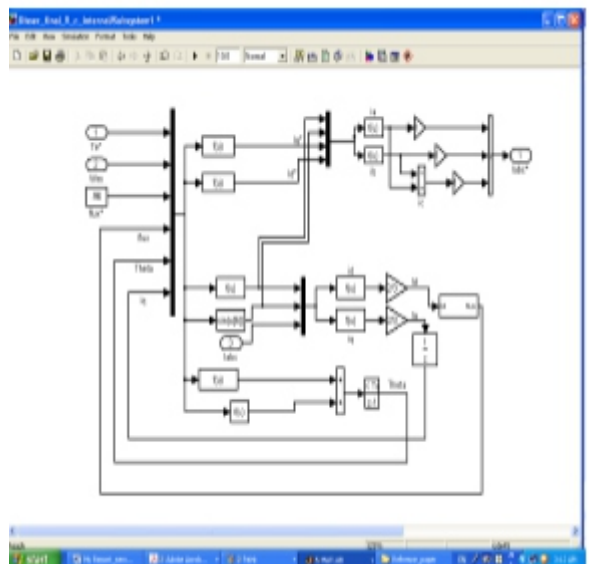


Figure 3: Matlab Simulink Vector Control Block.



**2.2.3 Induction Machine Parameters values corresponding to 50 HP motor**

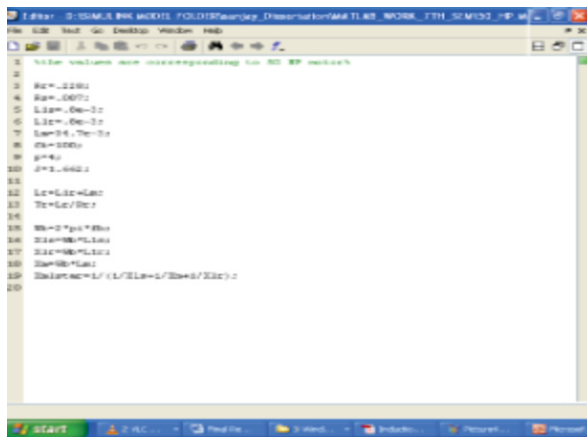


Figure 4: Parameters of Induction Machine.

**3. SIMULATION**

The vector control induction motor has been simulated using PI and Fuzzy controller in SIMULINK/MATLAB as shown below. Vector control based speed control of induction motor using PI controller.

**3.1 Vector control based speed control of induction motor using PI controller**

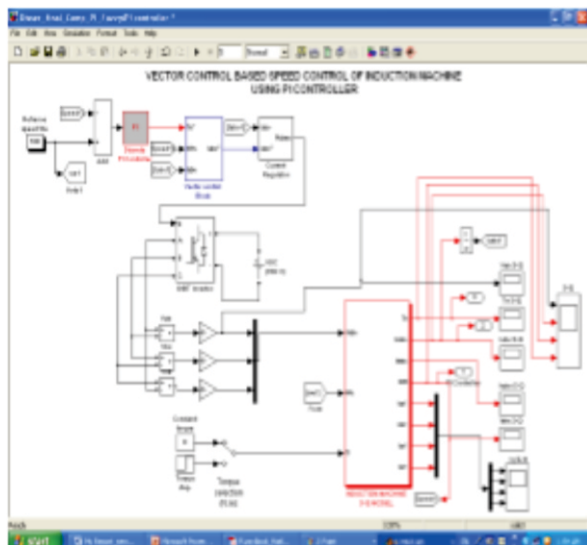


Figure 5: MATLAB/SIMULINK Diagram of Vector Control Induction Motor Drive Using PI Controller.

**4. SIMULATION RESULT AND DISCUSSION**

Several tests were performed to evaluate the performance of the PI controller based vector control of the IM drive system in MATLAB / SIMULINK. The speed responses are observed under different operating conditions such as a sudden change command speed etc. some sample results are presented in following sections.

**4.1 Simulation results of Vector control based speed control of induction motor using PI controller**

Function Block Parameter of PI Controller is shown below

- Proportional gain (Kp) : 7
- Integral gain (Ki) : 14
- Sample time : 2 micro SEC.

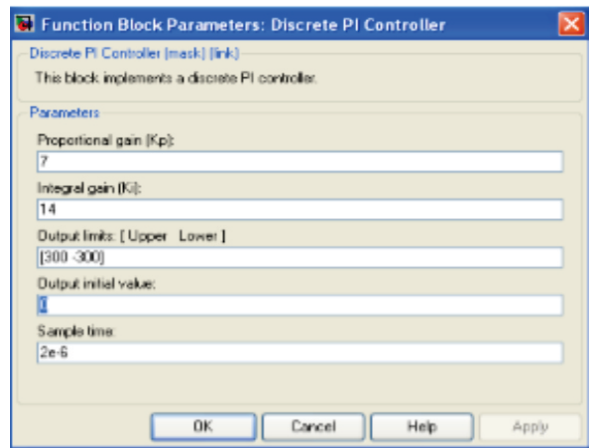


Figure 6: PI Controller Function Block Parameters.

**4.2 Speed Response using PI Controller.**

Figure 7 shows simulation result of speed of Induction Machine using PI controller.

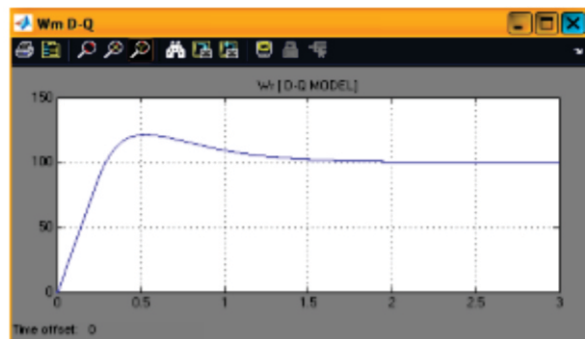
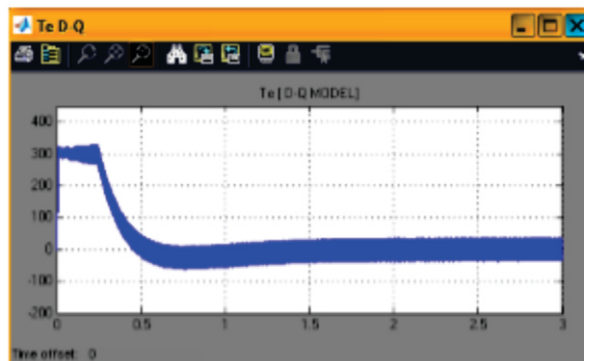


Figure 7: Simulation Result of speed response using PI controller.

**4.3 Torque Response using PI Controller**

Figure 8 shows simulation result of Torque of Induction Machine using PI controller.



**CONCLUSIONS:**

In this paper, implementation of a modular Simulink model for induction machine simulation for speed control of induction motor using PI controller has been introduced. Unlike most other induction machine model implementations, with this model, the user has access to all the internal variables for getting an insight into the Vector control operation using PI controller. Any machine control algorithm can be simulated in the Simulink environment with this model without actually using estimators. If need be, when the estimators are developed, they can be verified using the signals in the machine model. The ease of implementing controls with this model is also demonstrated with several examples.

**REFERENCES**

[1]"Position Sensorless Control of PM Electric Motor using Adaptive Observer of Rotary Coordinate System", Institute of Electrical Engineers Journal D (Industrial Application Journal) Vol.123-D No.5 p.600, 2003 ,Yoshihiko Kinpara|[2] Vector Control of AC Motor,Publisher: Nikkan Kogyo Shinbun Ltd. Author: Takayoshi Nakano|[3]S.Wade, M.W.Dunnigan, B.W.Williams, "Modeling and simulation of induction machine vector control with rotor resistance identification," IEEE Transactions on Power Electronics, vol. 12, no.3, May 1997, pp. 495-506.[4] K. L. SHI, T. F. CHAN, Y. K. WONG and S. L. HO, "Modeling and simulation of three-phase induction motor using Simulink", Int. J. Elect. Enging. Educ., Vol. 36, pp. 163–172.[5]Burak Ozpineci and Leon M. Tolbert,"Simulink Implementation of Induction Machine Model – A Modular Approach",IEEE-0-7803-7817-2/03/\$17.00 ©2003.



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