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PERFORMANCE EVALUATION OF THREE PHASE INDUCTION MOTOR BASED ON NO LOAD AND BLOCKED ROTOR TEST USING MATLAB

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Abstract: The asynchronous polyphase induction motor has been the motor of choice in industrial settings for about the past half century because power electronics can be used to control its output behavior. In past years, the dc motor was widely used because of its easy speed and torque controllability. The two main reasons are its ruggedness and low cost. The induction motor is a rugged machine because it is brushless and has fewer internal parts that need maintenance or replacement. This makes it low cost in comparison to other motors, such as the dc motor. Because of these facts, the induction motor and drive system have been gaining market share in industry and even in alternative applications such as hybrid electric vehicles and electric vehicles. In this work the result of indirect test (no load and blocked rotor) on three phase induction motor and Thevenin equivalent circuit parameters are obtained, and also the performance parameters by generating graphical user interface (GUI) by using Matlab programming are evaluated.
Keyword: Induction motor, Matlab, GUI.

I. INTRODUCTION

The induction motor is by far the most widely used choice for development application in industry and in the tertiary sector. Being both rugged and reliable, it is also the preferred choice for the variable-speed drive applications. Low cost, high reliability, fairly high efficiency, coupled with its ease of manufacture, makes it readily available in most parts of the world.

The typical constitution of a Squirrel-Cage Induction Motor, which is composed by three sets of stator windings arranged around the stator core. There are no electrical connections to the rotor, which means that there are no brushes, commutator or slip rings to maintain and replace. Large induction motor can also have a wound rotor [1, 3].

For calculating efficiency and torque using Thevenin Equivalent model of three phase induction motor as shown in fig: 1.1.

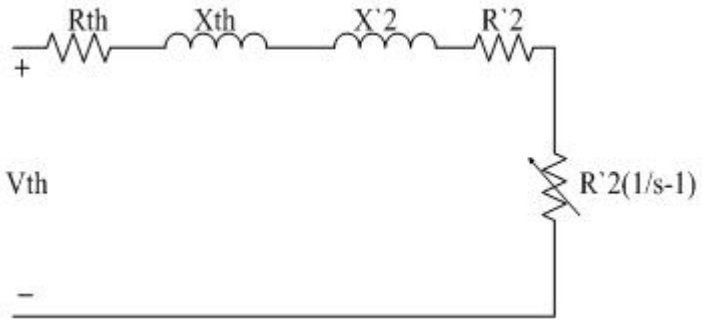

Fig: 1.1

Thevenin Equivalent Circuit of 3 Phase Induction Motor

$$Tst = (3*Vth^2*R2/s\ (j))/\ (ws*((Rth+R2/s\ (j))\ ^2+\ (Xth+X2)\ ^2)) \quad (i)$$

$$Smax=R2/sqrt\ (Rth^2+\ (Xth+X2)\ ^2) \quad (ii)$$

$$Tmax= (3*Vth^2)/\ (2*ws*(Rth+sqrt\ (Rth^2+\ (Xth+X2)\ ^2))); \quad (iii)$$

$$Eff=psh*100/Pin\_nl \quad (iv)$$

II. PARAMETER ESTIMATION INDUCTION MOTOR TESTS

Performance of three phase induction motor calculated by indirect test. Indirect test are no load and blocked rotor test .From these test also calculates the equivalent circuit parameters of induction motor

No-Load Test: Rated voltages are applied to the stator terminals at the rated frequency with the rotor uncoupled from any mechanical load. Current, voltage and power are measured at the motor input. The losses in the no-load test are those due to core losses, winding losses, wind age and friction.

Blocked Rotor Test: The rotor is blocked to prevent rotation and balanced voltages are applied to the stator terminals at a frequency of 25 percent of the rated frequency at a voltage where the rated current is achieved. Current, voltage and power are measured at the motor input.

III. Importance of Parameter Estimation

On the basis of above test , it is clear that the performance evaluation for three phase induction motor is evaluated and these test is carried out to give the correct information regarding induction machine this gives the importance of these parameter to have certain characteristics has been obtained to analysis the machine performance .

IV. Methodology of Determining Induction Machine to Different Quantities for Performance Evaluation

Applied parameters using the Matlab software to obtained desired induction machine performance

V. Graphical User Interface

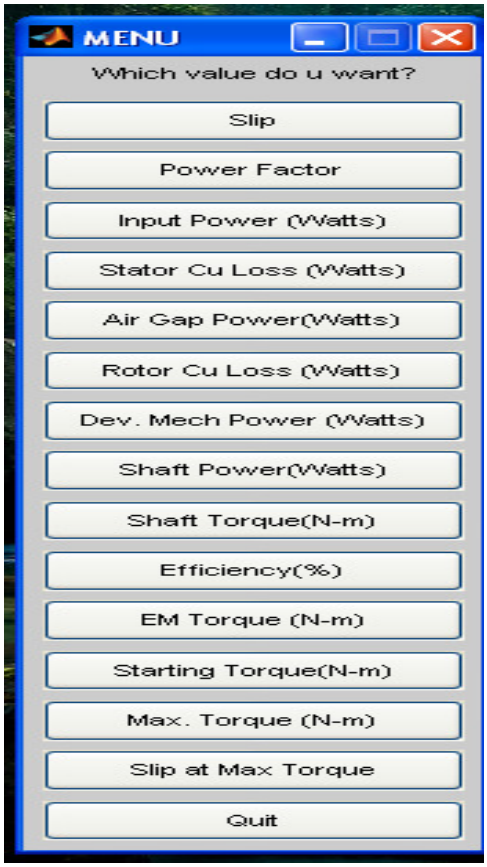

Fig: 1.2

GUI

Table.1 No load parameters calculations for 3 phase IM

S.N.	SPECIFICATIONS	VALUES
1.	Stator Resistance	2.8 ohm
2.	Line to line voltage	2200 V
3.	No load Current	4.5 A

4.	No load Input Power	1600 W
5.	Phase Voltage at no load	1270.17 V
6.	No load Impedance	282.26 ohms
7.	No Load power factor	0.093
8.	Power factor angle	84.64 deg
9.	Magnetizing branch volt	1257.57 V
10.	Current through Xm ,Im	4.48 A
11.	Current through Rc , Ic	0.41 A
12.	Magnetizing Reactance	280.68ohms
13.	Core Resistance	2994.99ohm
14.	Magnetizing Impedance	26.6+278.2i
15.	Approximate Reactance	1.5754 ohms
16.	Stator Copper Losses	170.1 W
17.	Rotational Losses	1429.9 W

Table.2 Full load parameters calculations for 3 phase IM

S.N.O.	SPECIFICATIONS	VALUES
1.	Full load Line Voltage	270 V
2.	Full load Phase Voltage	155.8846 ohms
3.	Full load Current	25 A
4.	Full load Impedance	6.2354 ohms
5.	Full load Power	9000 W
6.	Full load Power factor	0.7698
7.	Power factor angle	39.664 degree
8.	Full load Impedance	4.8+3.9799i ohm
9.	Rotor resistance	2 ohms
10.	Approximate	2.4045 ohms

Table.3 Thevenin Equivalent Circuit Parameter

S.N.	SPECIFICATIO	VALUES
1.	Thevenin	1263.0812 V
2.	Thevenin	2.7688 ohms
3.	Thevenin	1.5754 ohms

Table.4 Calculation of starting and pull-out torque

S.NO.	SPECIFICATIONS	VALUES
1.	Rated frequency , f	50 Hz
2.	No. of poles , P	6
3.	Synchronous speed , Ns	1000 rpm
4.	Synchronous speed ,Ws	104.7198
5.	Starting Torque, Tstart	2369.20
6.	Slip for Tmax , Sm	0.41251
7.	Maximum Torque,Tmax	3000.06

VI. Table.5 COMPARISON OF RESULTS

Items	Normal[13]	SA[13]	Proposed Mat- lab Based Programming
Full Load Slip	0.0699	0.056	0.0416
Efficiency	0.80309	0.828	0.893
Starting Torque	1.2027 pu	1.3444 pu	2369.2083 Nm

VII. GRAPH RESULTS (Shown in Fig: 1.3)

1) SLIP V/S SPEED

2) SPEED V/S TORQUE

3) SLIP V/S TORQUE

4) SLIP V/S EFFICIENCY

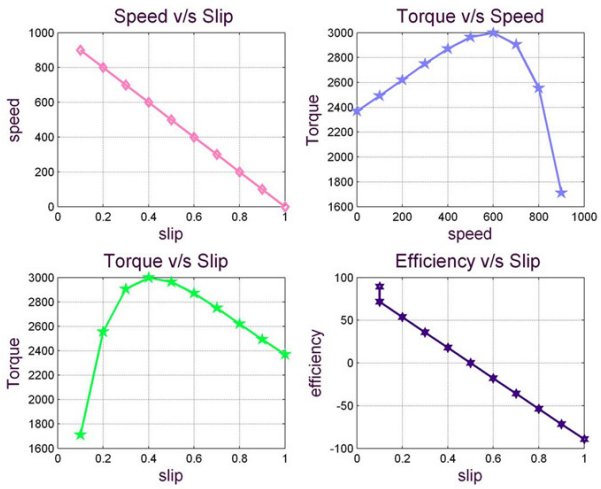

Fig: 1.3. Comparative Characteristics

CONCLUSION AND FUTURE WORK

In this paper generate the GUI for three phase induction motor taking the results of indirect test of three phase induction motor, I got various parameters results in form of improved efficiency, better result of various torque and decrease in slip with increase in efficiency. I also plot the graphs between various GUI results as speed-slip, torque-slip, efficiency-slip and torque speed characteristics various results and obtained slip at maximum torque and comparing the results so, I got improvement in efficiency. Max torque, starting torque and decreasing in slip compared to the normal operation.

APPENDIX-I

The results of the no-load and blocked rotor tests on a three-phase, 60hp, 2200 V, six-pole, 50 Hz, squirrel-cage induction motor are shown below. The three-phase stator windings are wye-connected.

No-load test Frequency = 50 Hz

Line-to-line voltage = 2200 V

Line current = 4.5 A

Input power = 1600 W

Blocked-rotor test Frequency = 15 Hz

Line-to-line voltage = 270 V

Line current = 25 A

Input power = 9000 W

Stator resistance 2.8 S per phase

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