Dynamic Algorithm for 3-Phase Induction Motor Speed Control using Stator , Rotor Voltage and Variable Frequency Control

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Abstract : Three-phase squirrel-confine induction motors are commonly used as present day drives since they are self-starting, strong and proficient. Single-phase induction motors are used comprehensively for more diminutive weights, for instance, nuclear family contraptions like fans. Though usually used in fixed-speed organization, induction motors are logically being used with variable-frequency drives (VFDs) in factor speed organization. VFDs offer especially noteworthy imperativeness venture supports open entryways for existing and arranged induction motors in factor torque spiral fan, siphon and blower load applications. Squirrel confine induction motors are in all regards commonly used in both fixed-speed and variable-frequency drive (VFD) applications.The proposed approach applies the idea of the speed control of the 3 phase induction motor utilizing stator voltage control, rotor voltage control and variable frequency control. The outcomes accomplished are very tasteful.

***IndexTerms* - Stator Control, RotorControl, Variable Frequency Control, 3 Phase Induction Motor.**

I. INTRODUCTION

The motor which wears down the rule of electromagnetic induction is known as the induction motor. The electromagnetic induction is where the electromotive power actuates over the electrical transport when it is placed in a turning appealing field. A motor with just armortisseur windings is called an induction motor. An induction motor is the most modest electrical machine from constructional viewpoint, in the majority of the cases. Induction motor tackles the rule of induction where electro-alluring field is incited into the rotor when turning appealing field of stator cuts the stationary rotor. Induction machines are by far the most generally perceived sort of motor used in mechanical, business or private settings. It is a three phase AC motor. Its trademark features are: [1]

Fig 1.1 Induction Motor

a) Simple and rough development
b) Low cost and least upkeep
c) High reliability and adequately high capability
d) Needs no extra turning over motor and need not be synchronized

In a DC motor, supply is ought to have been given for the stator curving similarly as the rotor winding. However, in an induction motor only the stator winding is sustained with an AC supply.

a) Alternating transition is made around the stator winding due to AC supply. This trading motion turns with synchronous speed. The turning motion is called as "Turning Magnetic Field" (RMF). [1]

b) The relative speed between stator RMF and rotor conductors causes an actuated emf in the rotor conductors, as shown by the Faraday's law of electromagnetic induction. The rotor conductors are shortcircuited, and accordingly rotor current is conveyed as a result of impelled emf. That is the reason such motors are called as induction motors. [1]

c) Now, affected current in rotor will in like manner convey substituting motion around it. This rotor transition falls behind the stator motion. The course of instigated rotor current, as shown by Lenz's law, is with the true objective that it will by and large repudiate the explanation behind its age.

d) As the explanation behind age of rotor current is the relative speed between turning stator motion and the rotor, the rotor will endeavor to compensate for wasting time with the stator RMF. Thusly the rotor turns a comparable route as that of stator transition to restrain the relative speed. In any case, the rotor never wins concerning getting up to speed the synchronous speed. This is the fundamental working principle of induction motor of either type, single phase of 3 phase. [1]

$$Ns = \frac{120 \times f}{P} \quad (RPM)$$

Where, f = frequency of the supply

P = number of poles

Rotor endeavors to get up to speed the synchronous speed of the stator field, and in this way it turns. In any case, eventually, rotor never wins concerning compensating for wasting time. If rotor gets up to speed the stator speed, there won't be any relative speed between the stator motion and the rotor, therefore no started rotor current and no torque creation to keep up the unrest. In any case, this won't stop the motor, the rotor will back off as a result of loss of torque, and the torque will again be connected due to relative speed. That is the reason the rotor turns at speed which is for each situation less the synchronous speed.

The contrast between the synchronous speed (Ns) and real speed (N) of the rotor is called as slip..

$$\%\ \text{slip} \quad s = \frac{Ns - N}{Ns} \times 100$$

II. Literature Survey

R. P. Vieira and H. A. Grundling[1] This paper explores the issue of Single-Phase Induction Motor (SPIM) sensorless speed control. A discrete time PI controller and a sensorless procedure are finished on a PC-based stage utilizing a standard three-phase inverter drive and vector control. A mutilated rotor change masterminded control strategy is made subject to a sensorless system. A MRAS with a Kalman channel check is made for a rotor speed estimation. Multiplication and test results are appeared to support the adequacy of the system.

A. Z. Latt and N. N. Win [2], Single-phase induction motors are generally utilized in home gadgets and mechanical control. The multispeed activity and multipurpose task are given by controlling the speed of these motors. This evaluation paper is variable speed drive of induction motor utilizing frequency control procedure. It is to build up the strong state control system to be solid and monetarily practical to use with fragmentary drive motors. The proposed variable speed drive breakers power change an area (AC to DC and DC to AC), utilized the exchanging fragment of IRF 840 N-channel MOSFET. The four IRF 840 MOSFETS are utilized as H-interface inverter to give the substituting current to the motor. In this drive, C124 transistors and MJE 13002 transistors are utilized as driver circuit to drive the H-partner inverter. There are two power supplies in this drive. The 12 V power supply is utilized for frequency control circuit and driver circuit. The 300 V power supply is utilized for H-interface inverter. In this drive, beat width rule SG3525A IC is utilized to control the frequency. The frequency degree of the built variable drive circuit is 16 Hz to

56 Hz at steady voltage for changing the speed of induction motor. In this appraisal paper, drive plans of single-phase induction motor, rule assignments of bits utilized in made variable speed drive, and structure check to gather this drive are combined. Also, the test starter of this drive when driving a fragmentary torque single-phase induction motor are portrayed.

A. Hmidet and O. Hasnaoui[3] Induction motors of wound rotor or squirrel pen type are exhaustively utilized in industry application in light of their straightforwardness and power. Everything considered, for quite a while, these sorts of motors were utilized particularly in factor speed drives. During the two consistently back, in perspective on the amazing progress in microelectronic control systems and power converters they wound up being likewise an enormous in controlled enduring rate drives. This paper demonstrates a reaction for control an AC Induction Motor (IM) utilizing WaijungBlockset and STM32F4 DISCOVRY that empower down to business plan, reducing the system parts and expansion effectiveness. The reason for this work is to keep a suffering pace at variable mechanical torque.

Along these lines a shut circle speed control for an induction motor with scalar control strategy is appeared. Attestation of the proposed controller is given by test tests. The primer results show the sensibility of the speed controller with a wide degree of weight.

M. Chen and W. Zhang[4] This paper mulls over the utilization of H2 ideal control to speed controller for vector controlled induction motor drives. A mechanical progression model picked up from vector power is utilized in the structure. An interpretive immaculate speed controller is acquired which has a sort of PI controller. Proliferation subject to MATLAB/Simulink is done to check the control plot, and the outcomes show that the orchestrated controller has unprecedented speed following point of confinement with respect to different speed direction and is strong against weight torque collections.

A. H. M. Yatim and W. M. Utomo[5], Development of a practicality improvement control for variable speed drive system is basic from the perspectives of significance saving similarly as from the broad point of view of nursery discharge. In this paper the plans of a Back Engendering Based Productivity Advancement Control (BPEOC) for variable speed blower induction motor drive is portrayed. The controller is relied upon to make signal voltage and frequency references all the while. This strategy ponders control of both the speed and ability. So as to accomplish a powerful BPEOC from collection of motor parameters, an electronic learning estimation is utilized. Multiplication of the BPEOC and research office test set up has been made utilizing TMS320C60 impelled sign processor. The outcome showed an imperative growth in benefit and an improvement in speed execution.

Ping Liu and LanyingHao[6] In sales to dispose of the impact of parameter vulnerabilities on field-engineered control for induction motor drive, a sliding-mode speed controller with key sliding surface is proposed. In this proposed control plot the sliding-mode control system is worked related to the field-masterminded control method to improve the controller execution. The assessed rotor speed utilized in speed investigation circle is directed by a versatile calculation dependent on surveyed terminal aggregates. Security evaluation dependent on Lyapunov hypothesis is familiar with exhibit that the rotor speed is exponential focused. Reenactment results are besides shown to confirm the attributes of the proposed when in doubt control think up Y.

Feng, Minghao Zhou, X. Zheng, F. Han and X. Yu[7] This paper proposes a nonsingular terminal sliding-mode control method for induction motors. In light of the numerical model of induction motors and the field course control rule, the shut circle speed control system of IMs are organized. The controllers for speed, advancement, and surges of an induction motor are composed only utilizing nonsingular terminal sliding-mode control system and the Lyapunov quality hypothesis. The prattling and single wonders existed in ordinary terminal sliding-mode control are disposed of. The redirection results demonstrate the proposed method can improve the system reaction speed, relentless state shows, and power of induction motor speed control systems.

III. PROPOSED WORK

Stator Voltage Control of an Induction Motor

Stator Voltage Control is a strategy used to control the speed of an Induction Motor. The speed of a three phase induction motor can be contrasted by changing the supply voltage. As we unquestionably understand that the torque made is relating to the square of the supply voltage and the slip at the most outrageous torque is self-sufficient of the supply voltage. The assortment in the supply voltage does not change the synchronous speed of the motor. [8]

Rotor Voltage Control of an Induction Motor

In this technique for speed control of three phase induction motor outside opposition are included rotor side. The condition of torque for three phase induction motor is

$$T \propto \frac{sE_2^2 R_2}{R_2^2 + (sX_2)^2}$$

The three-phase induction motor works in a low slip region. In low slip territory term (sX2)2 ends up being amazingly little when stood out from R2. Along these lines, it might be ignored. What's more, besides E2 is steady. So the state of torque after unraveling advances toward getting to be,

$$T \propto \frac{s}{R_2}$$

SPEED CONTROL OF INDUCTION MOTOR BY VARIABLE FREQUENCY CONTROL

Variable Frequency Control is a method which is used to control the speed of an induction motor. The synchronous speed and thusly, the speed of the motor can be controlled by moving the supply frequency. The synchronous speed of an induction motor is given by the association showed as pursues.

$$N_s = \frac{120f}{P}$$

The EMF actuated in the stator of the induction motor is given by the condition demonstrated as follows.

$$E_1 = 4.44k_{w1}f\varphi T_1$$

IV. RESULT ANALYSIS

Result Analysis

4.1 Using Proposed Stator Voltage Control

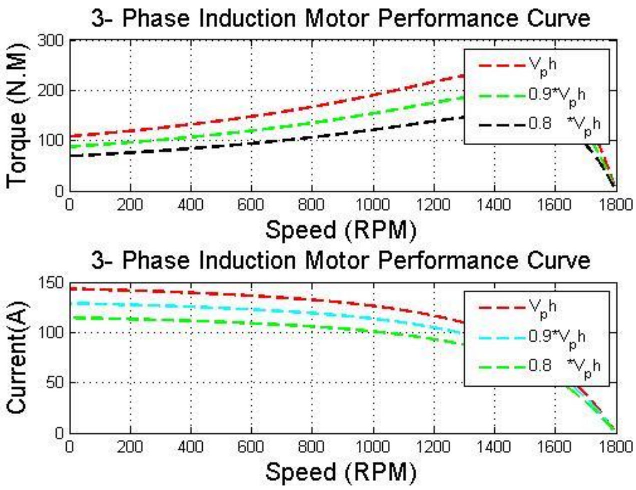

Fig 2 Result Case I

4.2 Using Proposed Stator Voltage Control with Maximum Load

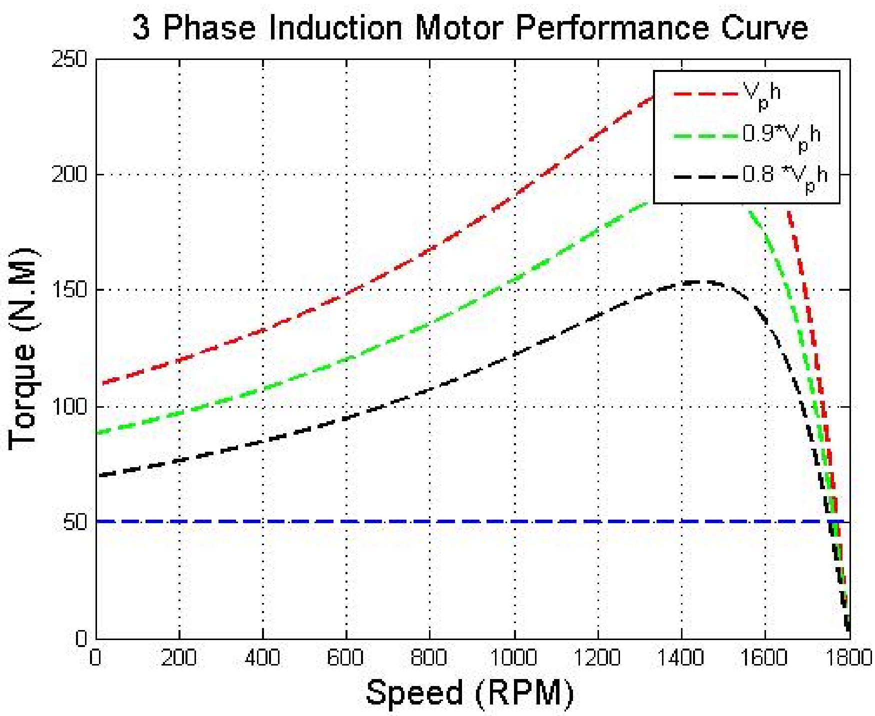

Fig 3 Result Case II

4.3 Using Proposed Rotor Voltage Control

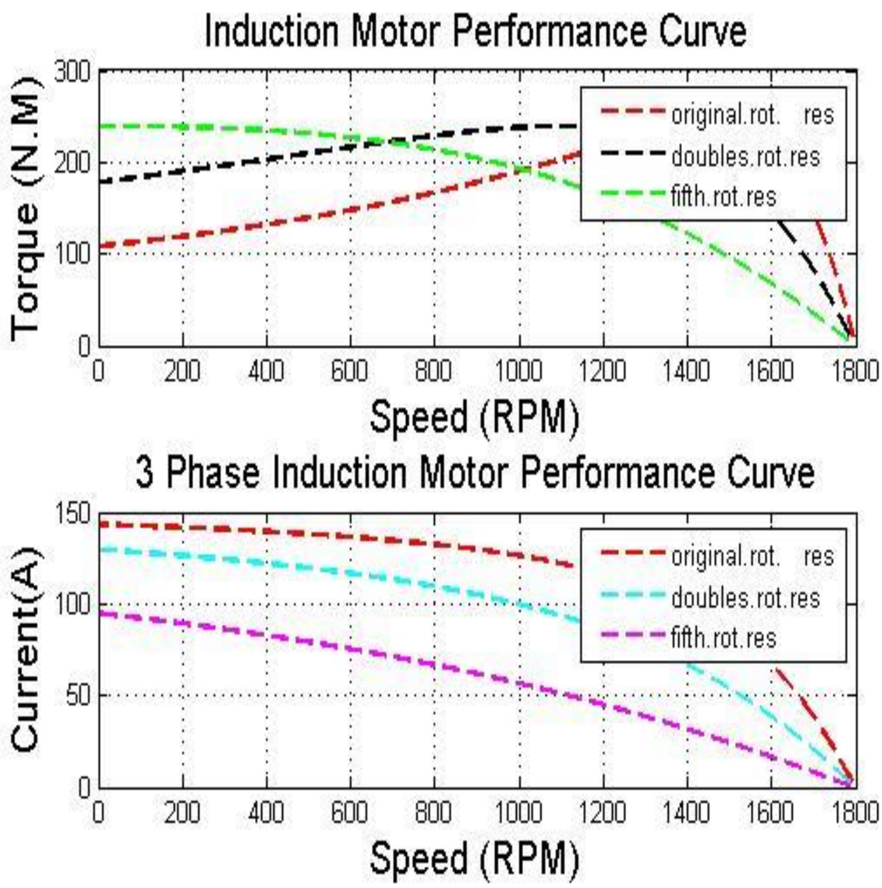

Fig 4 Result Case III

4.4 Using Proposed Rotor Voltage Control with Maximum Load

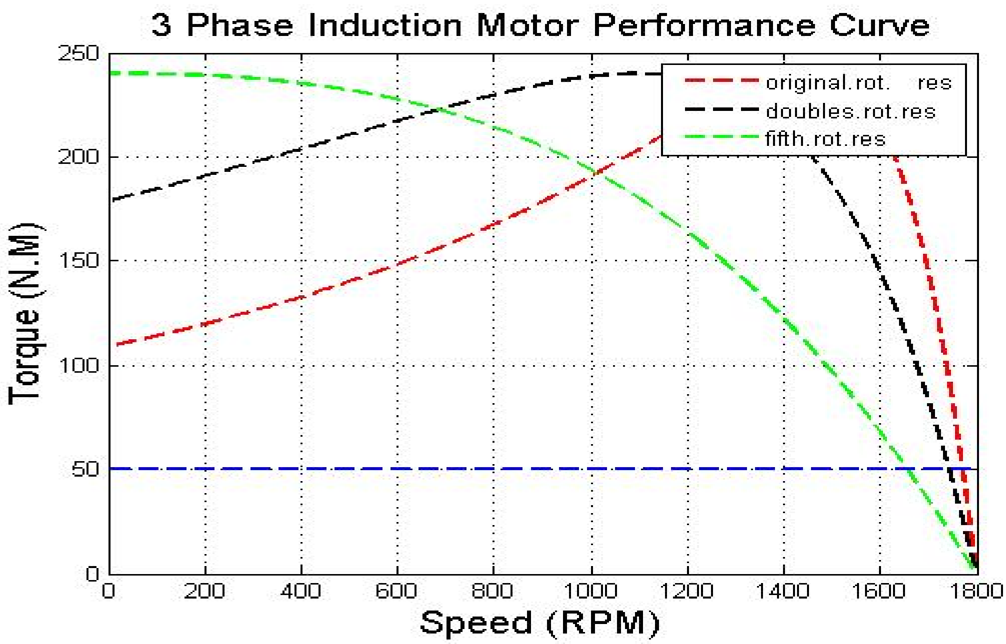

Fig 5 Result Case IV

4.5 Using Proposed Variable Frequency Control

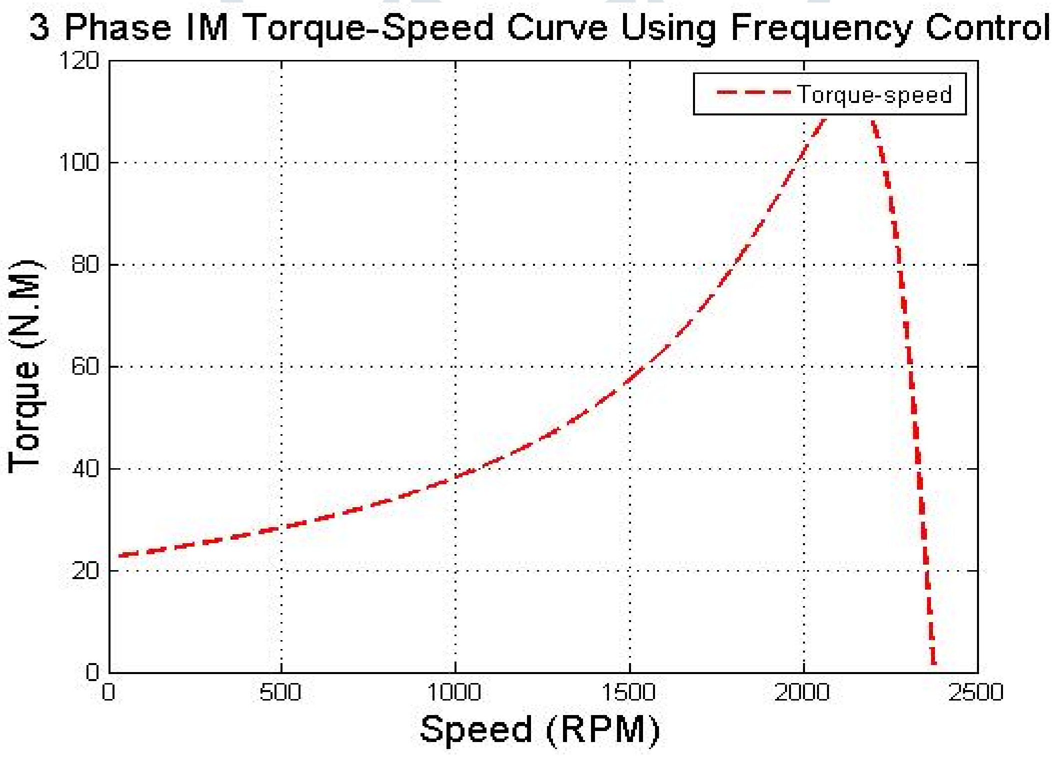

Fig 6 Result Case V

V. Conclusion

An induction motor or strange motor is an AC electric motor where the electric stream in the rotor expected to make torque is procured by electromagnetic induction from the appealing field of the stator winding. An induction motor can subsequently be made without electrical relationship with the rotor. An induction motor's rotor can be either wound sort or squirrel-confine type. Three-phase squirrel-confine induction motors are commonly used as present day drives since they are self-starting, strong and productive. Single-phase induction motors are used comprehensively for humbler weights, for instance, nuclear family contraptions like fans. But usually used in fixed-speed organization, induction motors are dynamically being used with variable-frequency drives (VFDs) in factor speed organization. VFDs offer especially noteworthy essentialness speculation supports open entryways for existing and arranged induction motors in factor torque outspread fan, siphon and blower load applications. Squirrel confine induction motors are in all regards commonly used in both fixed-speed and variable-frequency drive (VFD) applications.The proposed approach applies the idea of the speed control of the 3 phase induction motor utilizing stator voltage control, rotor voltage control and variable frequency control. The outcomes accomplished are very tasteful.

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