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TWO-LEVEL INVERTER FOR DIRECT TORQUE CONTROL INDUCTION MOTOR DRIVE

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Abstract: *For Induction motor drive ,Direct torque control is a superior method. Digital signal processor using 28335 has an advanced control using quadrature pulse encoder. Integrated power module,Quadrature Encoder pulse Sensor gets used to determine the fluxes and torque. This work represents the simulation of Direct torque control Induction motor drive using two level inverter using simple pulse width modulation technique. Simulation results are verified by using Simulation.*
Keywords: - *3.73KW, 1750RPM,60 Hz. Induction Motor*

I. INTRODUCTION

Direct Torque Control Scheme is easiest scheme. By adjusting the values of torque and flux hysteresis band values of stator flux and torque can be obtained. Loci of flux trajectory are obtained by proper vector selection. In Direct torque control a processor like 28335 for quick response. For Direct torque control using 28335, Quadratur Encoder Pulse(QEP) sensor with Integrated Power Module is required. Matlab and Simulink are integrated with code composer studio and DSPTMS320F28335 and sinusoidal voltage waveform in the three phase inverter are obtained using capacitor voltage source. Sampling time like regular, asymmetric sampling time and re-sampling time is used by DSP system. This sampling time introducing delay in the system for the generation of proper pulse width modulation.

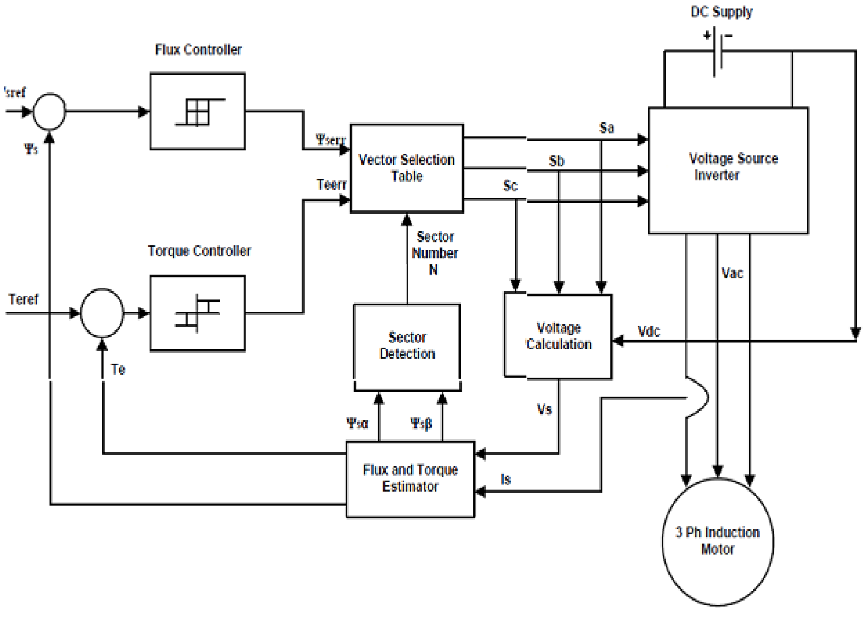

Figure: 1 Basic Direct Torque Induction Scheme

II. DIRECT TORQUE CONTROL TECHNIQUE

Two level inverter fed Induction Motor switching device from 1 to 6 and voltage vectors V0-V7, these vectors uses by Direct torque control technique,

Switching States of VSI:

$$V_{ab} = V_a - V_b \quad \text{----- (1)}$$

$$V_{bc} = V_b - V_c \quad \text{----- (2)}$$

$$V_{ca} = V_c - V_a \quad \text{----- (3)}$$

Sa consisting of switching devices T1 and T4

III. SWITCHING STATES FOR VOLTAGE SOURCE INVERTER

STATE	STATE No.	SWITCH STATES		
		Sa	Sb	Sc
T1, T2, T6 are on	1	1	0	0
T2, T3, T1 are on	2	1	1	0
T3, T4, T2 are on	3	0	1	0
T4, T5, T3 are on	4	0	1	1
T5, T6, T4 are on	5	0	0	1
T6, T1, T5 are on	6	1	0	1
T1, T3, T5 are on	7	1	1	1
T4, T6, T2 are on	0	0	0	0

Table: 1 Selections for Inverter switching states

An Electromagnetic Torque in terms of flux linkage and current is given by the following equation

Electromagnetic Torque = 3/2PΨs x Is ------- (4)

Where Ψs= stator flux linkage

$$Te = \frac{3}{2} \bullet \frac{P}{2} \bullet \frac{Lm}{LsLr} \bullet \left|\overline{\lambda r}\right| \bullet \left|\overline{\lambda s}\right| \bullet \sin\alpha ------(5)$$

In the above equation motor torque control by an angle alpha between stator and rotor flux linkage

Ie ΔTe = 1.5P/2Lm/Ls' (Ψs+ΔΨs) Ψr Sinγ -------- (6)

Hence Torque can be either controls by stator flux rotation same in the position of torque

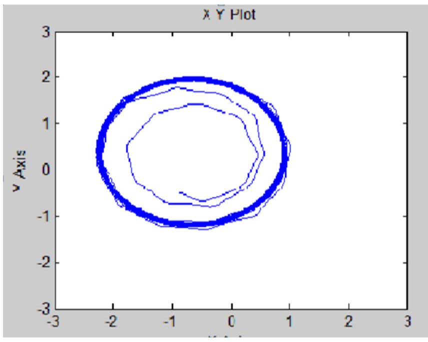

Figure: 2 Loci of Flux Trajectory In The Torque Control

With stationary reference frame , flux linkage of an Induction Motor is given by:

$$Vqs = r_s i_{qs} + \frac{d\lambda qs}{dt} + \omega \lambda_{ds} \quad \text{----------(7)}$$

$$Vds = r_s i_{ds} + \frac{d\lambda_{ds}}{dt} + \omega \lambda qs \quad \text{----------(8)}$$

In stationary reference w=0, hence equation is *written as:*

$$\overline{V_S} = R_S \overline{I_S} + \frac{d\overline{\Psi}_S}{dt} \quad \text{-------------(9)}$$

As stated in equation above small value of stator resistance is ignored and equation can be rewritten as

$$\overline{\Psi}_s \approx \overline{\Psi}_{s0} + \int_0^t \overline{V}_s dt \quad \text{-------------(10)}$$

For periodic time the value of voltage can be given as:

$$\overline{\Psi}_s(k+1) \approx \overline{\Psi}_s(k) + \overline{V}_s T_e \quad \text{----------- (11)}$$

The above equation can be written by neglecting the drop due to resistance

$$\Delta \overline{\Psi}_s \approx \overline{V}_s T_e \quad \text{------------(12)}$$

Loci of the flux is determine by proper vector selection. By using stator current ia,ib,ic and voltage which are the stator variables desire value of flux vector is determine. In torque and flux hysteresis band by limiting this values torque can be calculated as:

$$Te = \frac{3}{2} \bullet \frac{P}{2} \bullet (\lambda_{ds} i_{qs} - \lambda_{qs} i_{ds}) \quad \text{--------------(13)}$$

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IV. DIRECT TORQUE CONTROL OF INDUCTION MOTOR USING TWO LEVEL INVERTER

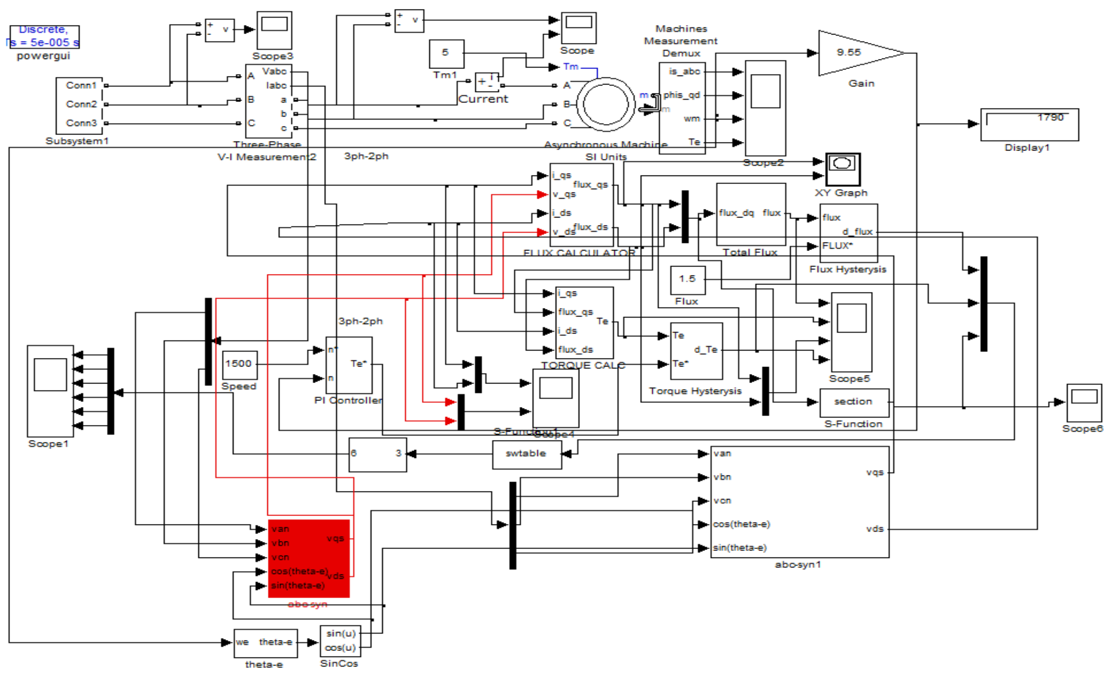

Figure: 3 Direct Torque Control of Induction Motor Using Two Level Inverter

V. SIMULATION RESULT

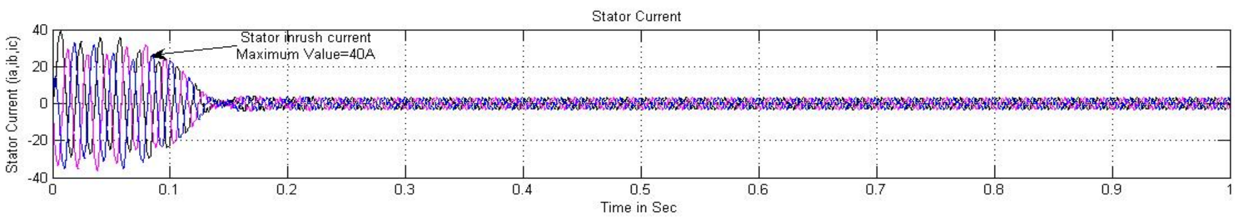

Fig 4 : Plot For Stator Current

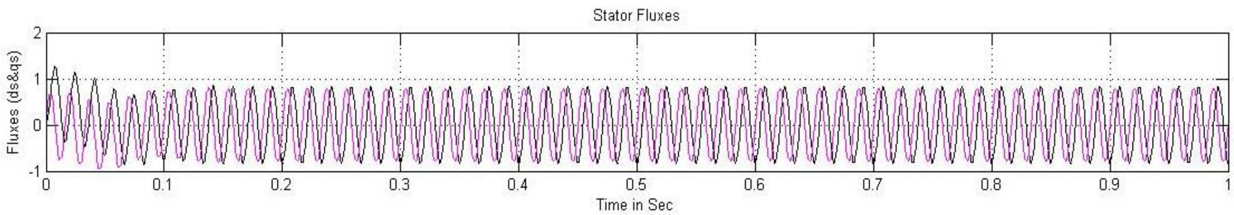

Fig 5: Plot for ds-qs Fluxes

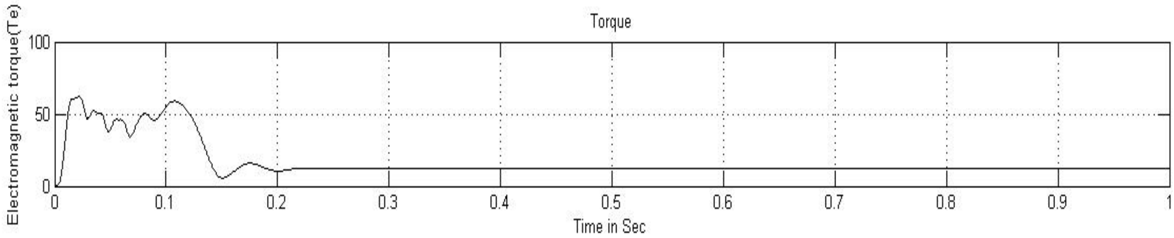

Fig 6 : Plot for Electromagnetic Torque

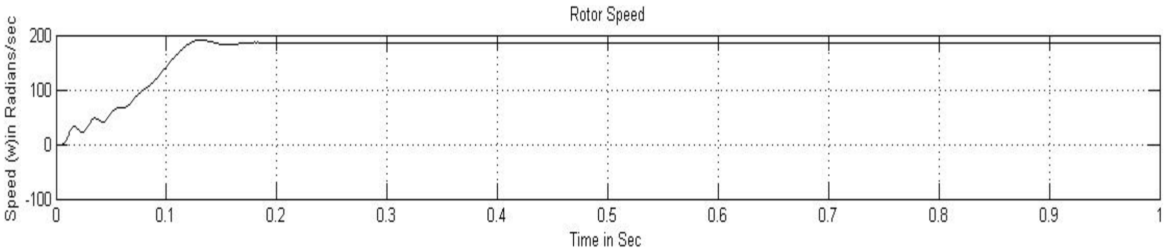

Fig 7 : Plot for Rotor Speed

VI. CONCLUSION

Using two level inverter, Direct Torque control scheme for Induction Motor drive, the result for stator current, Stator fluxes (ds_qs fluxes), Electromagnetic Torque and rotor speed is obtained using Matlab simulation. For minimizing the ripples in the voltage the closed loop control system is specified for Matlab simulation.

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