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# DYNAMIC SIMULATION of DIRECT TORQUE CONTROL INDUCTION MOTOR

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**Abstract -** *To supervising torque in asynchronous motor DTC are most desirable admirable supervising setup. Unlikely treated as an alternate of the FOC or vector supervises approach. Both supervise device are variant on basis of average overall performance on the extraordinary hand intention are similar. Their motive is to supervise effectively the torque and flux. Torque supervises of asynchronous computing system construct direct torque manipulate sketch has set up and ordinary instructional work granted in the exploration.*

***Key word***: DTC controller, MATLAB coding Induction motor, three phase voltage source inverter, and speed estimator block mechanical load system, etc.

## 1. INTRODUCTION

The easy asynchronous motor fulfils admirably the requirements of drastically regular speed drive. All the same, two elements have give upward jostle to a re-examination of numerous the particular workout routines consideration universal overall performance caliber and mass manufacturing in casting and concerning the fee of electric powered energy. The capability to regulate the speed of the industrial energy addresses both these concerns. Direct torque control of induction motor is an approach to manage the torque and flux exactly and freely. It is construct stator flux supervise in the stator immovable coordinate device making use of straight supervise of the converter switch

### 1.1 Flux control

An identical revolving stator coil flux is useful, utilizes one of the sectors whenever. Magnitude of stator coil-flux phasor is $\boldsymbol{\Theta_{fs}}$ and a momentary location is $\boldsymbol{\lambda_s}$ Correlative **d** and **q** axes elements are $\boldsymbol{\lambda_{ds}}$ and $\boldsymbol{\lambda_{qs}}$ subsequently.

### 1.2 Torque control

Differentiation of the require force to the force evaluated taken away the stator coil flux linkages and stator coil currents apply torque control like:-

$$T_e = \frac{3}{2}\frac{p}{2}\left(\lambda_{ds} i_{qs} - \lambda_{qs} i_{ds}\right) \qquad (1.1)$$

Through a window comparator refine the error torque to intending automatic product, ST, in such a way as exact in the table 1.

**Table -1.1:** Generation of $S_T$

| Condition | $S_T$ |
|---|---|
| $(T_e^* - \hat{T}_e) > \delta T_e$ | 1 |
| $\delta T_e < (T_e^* - \hat{T}_e) < -\delta T_e$ | 0 |
| $(T_e^* - \hat{T}_e) < -\delta T_e$ | -1 |

$\boldsymbol{\delta T_e}$ is the Torque window passable above the demanded torque.. Explanations of $\boldsymbol{S_T}$ is in this way: when it is 1 quantity to rising the voltage phasor, 0 categorical to put it at zero, - 1 needs decelerate the voltage phasor returned of the flux phasor to produce reclamation.

**Table 1.2:** Switching states for accessible $S_\lambda$ , $S_T$, and $S_\theta$

| $S_\lambda$ | $S_T$ | $S_\theta$ | | | | | |
|---|---|---|---|---|---|---|---|
| | | <1> | <2> | <3> | <4> | <5> | <6> |
| 1 | 1 | VI (1,1,0) | I (1,0,0) | II (1,0,1) | III (0,0,1) | IV (0,1,1) | V (0,1,0) |
| 1 | 0 | VIII (1,1,1) | VII (0,0,0) | VIII (1,1,1) | VII (0,0,0) | VIII (1,1,1) | VII (0,0,0) |
| 1 | -1 | II (1,0,1) | III (0,0,1) | IV (0,1,1) | V (0,1,0) | IV (1,1,0) | I (1,0,0) |
| 0 | 1 | V (0,1,0) | VI (1,1,0) | I (1,0,0) | II (1,0,1) | III (0,0,1) | IV (0,1,1) |
| 0 | 0 | VII (0,0,0) | VIII (1,1,1) | VII (0,0,0) | VIII (1,1,1) | VII (0,0,0) | VIII (1,1,1) |
| 0 | -1 | III (0,0,1) | IV (0,1,1) | V (0,1,0) | VI (1,1,0) | I (1,0,0) | II (1,0,1) |

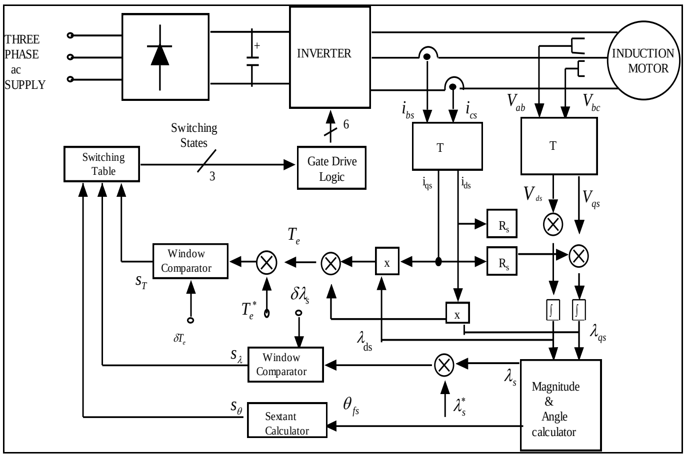


**Fig – 1.1:** Block diagram graphic of the direct torque (self)i Induction motor drive

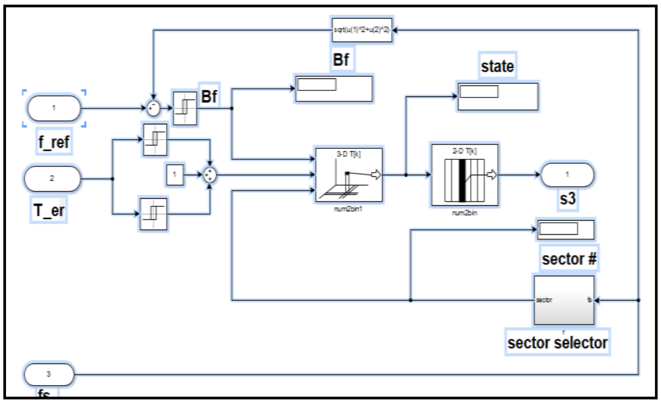


**Fig -1.2:** Simulink diagram of DTC Controller

## 2. MODEL OF INDUCTION MOTOR

Successive adoption are formed in spite of solution,

1 The motor is straight that is concentration in the seductive route is forgotten.

2 The puff space of the instrument is identical and the electromagnetic domain curving disposes.

3 Motor constants keep unvarying.

4 The damping coactive correlated machine-driven revolving scheme of the instrument & machine-driven pile is ignored.

Asynchronous motor can characterize through the following equations in the arbitrary reference frame, which rotate at a speed of $\omega$ in the direction of rotation

$$V_{qs} = R_s I_{qs} + \omega\lambda_{ds} + p\lambda_{qs} \quad (2.1)$$

$$V_{ds} = R_s I_{ds} - \omega\lambda_{qs} + p\lambda_{ds} \quad (2.2)$$

$$V_{os} = R_s I_{qs} + p\lambda_{os} \quad (2.3)$$

$$V_{qr} = R_r I_{qr} + (\omega - \omega_r)\lambda_{dr} + p\lambda_{qr} \quad (2.4)$$

$$V_{dr} = R_r I_{dr} - (\omega - \omega_r)\lambda_{qr} + p\lambda_{dr} \quad (2.5)$$

$$V_{or} = R_r I_{or} + p\lambda_{or} \quad (2.6)$$

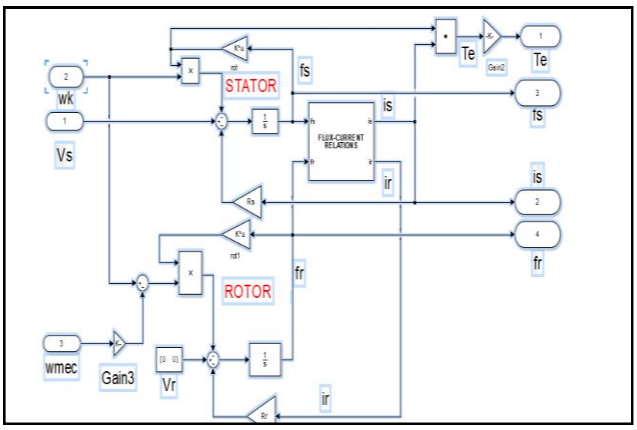


**Fig 2.1:** Simulink diagram of induction motor in arbitrary reference frame

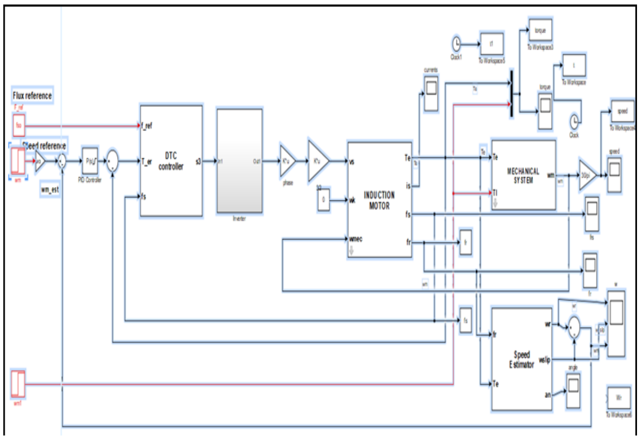

**Fig:-2.2:** Simulink diagram of direct torque control induction motor

## 3. RESULT

### 3.1 Validation of Dynamic modelling result

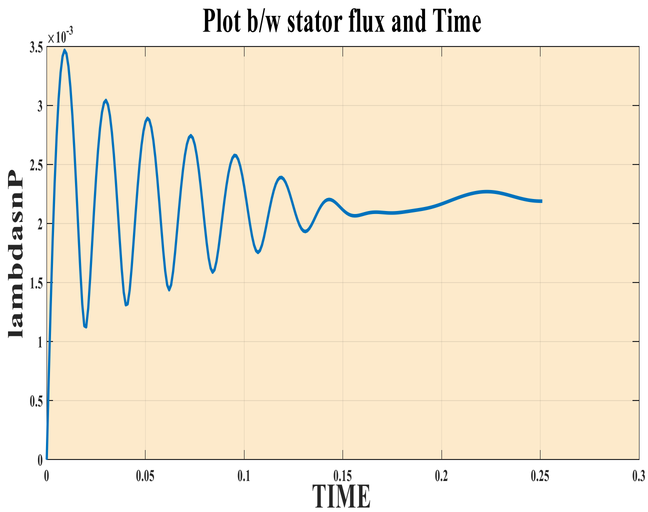


**Fig- 3.1.1:** Graph b/w stator flux linkage & duration without P controller.

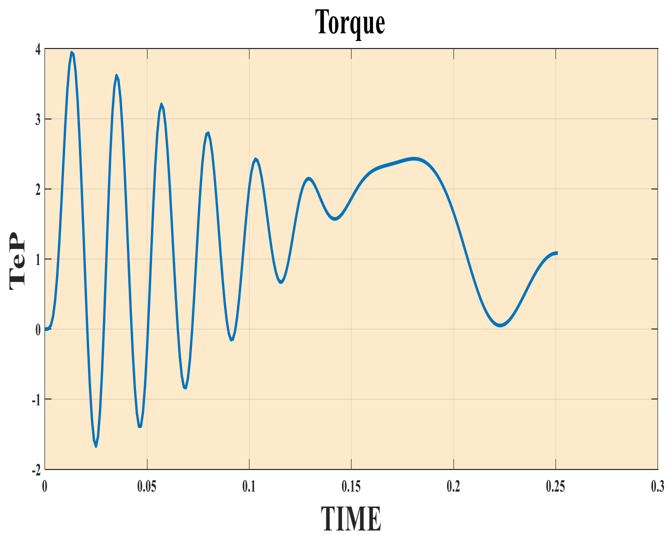


**Fig. 3.1.2:** Graph between normalised torque & duration without P controller

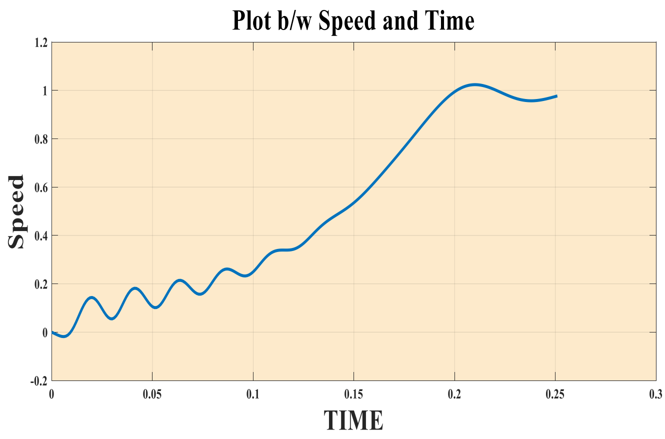


**Fig. 3.1.3:** Graph b/w speed &duration without P controller

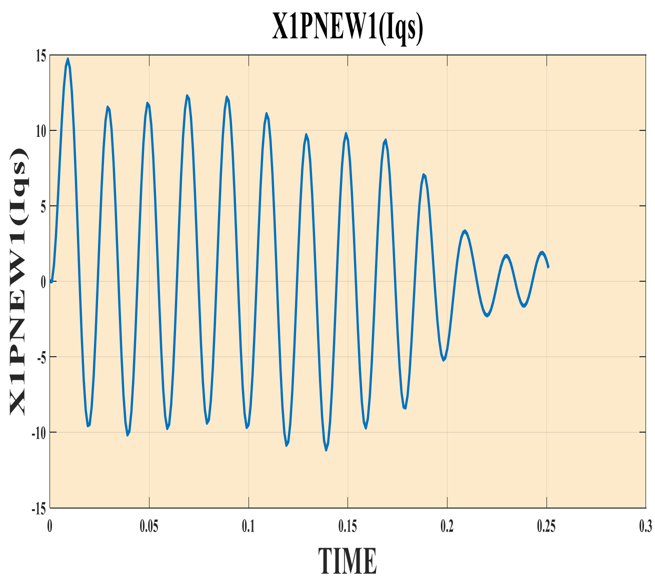


**Fig. 3.1.4:** Graph b/w q-axis stator current & duration without P controller

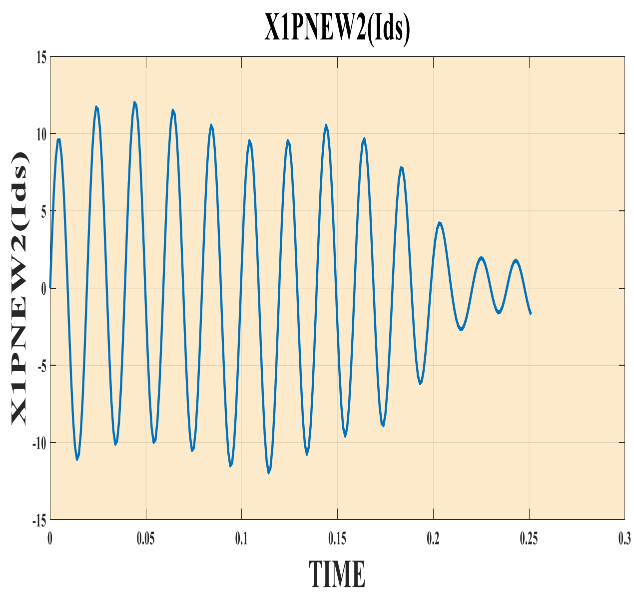


**Fig-3.1.5:** Graph b/w d-axis stator current & duration without P controller

The response curves indicated above approximately match with those given in the reference [9].

### 3.2 P Controller Tuning result

DTC scheme is carried out on the dynamic model of the asynchronous machine for its velocity manipulates the usage of P controller. In the current investigation, the aspired velocity is stay put at 0.8 per unit. The initiative condition of the stationary coil fluxes stay put at 0.966 per unit. To obtain best response attempt is made changing the$K_{pL}$, of the moor.

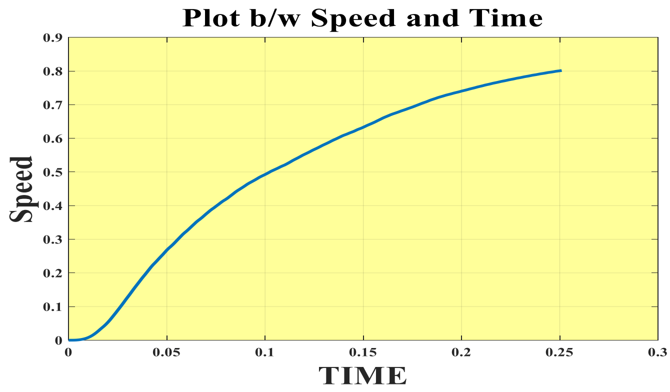


**Fig-3.2.1 (a):** Graph b/w speed & duration with P controller when $K_{PL} = 0.009$,

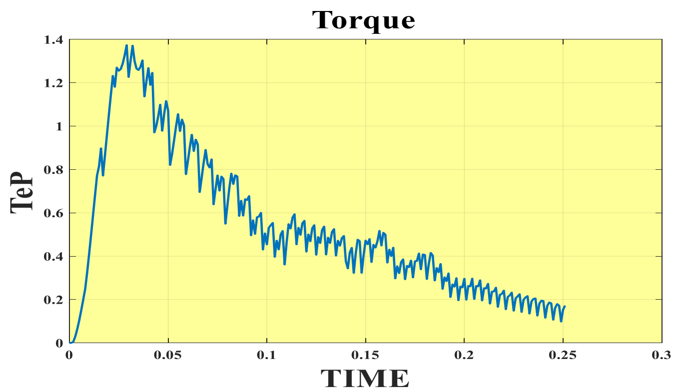


**Fig- 3.2.2(b):** Graph b/w Torque and duration when$\boldsymbol{K_{pL} = 0.009}$

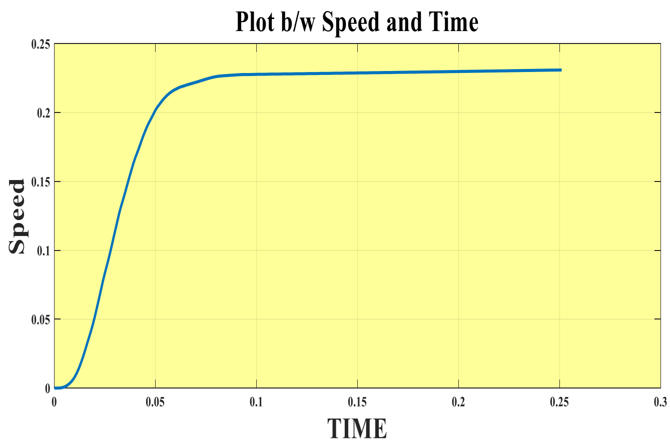


**Fig-3.2.3 (a):** Graph b/w speed & duration with P controller when $K_{PL} = 0.009$,

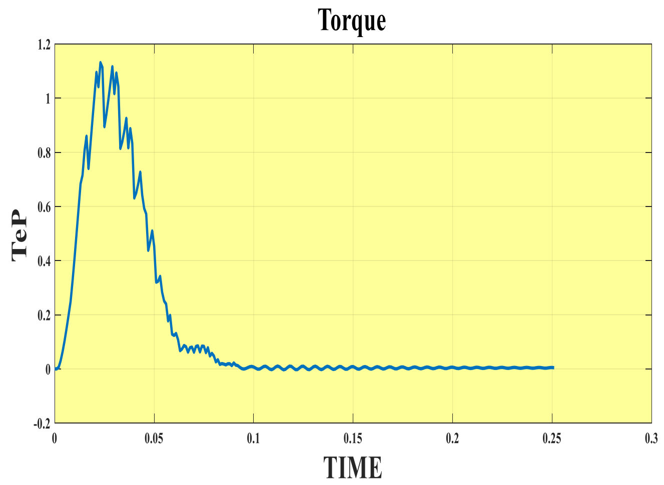


**Fig- 3.2.4(b):** Graph b/w Torque and duration with P controller when $K_{pL} = 0.015$

### 3.3 SIMULATION of DIRECT TORQUE CONTROL INDUCTION MOTOR WITHOUT P CONTROLLER

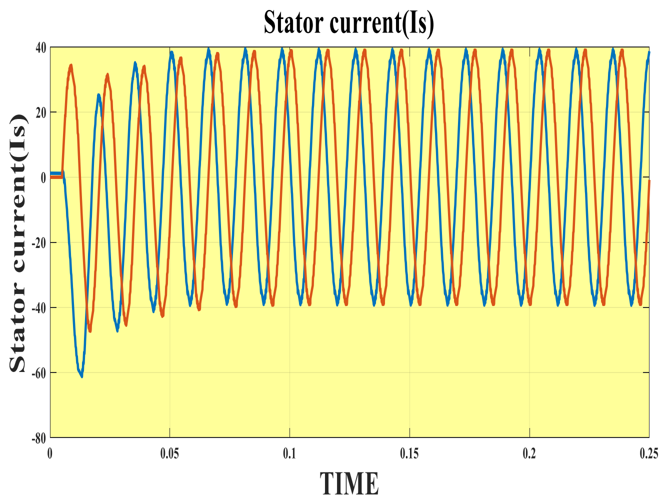


**Fig-3.3.1:** Graph b/w stator current with Proportional (P) controller

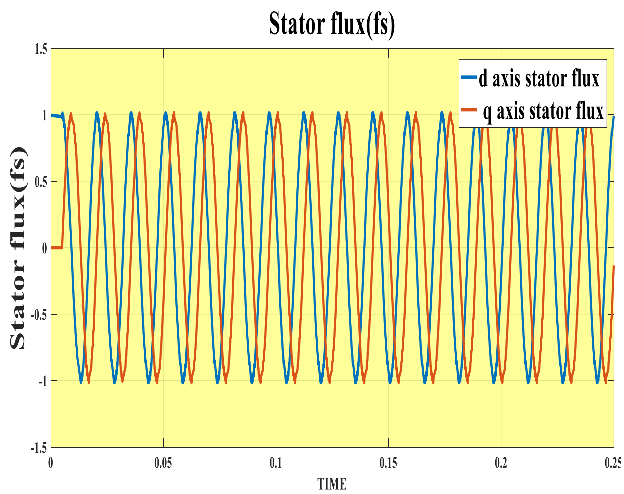


**Fig-3.3.2:** Graph b/w stator flux & duration with Proportional controller

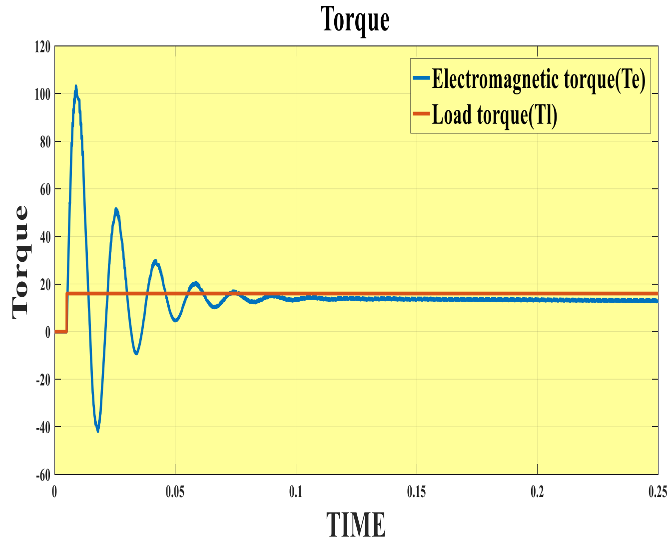


**Fig-3.3.3:** Graph torque & duration with Proportional controller

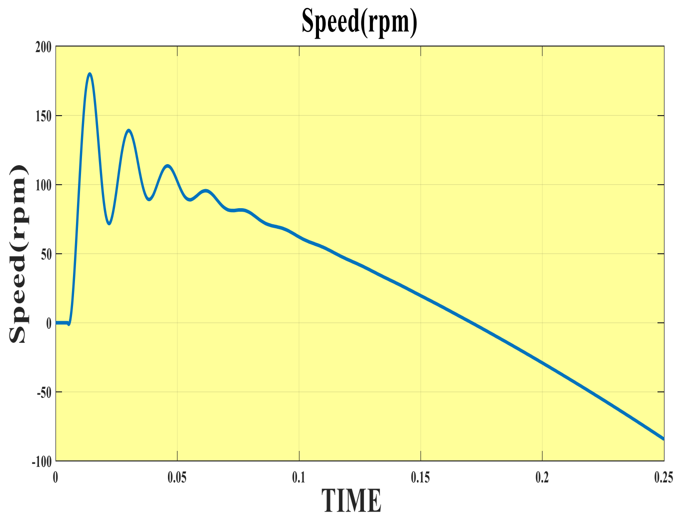


**Fig-3.3.4:** Graph torque & duration with Proportional controller

### 3.4 SIMULATION OF DIRECT TORQUE CONTROL INDUCTION MOTOR WITH P CONTROLLER

For the scheme$R_r$, $l_s$, $l_r$, $l_m$, j, p, $t_{load}$ bring into play. This method calls regeneration manage of torque and stationary coil fluxes that is estimated out of the evaluated stationary coil voltage and currents. In the method makes use of stator flux-linkages control The torque, flux and pace mistakes are determined in the beginning that forces to the most favorable pulse decision in spite of voltage supply inverter switch, the three segment voltage values, bought at the output of the VSI, are used for the calculation of Ids,$I_{qs}$, $\lambda_{ds}$, $\lambda_{qs}$after abc to dq0 transformation. Then calculation of electromagnetic torque, actual speed, stator, flux, estimated torque and estimated speed observe on the groundwork of which the torque, flux and pace blunders are generated. It is proposed to evolve an appropriate velocity controller for a regular induction motor in the current investigations

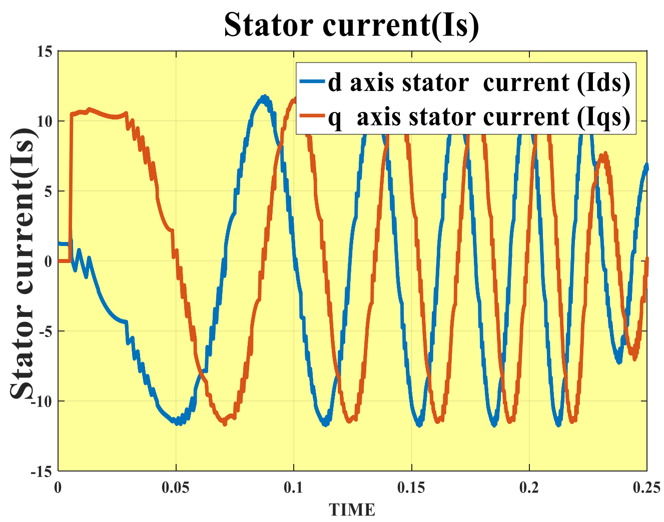


**Fig: -3.4.1:** Graph b/w stator current &duration with P controller

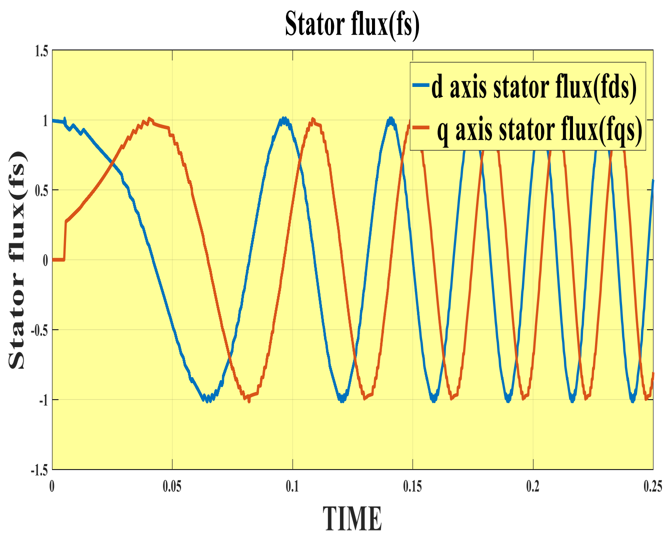


**Fig: - 3.4.2:** Graph b/w stator flux & duration with P controller

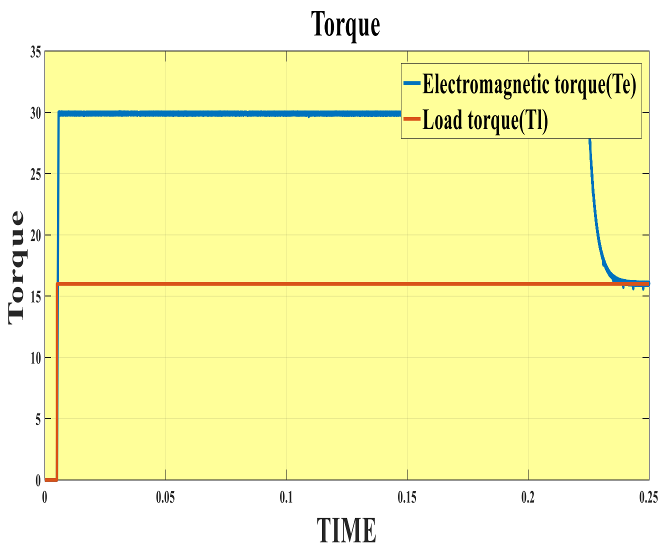


**Fig-3.4.3:** Graph b/w torque & duration with P controller

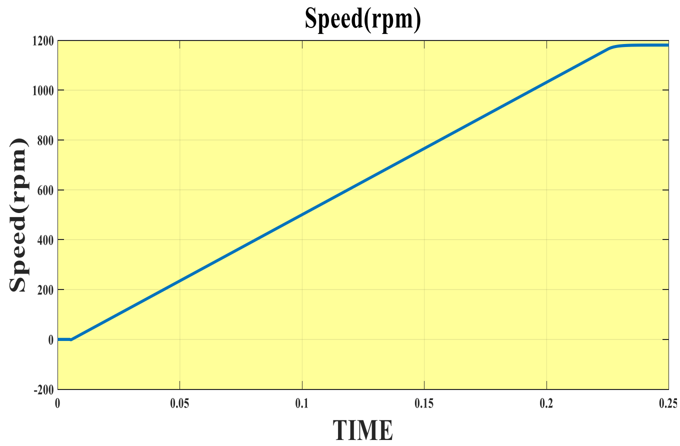


**Fig 3.4.4:** Graph b/w speed & duration with P controller

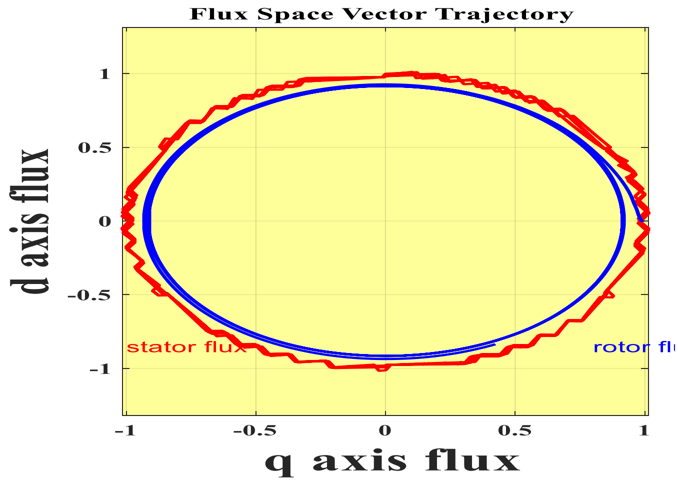


**Fig 3.4.5:** Graph of the flux space vector trajectory

## 4. CONCLUSION

For obtaining an effective respond of the induction motor the MATLAB code has been developed along the P flux controller in spite of velocity governing of the asynchronous machine drive for the similar asynchronous machine drive li. To achieve a satisfactory respond in tune with the P controller applying a hit and trial approach. Perform Matlab coding & simulation result with & without proportional controller. The result of simulation modeling and Matlab coding are comparable

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