New Strategy for Controlling Speed in 3-Phase Induction Motor

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Abstract : The three-phase AC induction motor is a pivoting electric machine that is intended to work on a three-phase supply. This 3 phase motor is likewise called as an asynchronous motor. These AC motors are of two sorts: squirrel and slip-ring type induction motors. VVVF represents Variable Voltage Variable Frequency. VVVF Speed Control technique is broadly utilized strategy for Induction Motor. Thus on the off chance that we can change the frequency f, it is conceivable to change the speed of induction motor. Presently frequency of force supply can undoubtedly be changed utilizing power gadgets like inverter. The inverter changes over DC power into AC force and feeds to induction motor. Inverter yield might be either consistent voltage variable frequency or variable voltage variable frequency. The proposed work simulates the 3-Phase Induction motor power control using VVF method.

***IndexTerms* – Three Phase Induction Motor , VVF Control.**

I. Introduction

An induction motor (otherwise called an asynchronous motor) is a usually utilized AC electric motor. In an induction motor, the electric flow in the rotor expected to create force is gotten by means of electromagnetic induction from the pivoting attractive field of the stator winding. The rotor of an induction motor can be a squirrel confine rotor or wound sort rotor.Synchronous speed is the speed of pivot of the attractive field in a rotating machine, and it relies on the frequency and number shafts of the machine. The induction motor consistently runs at speed not as much as its simultaneous speed. [1] The pivoting attractive field delivered in the stator will make flux in the rotor, subsequently making the rotor turn. Because of the slack between the flux current in the rotor and the flux current in the stator, the rotor won't ever reach its turning attractive field speed (for example the simultaneous speed). [1]

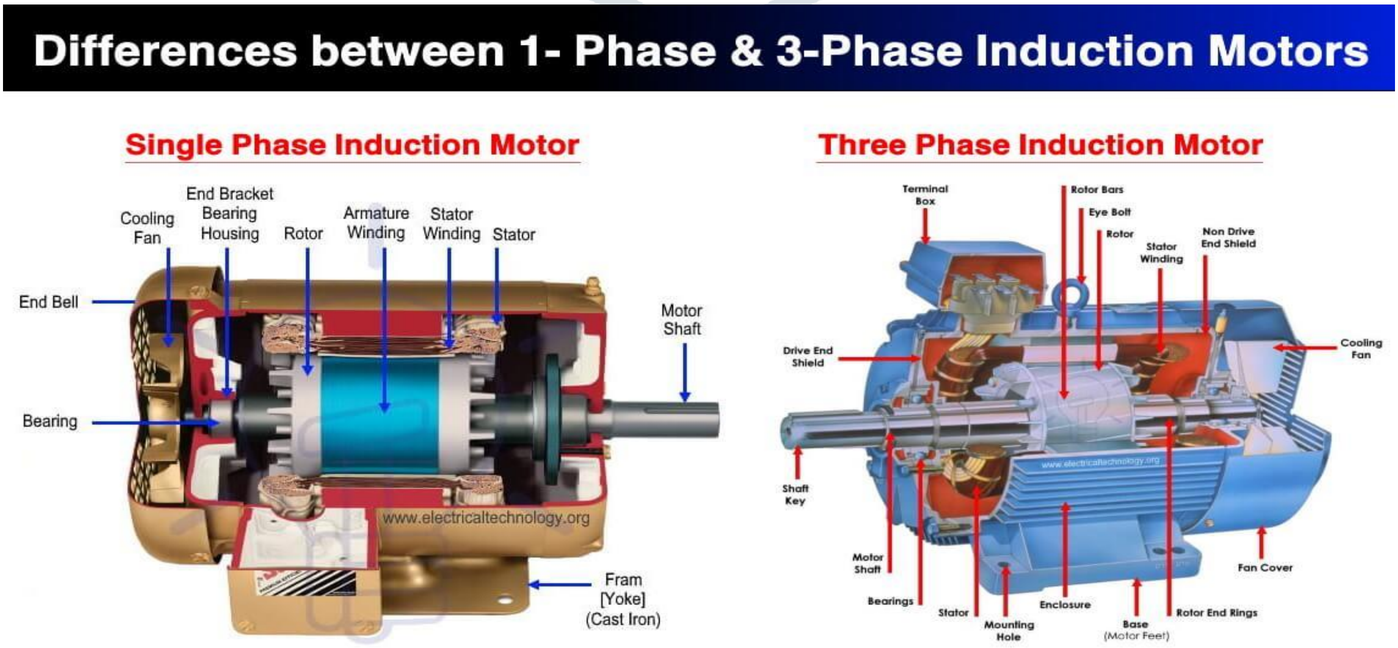

Fig 1 Single and Three-Phase Induction Motor

There are fundamentally two sorts of induction motor. The kinds of induction motor rely on the information supply. There are single phase induction motors and three phase induction motors. Single phase induction motors arenot a self-turning over motor, and three phase induction motor are a self-turning over motor. We need to give twofold excitation to make a DC motor to turn. In the DC motor, we give one inventory to the stator and another to the rotor through brush game plan. However, in induction motor, we give just one stock, so it is intriguing to realize how an induction motor functions. [2] It is basic, from the actual name we can comprehend that here, the induction cycle is included. At the point when we give the inventory to the stator winding, an attractive flux gets created in the stator because of the progression of current in the loop. The rotor winding is masterminded to the point that each curl turns out to be shortcircuited. [2] The flux from the stator stops the circuited loop in the rotor. As the rotor coils are shortcircuited, according to Faraday's law of electromagnetic induction, the current will begin coursing through the curl of the rotor. At the point when the current through the rotor coils streams, another flux gets produced in the rotor. Presently there are two fluxes, one is stator flux, and another is rotor flux. The rotor flux will slack regarding the stator flux. Hence, the rotor will feel a force which will make the rotor to turn toward the pivoting attractive field. This is the working rule of both single and three-phase induction motors. It has just one phase still it makes the rotor to turn, so it is very fascinating. Prior to that, we need to know why a solitary phase induction motor is certainly not a self-turning over motor and how we beat the issue. We realize that the AC supply is a sinusoidal wave and it creates a throbbing attractive field in the consistently circulated stator winding. [3]

Since we can expect the throbbing attractive field as two oppositely turning attractive fields, there will be no resultant force delivered at the beginning, and thus the motor doesn't run. Subsequent to giving the stockpile, if the rotor is made to pivot one or the other way by an outer power, at that point the motor will begin to run. We can take care of this issue by making the stator twisting into two winding – one is the primary winding, and another is helper winding. We interface one capacitor in arrangement with the helper winding. The capacitor will have a phase effect when current courses through the two coils. When there is a phase distinction, the rotor will produce a beginning force, and it will begin to turn. Practically we can see that the fan doesn't pivot when the capacitor gets separated from the motor, however in the event that we turn with the hand, it will begin turning. That is the reason we utilize a capacitor in the single-phase induction motor. [4] Because of the different preferences of an induction motor, there is a wide scope of utilizations of an induction motor. Probably the greatest preferred position is their high productivity – which can go as high as 97%. The principle detriment of an induction motor is that the speed of the motor differs with the applied burden. The course of pivot of induction motor can without much of a stretch be changed by changing the phase succession of three-phase supply, i.e., if RYB is a forward way, the RBY will make the motor to turn backward bearing. This is on account of three phase motor, however in a solitary phase motor, the course can be switched by turning around the capacitor terminals in the winding.[4]

II. RELATED WORK

X. D. Xue and K. W. E. Cheng [5]This paper displays a control intend to actualize the essentialness hold assets of three-phase induction motors when they work under long stretch light-weight or little commitment extent load. The proposed plan relies upon the standard Of Variable Voltage Control (VVC) at steady speed. The essentialness sparing regulator for three-phase induction motors is made. A gathering of the tests show that the proposed plan offers rise to the noteworthy essentialness speculation reserves.

Y. N. Dementyev, N. V. Kojain, A. D. Bragin and L. S. Udut [6] The norms of execution of the control framework with sinusoidal PWM inverter voltage frequency scalar and vector control induction motor are examined. Assessments of direct control framework with sinusoidal PWM control framework and sinusoidal PWM control with an additional third-consonant sign and increment changed control sign are finished.

There are shown the most extraordinary adequacy and certifiable characteristics phase and line inverter yield voltage at the best plentifulness of the control signals. Proposals on the choice of supply voltage induction motor electric drive with frequency scalar control are presented.

W. Srirattanawichaikul and Y. Kumsuwan [7]This paper shows a Spasmodic Bearer Based Space Vector Pulsewidth Adjustment (CB-SVPWM) technique for three-phase voltage source inverter (VSI) sustained hilter kilter Two-Phase Induction Motor (TPIM) drives. The proposed change methodology relies upon the overall state of the zero-gathering voltage mixture signal yet to be determined signs for the drive's TPIM plot.

This technique engages to decrease the ordinary trading disasters of the force devices and improve the introduction of the TPIM. The practicality and execution of the proposed change strategy is checked through both reenactment and exploratory results, which are shown to give the capacity and strength of the proposed framework.

K. Iino, K. Kondo and Y. Sato [8]This paper deals with a control system and a structuring strategy for the capacitance of the compensation capacitor for a single phase to three phase lattice converters with the variable speed drive capacity of Induction Motors (IMs). Anticipating the utilization of railroad pulling powers, automobiles and lifts, motors drive inertial weight. In such cases, both the load power and the stack voltage increase in degree to the rotor speed. The adequacy of the compensation capacitor voltage is controlled to ingest the single phase power vacillation, close by the pile power. Makers propose a procedure to pick the data side boundaries, for instance, the capacitance of the compensation capacitor, pondering the data voltage and the force of the IM. Makers probably affirm that a singular phase to three phase MC can drive IMs with the proposed methodology.

B. Kimiaghalam, M. Rahmani and H. Halleh,[9]This paper shows a hybrid soft reasoning regulator with vector-control methodology for induction motors. The vector-control methodology has been improved by using FLC as opposed to an essential PD regulator. In this creamer regulator incredible rule is accomplished through utilization of the FLC, while trustworthiness of the framework during transient and around wide extent of working centers are ensured through usage of the vector-control. The cream regulator has been affirmed by applying it to a nonlinear model of the motor.

Q. Wu, L. Li, Y. Ache and Y. Wang[10] According to the rotor movement orchestrated interesting logical model from Induction motor, the speed can be assessed with simultaneous speed subject to the force current differential. Brushing with slip condition, in this paper we set up speed sensor less vector control arrangement of Induction motor with current hysteresis circle control inverter. The reenactment results exhibit that the control plan is authentic and the speed assessment plan is depicted by higher exactness, speedier incredible reaction execution and higher enduring accuracy.

L Chandrasekar, S Anbuchandran, Dr.R Sankar [11] There are various occasions where only two obvious speeds are needed with no additional cost to that of the motor like siphon , fan and windmill generator applications. In such applications VFD drives are not doable monetarily especially for gigantic rating of induction motors. At any rate Speed control by direct post changing best suit these applications. Speed control using shaft changing for 2:1 is an old thought (ensuing post technique) and is clear. For extents other than 2:1, the arrangement is jumbled. This endeavor is gotten ready for developing a 8/6/4 shaft changing induction motor not by minor circle reconnections. The system used for this is Sinusoidal Premodulation (PAM) Technique. By this procedure we can accomplish the ideal discrete rates/rating using single motor with direct shaft change drive part accordingly reducing the capital cost of theory on VFD drives and imperativeness getting a good deal on working cost of the all out system.

III. Proposed Work

V/F is contracted from voltage/frequency. V/F control is a selection motor control strategy which ensures the yield voltage comparing with the frequency, so it keeps up a consistent motor movement, turning away weak attractive and attractive submersion wonder from occurring. With variable voltage, variable repeat activity, any blend of voltage and repeat can be used to supply the motor, with the condition that activity should remain inside the limits of assessed voltage a frequency.AS was appeared with the fixed repeat notes, if the voltage drop over the stator is unessential in regard to the voltage drop over the charging reactance, it is reasonable to re-draw the indistinguishable circuit with the polarizing branch at the terminals of the circuit

Table 1 Comparison Pole Changing and

PoleChanging Method	VVVF Control Method
Pole Changing Method is one of the principle techniques for the speed control of an induction motor. This technique for controlling the speed by pole changing is utilized essentially for enclosure motor simply because the pen rotor consequently builds up various poles, which is equivalent to the poles of the stator winding.	A control strategy in which we can change the recurrence f, at that point it is conceivable to change the speed of induction motor. Presently recurrence of intensity supply can without much of a stretch be changed utilizing power hardware gadgets like inverter. The inverter changes over DC control into AC power and feeds to induction motor. Inverter yield might be either consistent voltage variable recurrence or variable voltage variable recurrence.
By and large pole machines will in general be the most proficient and as the pole number builds one requires more stator openings so sooner or later space turns into an issue in which case the stator distance across must increment and the length decline.	In this manner, by fluctuating voltage and recurrence, we can get diverse speed-torque qualities from a similar squirrel confine induction motor. This is on the grounds that we are in a superior position to control air hole transition which decides torque.

IV. IMPLEMENTATION AND RESULT ANALYSIS

The implementation of the proposed approach is done in Matlab

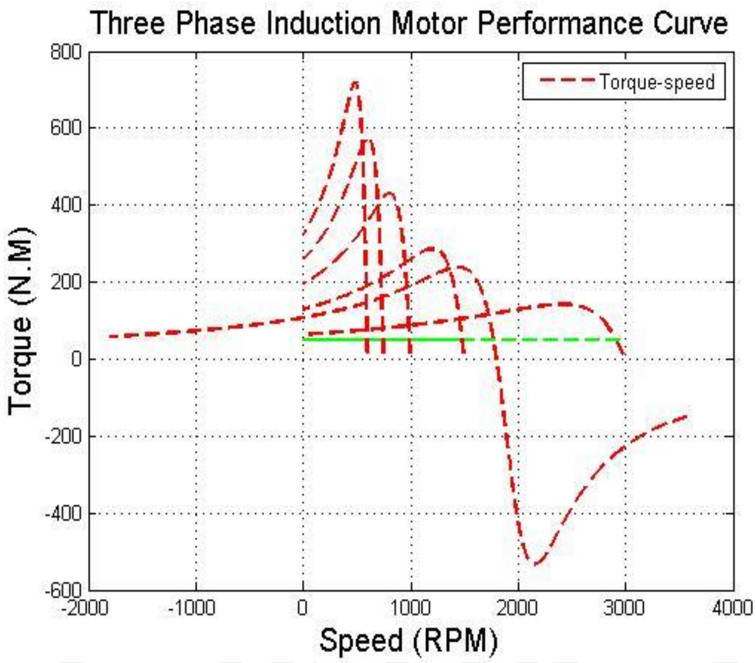

Fig 2 Three Phase Induction Motor Performance Curve

Fig 2 shows stator resistance= 0.641ohm ,stator reactance=1.106 ohm ,rotor resistance=0.332 ohm ,rotor reactance= 0.332ohm ,magnetizing reactance=26.3.

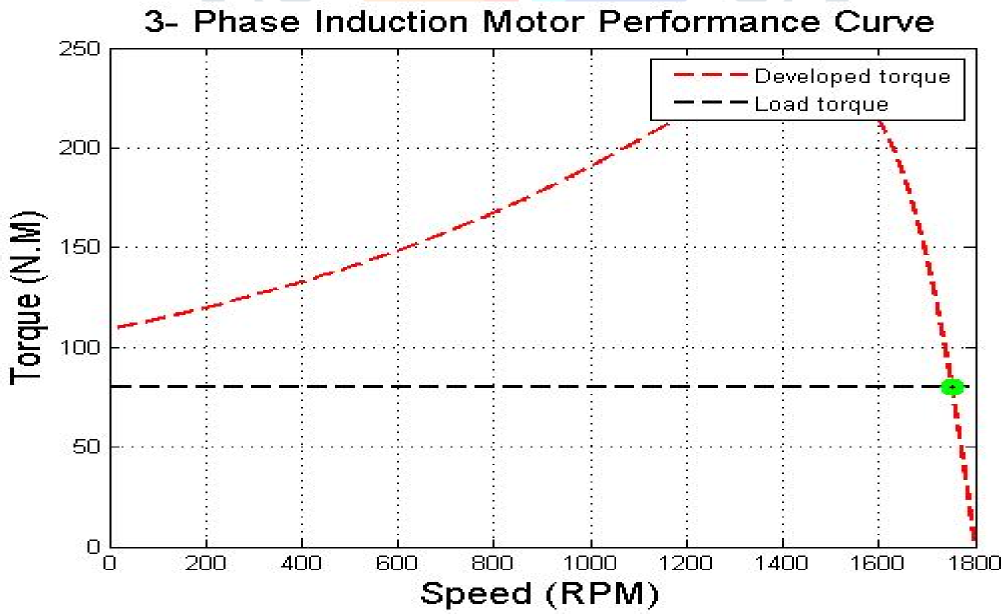

Fig 3 Three Phase Induction Motor Performance Curve With A Load

The Fig 3 ,stator resistance= 0.641ohm ,stator reactance=1.106 ohm ,rotor resistance=0.332 ohm ,rotor reactance=.464ohm ,magnetizing reactance=26.3.

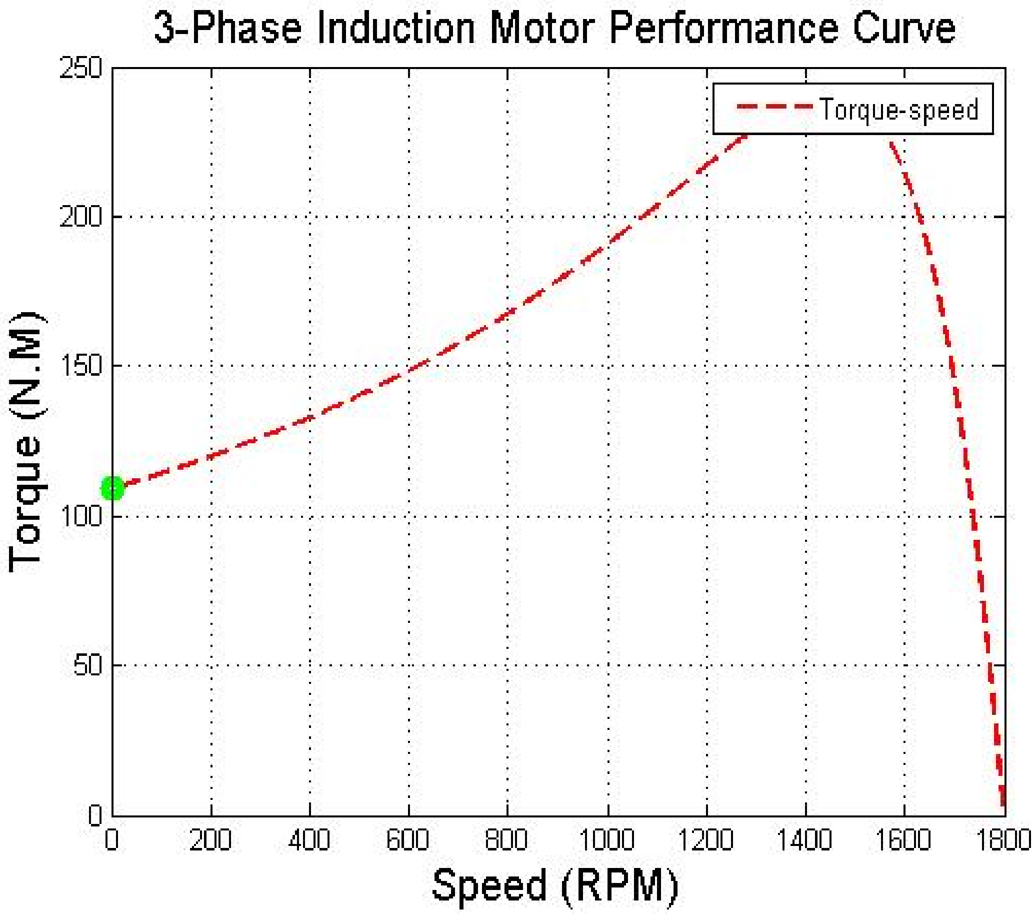

Fig 4 Three Phase Induction Motor Performance Curve With Maximum Torque

Fig 4 performance analysis are as follows, stator resistance= 0.641ohm ,stator reactance=1.106 ohm , rotor resistance=0.332 ohm ,rotor reactance=.464ohm ,magnetizing reactance=26.3.

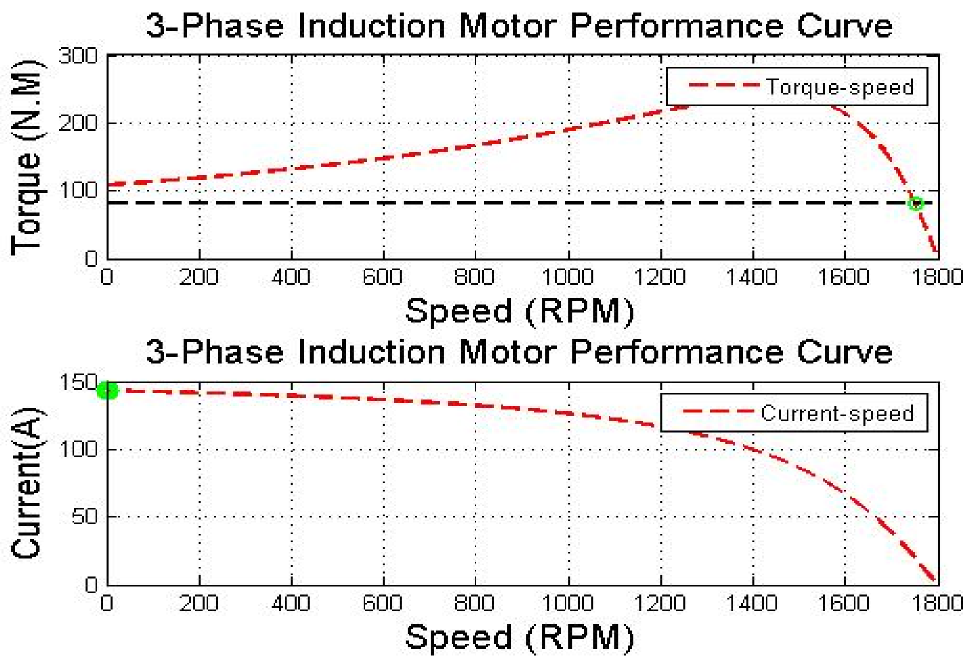

Fig 5Three Phase Induction Motor Full Load

Fig 5 shows performance analysis are as follows, stator resistance= 0.641ohm ,stator reactance=1.106 ohm , rotor resistance=0.332 ohm ,rotor reactance=.464ohm ,magnetizing reactance=26.3.

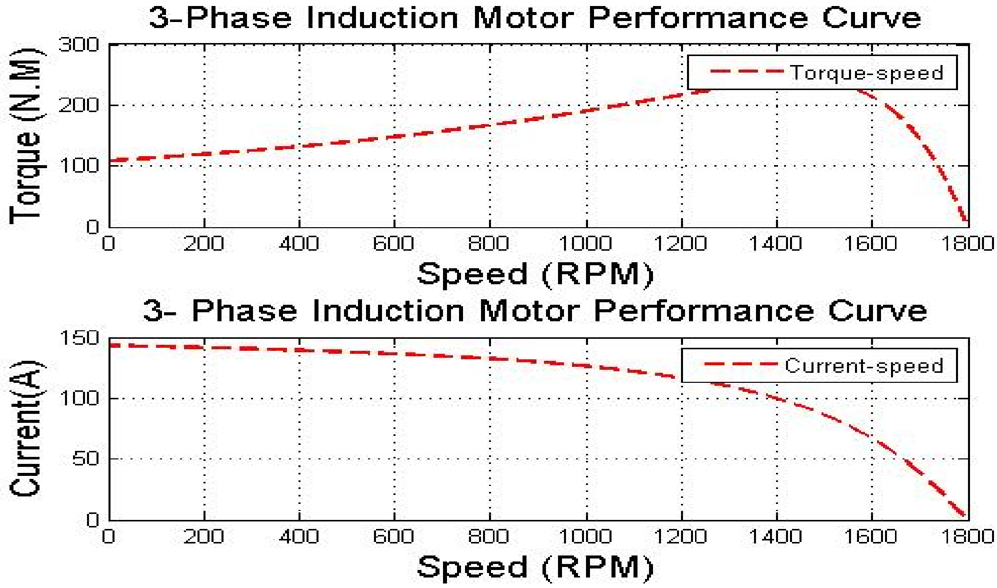

Fig 6 Three Phase Induction Motor Torque - Speed Curve & Current - Speed Curve

Fig 6 shows performance analysis are as follows, stator resistance= 0.641ohm ,stator reactance=1.106 ohm , rotor resistance=0.332 ohm ,rotor reactance=.464ohm ,magnetizing reactance=26.3.

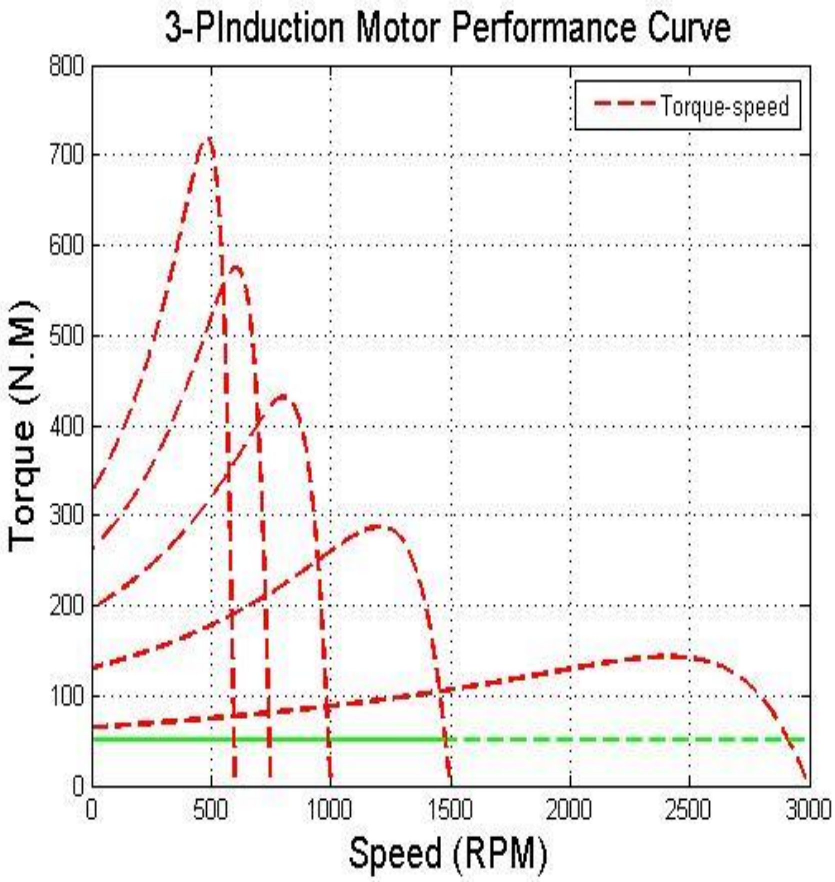

Fig 7 Three Phase Induction Motor Speed Control using the Pole Amplitude Modulation

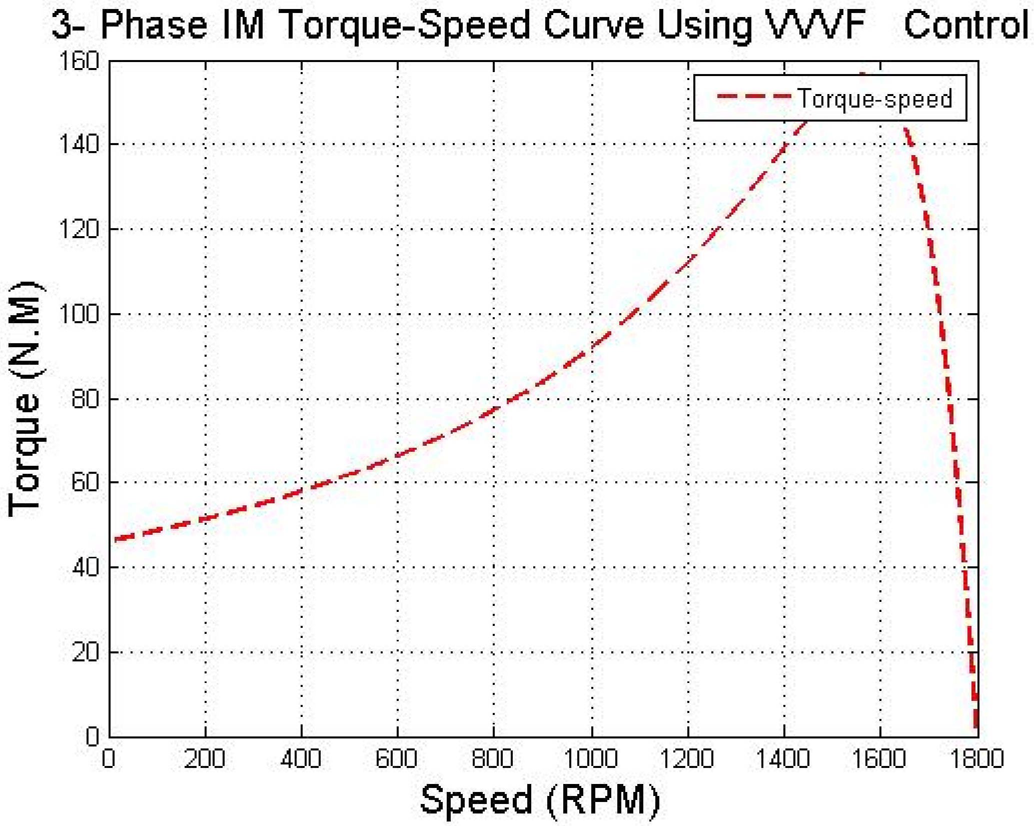

Fig 8 Result Case I

The result obtained with the case of f=60, the resultant torque and slip values are as follows,

Maximum Torque: 156.5468

Slip for Maximum Torque: 0.1299

The other settings are,

Stator Resistance= 0.66 Ohm

Stator Reactance=1.14 Ohm

Rotor Resistance=0.38 Ohm

Rotor Reactance=1.71 Ohm

Magnetizing Reactance=33.2

Base Synchronous Speed= 1800 rpm

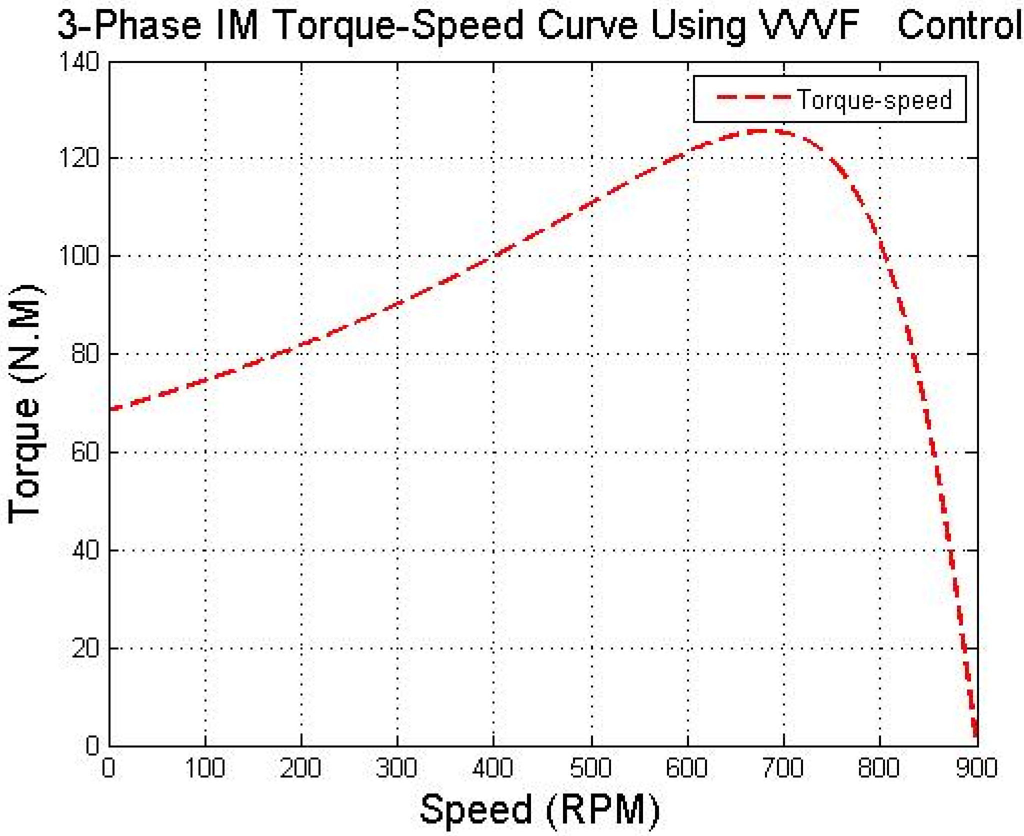

Fig 9 Result Case II

The result obtained with the case of f=60, the resultant torque and slip values are as follows,

Maximum Torque: 156.5468

Slip for Maximum Torque: 0.1299

The other settings are,

Stator Resistance= 0.66 Ohm

Stator Reactance=1.14 Ohm

Rotor Resistance=0.38 Ohm

Rotor Reactance=1.71 Ohm

Magnetizing Reactance=33.2

Base Synchronous Speed= 1800 rpm

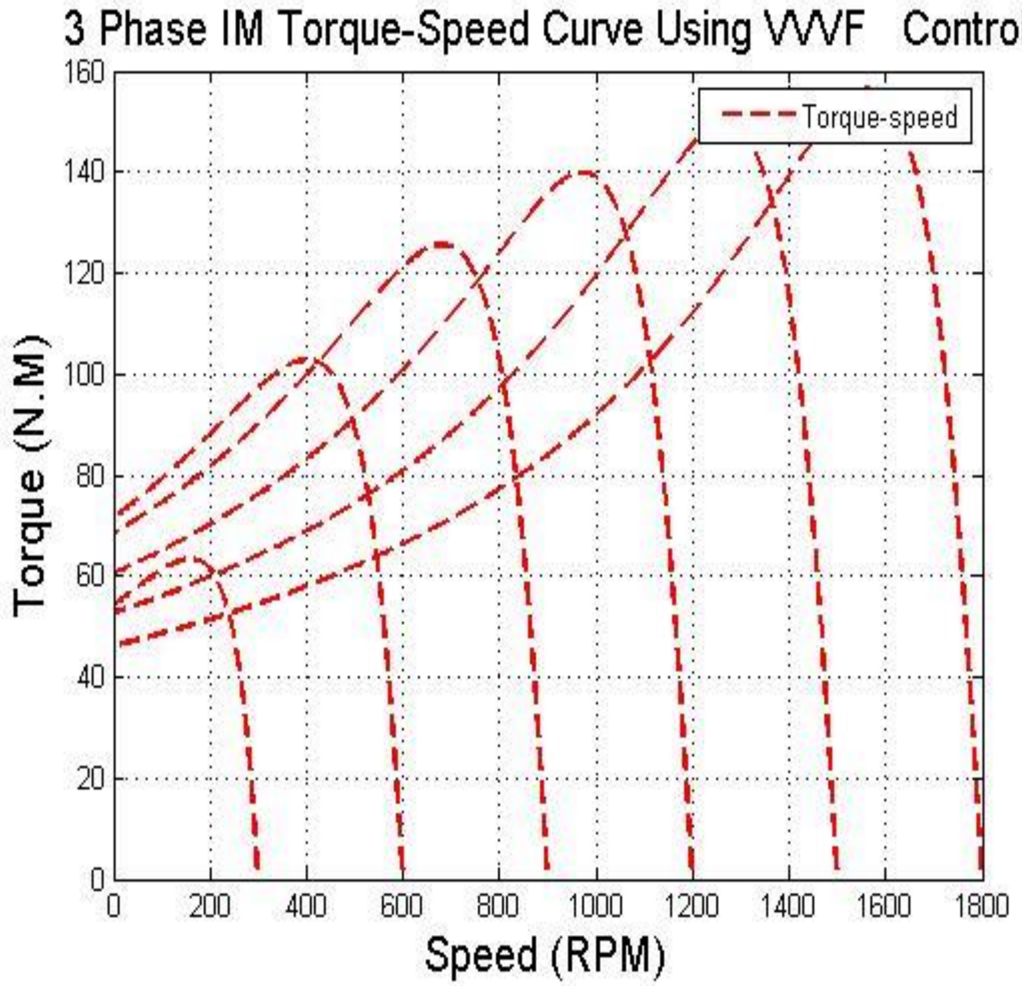

Fig 10 Result Case III

The result obtained with the case of f varying for 10 to 60, the resultant torque and slip values are as follows,

The other settings are,

Stator Resistance= 0.66 Ohm

Stator Reactance=1.14 Ohm

Rotor Resistance=0.38 Ohm

Rotor Reactance=1.71 Ohm

Magnetizing Reactance=33.2

Base Synchronous Speed= 1800 rpm

V. CONCLUSION

VVVF represents Variable Voltage Variable Frequency. VVVF Speed Control technique is broadly utilized strategy for Induction Motor. Thus on the off chance that we can change the frequency f, it is conceivable to change the speed of induction motor. Presently frequency of force supply can undoubtedly be changed utilizing power gadgets like inverter. The inverter changes over DC power into AC force and feeds to induction motor. Inverter yield might be either consistent voltage variable frequency or variable voltage variable frequency. The proposed work simulates the 3-Phase Induction motor power control using VVF method.

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