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Speed Control of an Induction Motor by Using Indirect Vector Control through PI Controller

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Abstract
The MATLAB model of speed control of induction motor by using indirect vector control through IP speed controller is represent in this model ,cage type 50 HP induction motor is use for representation of this model. The field orientation theory is take place for detailed studies of this model in simulation. Motor speed control by using PI control in Field orientated control (FOC) drives. .In induction motor scalar control have some limitation which is overcome by the field orientation control . The indirect vector controlled induction motor drive involve dissociate of the stator current in to torque and flux producing components.
Keywords: *Induction motor, Indirect vector control, Proportional integral controller*

1. Introduction

Separately excited dc motors were employed for high performance speed and servo applications till recently despite the fact that ac motors are less expensive, robust and have low inertia rotors. This was due to the inherent case of control of a dc motor compared to an ac motor. An induction motor it also least expensive but most widely used for industrial purpose is the squirrel cage type induction motor. For variable speed drive of the vector control schemes is developed. This method requires a speed sensor for speed control. The sensor less drives of induction motor has grown past few years due simple construction, less maintenance and high mechanical strength. With the vector control schemes the control of an induction motor is transformed into the control of a separately excited dc motor by creating independent channels stator current in to torque and flux .control performances are required. Therefore this problem is overcome by the variable-frequency. The absence of field angle sensors and the case of operation at low speeds compared to the direct vector control scheme has increased the popularity of the indirect vector control strategy. In vector controlled induction motor drive system parameter sensitivity has been treated as a secondary issue. Some of the effects like enhanced losses in the motor require a fundamental revision of the research direction. Parameter compensation is important in these motor drives in minimizing the losses in the motor for thermal lustiness and hence to have improve rating of the motor. This has the same importance as the elimination of the switching losses in the switching power devices which, increasing switching frequencies and output of the static power converters.

2. Scalar control

The purpose of the technique is use to control the magnitude of the chosen control quantities Scalar control method is based on varying two parameters. The speed can be varied by increasing or decreasing the supply frequency because of this current increase or decrease if current decreases the torque of motor is also decreases and by voltage of machine can be controlled to control the flux. Scalar control cannot be applied for controlling system with dynamic behaviour control. Vector control is more complex technique but scalar control technique is relatively simple. In scalar control, control only variable is due to magnitude variation and disregards the coupling effect in machine. A scalar controlled drive gives somewhat poor performance. Scalar control is easy to implement but due to the coupling effect (both torque and flux are function of voltage or current and frequency) gives slow response, in place of scalar control vector control give the good dynamic response.

3. Vector Control or Field Orientated Control (FOC)

The field orientation scheme in which the rotor flux vector is come to possess indirectly from measured rotor speed and calculated slip speed. and the flux vector is directly measured using Hall probes, search coils, or other measurement techniques. FOC is a control technique that is used in AC synchronous and induction motor applications. That was originally developed for high-performance motor applications which can operate smoothly over the full speed range, can generate full torque at zero speed, and is capable of fast acceleration and deceleration but that is becoming increasingly attractive for lower performance applications as well due to FOC's motor size, cost and power consumption reduction superiority The flux vector used for field orientation is the flux vector field orientation scheme in which the rotor flux vector is acquired indirectly from measured rotor speed and calculated slip speed field orientation to achieve dc motor characteristics in an induction motor derive. In DC machine the field flux is perpendicular to the armature flux. These two fluxes produce no net interaction on each other. By Adjusting the field current the DC machine flux can be control, and the torque can be controlled independently by adjusting the armature current An AC machine is complex because of the interactions between the stator and the rotor fields ,In induction motor stator and the rotor fields are not held at 90 degrees but vary with the operating conditions. We can obtain DC machine-like performance in holding a fixed the field and armature fields 90 degrees in an AC machine by orienting the stator current with respect to the rotor flux so as to attain independently controlled flux and torque.

4. Proportional – Integral (PI) control

The speed controller used is a proportional integral (PI) controller and is implemented in Its purpose is to generate the reference torque Te* based on the reference speed w_m* and the measured or estimated rotor speed w_m.

PI controller gains (Kp and Ki) maintain control performance even in the presence of parameter variation and in case of instability. The use of PI controllers for speed control of induction machine. PI controller when we need to solve the load disturbance rejection and overshoot problems simultaneously. Overshoot during a poor load disturbance rejection. If the gains of the controller will increases up to certain value, the torque become the system unbalance. To overcome this problem use limiter ahead of the PI controller This limiter causes the speed error to be maintained within the saturation limits.

5. Hysteresis Current Regulator

Hysteresis Current Regulator Measure each line current and subtract from the reference. The result is fed to a comparator with hysteresis. Pulse width modulation is achieved directly by the current control The switching frequency is chosen by means of the width of the tolerance band. No tuning is required and it give the fast response.

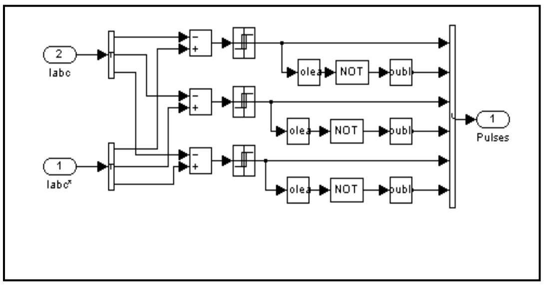

Figure 1: Hysteresis Current Regulator

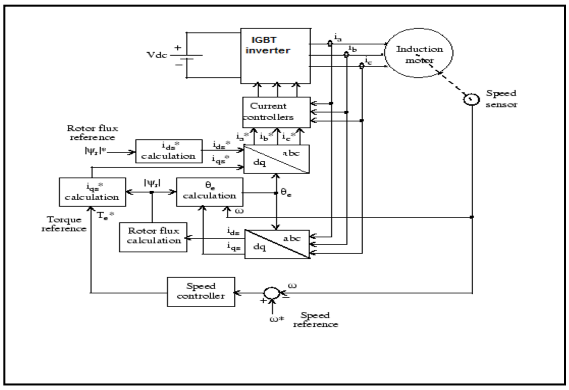

Figure 2: Block dig of indirect vecter control

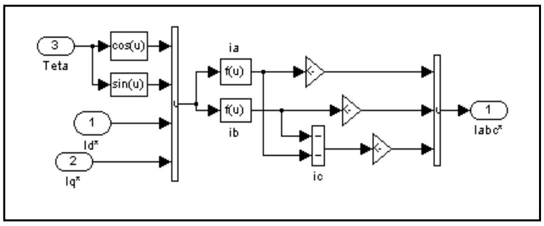

Figure 3: . d-q to abc transformation blocks

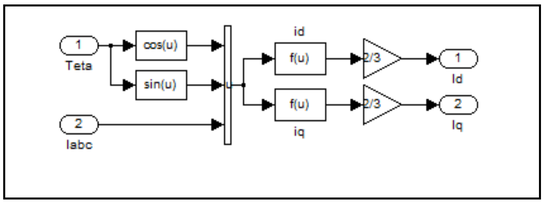

Figure 4: abc to d-q Transformation Blocks

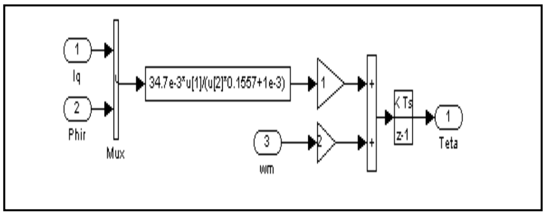

Figure 5: Theta Calculation block

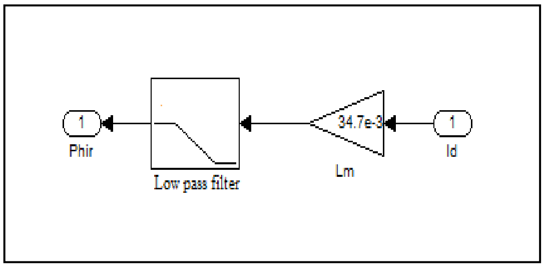

Figure 6: Flux Calculation Block

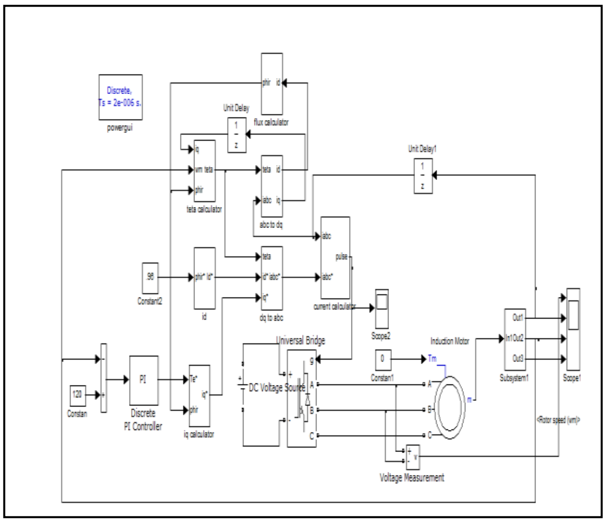

Figure 7: Matlab Simulink diagram

Results

Case-I Results at starting for no load.

Motor current (Iabc) = 400 amps

Torque (Te) = 300 N-m

Case-II Results at no load for speed reach 120 rad/sec at time t=0.751sec.

Motor current (Iabc) = 75 amp

Torque (Te) = 150 N-m

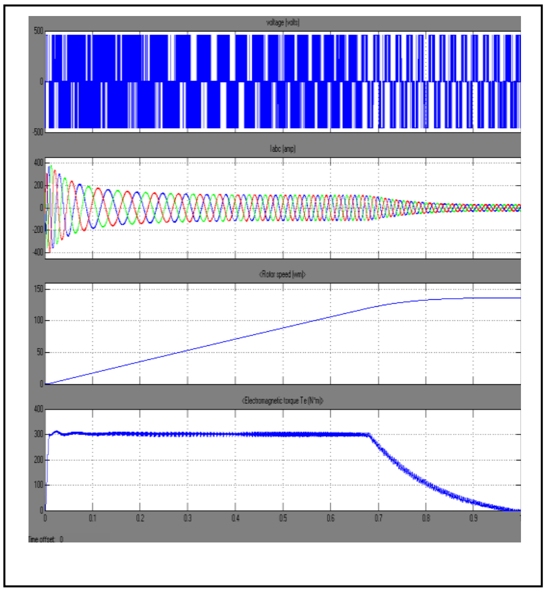

Figure 8: Simulation waveforms of voltage, current, speed, and torque with reference speed 120 rad/sec

Conclusion

The purpose and objective of this project are achieved in indirect vector control Schema. The drive system was simulated by using PI controller motor current is reduce successfully from 450 to 400 amp with same starting torque of 300 N-m.

Future Directions

By using Fuzzy logic controller the starting current of motor can also reduce more with constant speed. Fuzzy logic controller give a good dynamic behavior by controlling the starting current performance can be improved.

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Gyanendra Verma received the B.E. degree in Electrical And Electrical and Electronics from Radharaman institute of technology and science in 2011.and ME (EMD) from SATI Vidisha 2012-14
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