JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# Simulation of VVF Control on 3-Phase Induction Motors

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***Abstract :*** An induction motor can be an AC motor that converts current into magnetic fields to produce torque (and therefore, speed). It is an efficient motor that has widely been used in many industries and homes. An induction motor is an AC motor that utilizes electromagnetic induction to generate torque from a rotating gravitational field. The rotor will either be a squirrel cage or a squirrel cage, depending on the motor setup. The VVF rule is to create circuits that are voltage generators but has a frequency coefficient. The capacitance is changed when the voltage is adjusted, so it matches the control frequency of the circuit to change its oscillation. The VVF system prevents over- or under-heating of motors by adjusting the frequency and boost voltage to match the needs of different applications.

***Index Terms* – Induction Motor , 3-Phase Induction Motor , Electromagnetic Induction**

## I. INTRODUCTION

In an induction motor, the electric current in the rotor needed to produce torque is created via electromagnetic induction from the magnetic field of a stator winding. The rotor of an induction motor can be a squirrel cage or wound type. Induction motors are called 'asynchronous motors' as they operate at a speed less than their synchronous speed. The synchronous speed is how fast the magnetic field spins on a rotary machine. With an induction motor, it always runs slower than it synthesizes speed. [1]

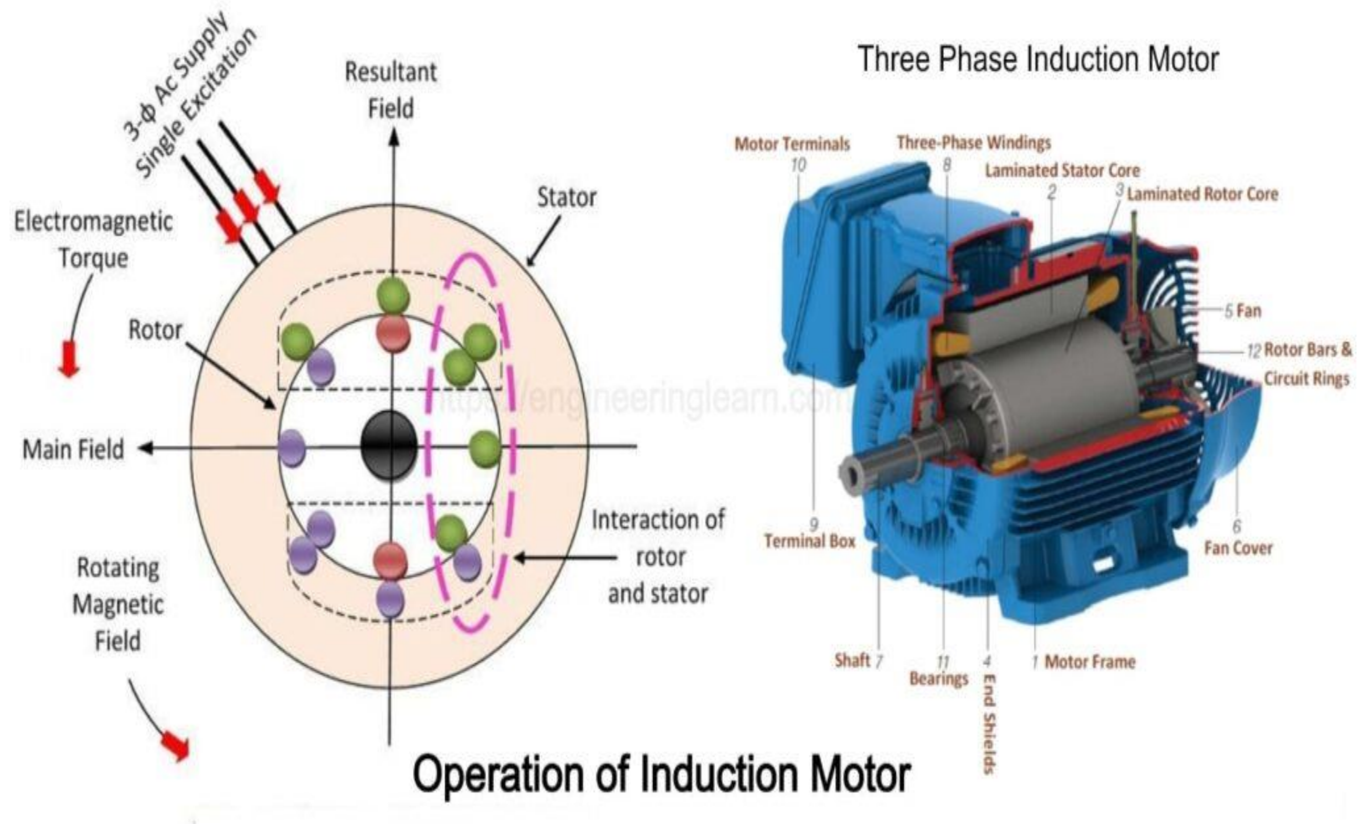



Fig 1. Induction Motor

In a rotating magnetic field, the lag between the flux current in the rotor and the flux current in the stator will cause the rotor to never reach its rotating magnetic field speed. There are two different types of induction motors- single phase and three phase. Single phase induction motors require only a single input supply and three phase induction motors require at least three inputs. [1]

A single-phase induction motor will not self-start a system. A three-phase induction motor, on the other hand, is capable of self-starting. To operate a DC motor, you provide power to the stator and to the rotor as well. An induction motor only needs one supply, which is why this type of motor is intriguing. [2]

Electricity takes the form of magnetic flux when it flows through a coil. The magnetic fields caused by flow of electricity in a coil causes the other coils to be short-circuited, which can transform mechanical energy into electrical energy (short-circuit is also conducting an electric current, and then this circuit will get broken). Due to the flux caused by the stator as it cuts across the short-circuited coil in the rotor, current starts flowing through the coils of the rotor. The flux from this current is what generates more flux in the rotor.[2]

There are now two types of flux. One is stator flux, which is leading, and the other is rotor flux, which is lagging.

A torque will be felt because of the rotation of magnetic field, and this will cause the rotor to rotate towards it. This is the way a single phase, three-phase motor operates. Each of the three phases has a 120 degree phase difference, and will rotate the rotating magnetic field. This causes the rotor to move. When an electric current is applied to the rotor, it will be attracted to one of the 3 winding coils. When that coil gets magnetized, the rotor will move towards that coil and then be repelled by the other ones. [3]

## II. Literature Survey

J. Thomas and A. Hansson[4] Researchers show that Enumerative Nonlinear Model-Farsighted Control is better than standard farsighted control for maintaining a vehicle's speed. This paper shows that by including an observer for fundamental activity, an AI can become smarter and accomplish better. The observer follows properties and offers efficient control. With the design of this fast power control, it is possible to perform better than with field-planned control. In the paper, it was also shown that by using a frequently changing confirm table, the drive execution can be improved more.

L. M. Child and SalithaK[5] L.M. Child and SalithaK proposes a new type of speed control for z source converter with DC interface voltage control, which is basically an AC/DC converter. This would help in designing the power conditioning system in automobiles, as well as other types of electric applications. Voltage Source Inverter can offer better speed control and drive tasks.

M. M. M. Negm, J. M. Bakhashwain and M. H. Shwehdi[6]A three-stage induction motor, or IM, has an ideal control structure that is decentralized and can be sped up or slowed down. The aforementioned system does this by blending the decentralized ideal IM model with various centrally controlled models to find a balance for speed. The Integrated Model Machine optimizes a synchronous reference graph that is executed using the Vector System.

A. H. Ahmad and A. Abbawi [7] used an adaptive single stage enlistment engine for their family and organization applications. The current study addresses the assessment of a speed control for an LSA engine. There are several possible ways to control the speed of an engine: voltage limitation, regenerative system and regenerative to voltage limitation, which is commonly used in this application. By far, the most common problem found with past methods has been slow speeds and starting issues.

Besides that, the capabilities of these engines are low compared to the proposed procedure. For this reason, we propose a novel technique for the regulator plan that prepares the optimal characteristics for recurrence and voltage for any reference speed. All of the circles in an open-circle framework are analyzed, then the result is shown. With a finite amount of circles, it follows that the real time period is following the best time period and the yielding between the actual pace and the reference velocity is sufficient (under 2%).

T. S. Radwan[8] The proposed regulator manages the issue of nonlinearities and boundary arrangements of acceptance engine with a modest amount of computation. Unlike regular cushioned reasoning regulators, this proposed regulator is much less demanding computationally. The quick force control plan of enlistment engine is first introduced. By then, the foreordained standards and their enlistment components of the proposed feathery framework are addressed. The regulator is shown to be solid, and inherently flexible in nature. The results show that it is sufficient.

Kuo-Kai Shyu, Li-Jen Shang, Hwang-Zhi Chen and Ko-Wen Jwo[9] The speed control of Direct Torque Controlled (DTC) motors relies on the attainability of fostering stator changes. Regardless, low speeds can be annoying and voltage drops are tantamount to upper stator voltages across the obstruction.

J. Ko, J. Choi and D. Chung[10] proposed a novel design for a navigation system that uses a neural framework regulator using soft control and neural frameworks planer. This regulator uses the back-multiplication procedure to assess the tradeoff between the desired response and the actual reaction.

This can be used to restrict how much of each signal there is. A system was used by scientists where they used a machine learning algorithm to make an AI system that would adapt and change like robots do in the sci-fi movies. The stability of the Cessna 208 is tested under various working conditions and is proven to be accurate and fast.

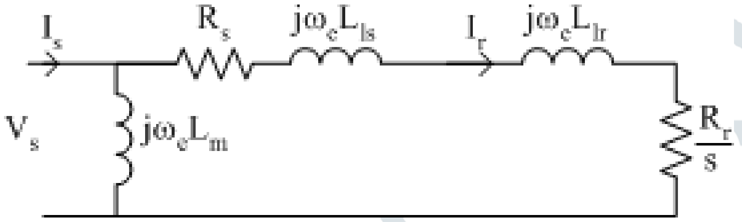
Y. Luo and C. Lin[11] An analysis of a MRAS (model reference adaptable system) for the selection of the sensorless controlled motor drive was a result. The trend of MRAS is the integration of flexible efficient devices instead of these commonly used traditional ones. The program and assignments are done with MATLAB programming and Simulink, which help to do the the research. Fundamental operations, such as reenactment, and entertainment give deeper insight into the MRAS based overviewed speed techniques that can be used.

L Chandrasekar, S Anbuchandran, Dr.R Sankar [12] This paper is about a technical approach to reduce the amount of time spent changing over an electrical motor. Specifically, it works to match the frequency of a rotating engine with that on stator, lengthening the process from hours to minutes. Using a single motor means we can cut the cost of electricity and have a more efficient system overall..

### III. PROPOSED WORK

## VVVF control

"With variable voltage, variable repeat movement, any blend of voltage and repeat can be used to supply the engine, with the condition that action should remain inside the limits of assessed voltage a frequency.AS was displayed with the fixed repeat notes, if the voltage drop over the stator is insignificant 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."




Analysis of the circuit leads to the following torque equation

$$\tau = 3\frac{p}{2}\frac{R_r}{\omega_{sl}}\frac{V_s^2}{\left(R_r+\dfrac{R_r}{s}\right)^2 + j\omega_e^2\left(L_{lr}+L_{ls}\right)^2}$$

"Presently, going above and beyond, in the event that the charging voltage is near the stator supply voltage, at that point the stator opposition can be ignored from the torque conditions:"

$$\tau \approx 3\frac{p}{2}\frac{R_r}{\omega_{sl}}\frac{V_s^2}{\left(\dfrac{R_r}{s}\right)^2 + \omega_e^2\left(L_{ls}+L_{lr}\right)^2}$$

$$\tau \approx 3\frac{p}{2}\frac{R_r}{s\omega_e}\frac{s^2\omega_e V_s^2}{R_r^2+s^2\omega_e^2\left(L_{ls}+L_{lr}\right)^2}$$

$$\tau \approx 3\frac{p}{2}\left(\frac{V_s}{\omega_e}\right)^2\frac{\omega_{sl}R_r}{R_r^2+\omega_{sl}^2\left(L_{ls}+L_{lr}\right)^2}$$

"Examining the torque condition over two can be made:"

- "Supply voltage over supply recurrence is around equivalent to motion. In this manner, if the apportion V/f is held steady, transition will be around consistent"
- "If slip is little, the torque condition lessens to"

$$\tau \approx \frac{p}{2}\frac{3}{R_r}\psi^2\omega_{sl}$$

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**IV. PROPOSED CONCEPT**

Simulation Conducted in MATLAB

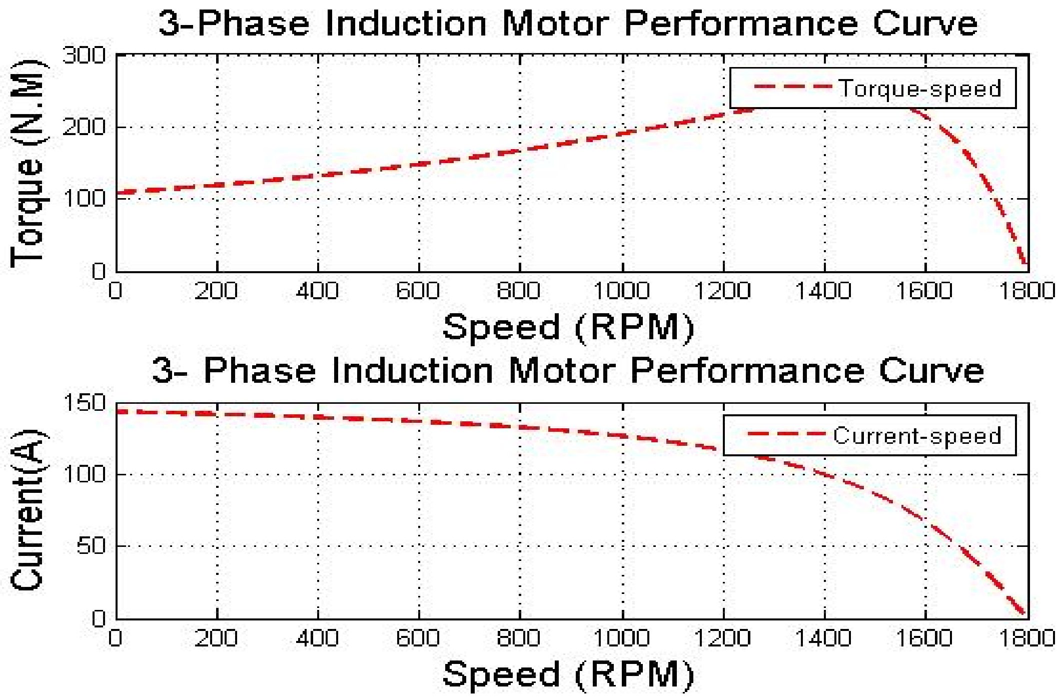


Fig 2. Torque and Current

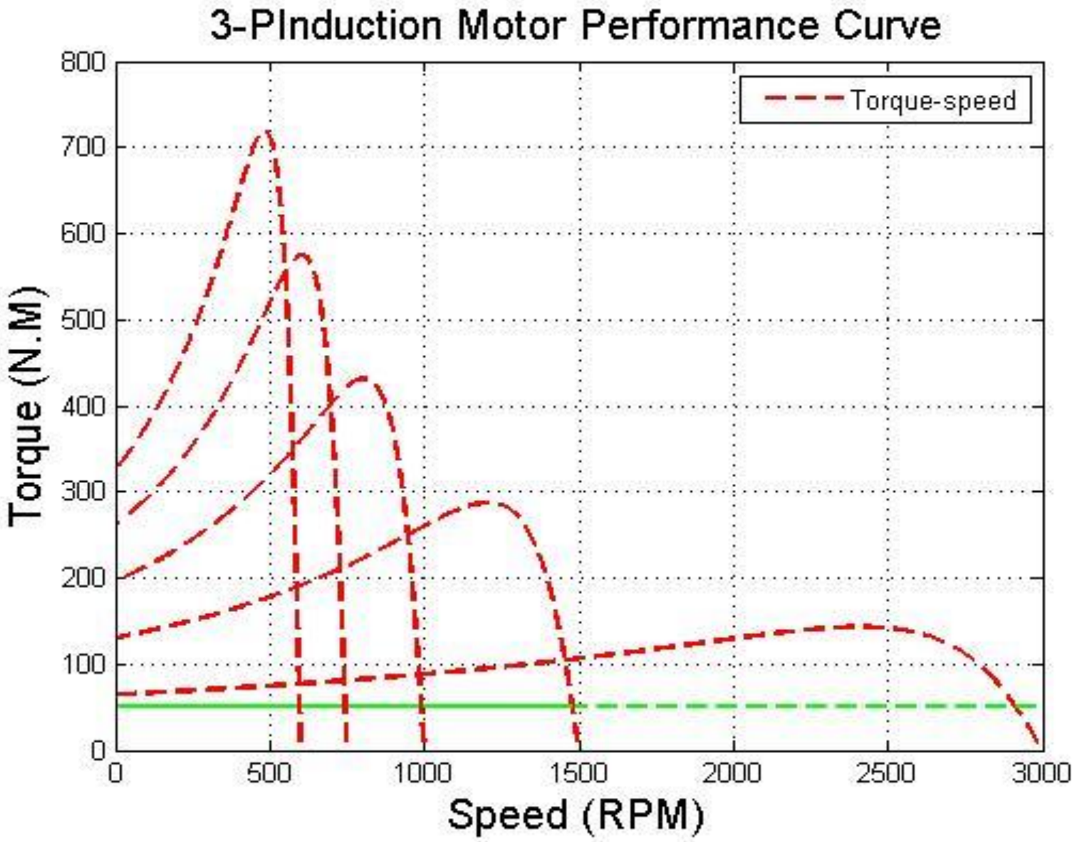


Fig 3. Pole Amp.

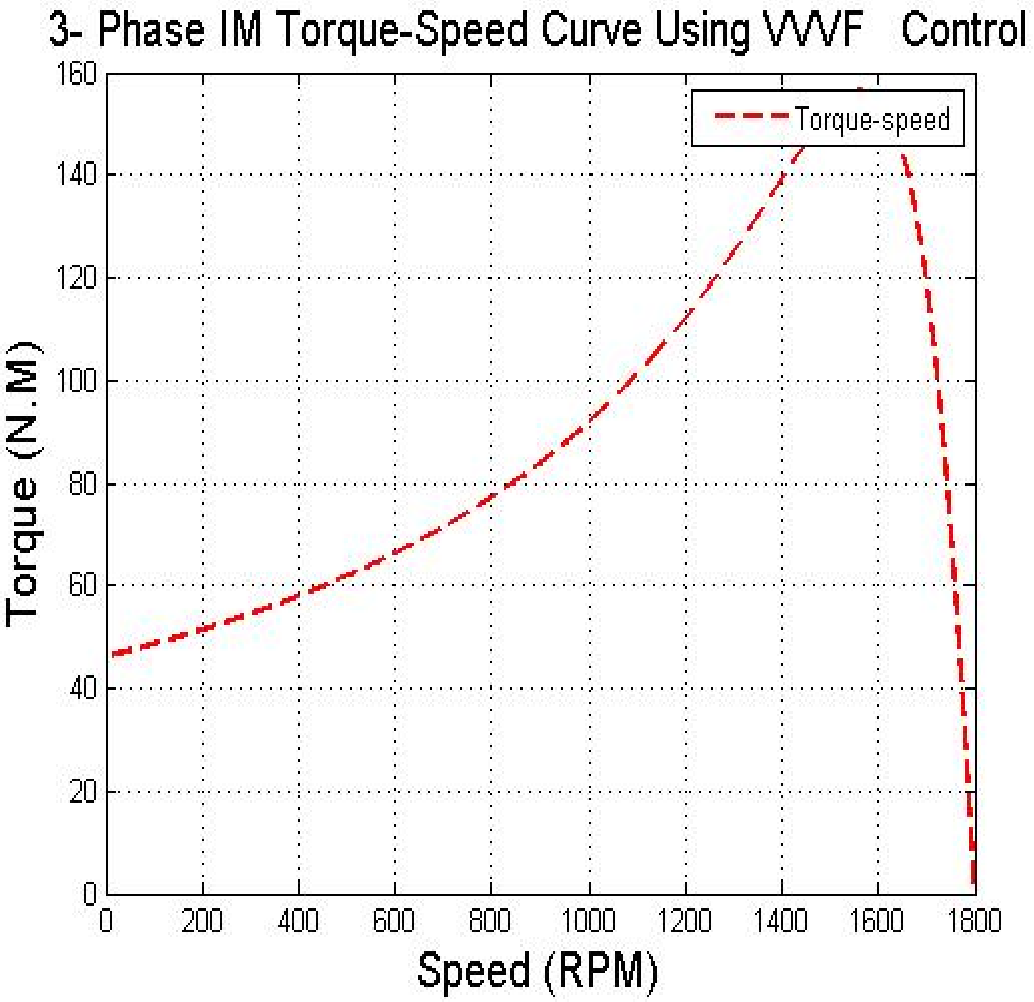


Fig 4. VVF Concept

Table 1. Base And Proposed VVVF Approach

| Pole Changing Method | VVVF Control Method |
|---|---|
| "Pole Changing Method is one of the rule procedures for the speed control of an induction motor. This procedure for controlling the speed by pole changing is used basically for nook motor essentially on the grounds that the pen rotor thusly develops different poles, which is identical to the poles of the stator winding." | A control system in which we can change the repeat f, by then it is possible to change the speed of induction motor. By and by repeat of force supply can without a very remarkable stretch be changed using power equipment contraptions like inverter. The inverter changes over DC control into AC power and feeds to induction motor. Inverter yield may be either reliable voltage variable repeat or variable voltage variable repeat. |
| All things considered pole machines will overall be the most capable and as the pole number forms one requires more stator openings so eventually space transforms into an issue wherein case the stator distance across must addition and the length decline. | In this way, by fluctuating voltage and repeat, we can get different speed-force characteristics from a comparative squirrel bind induction motor. This is in light of the fact that we are in a better situation than control air opening change which chooses force. |

## V. Conclusion

The **VVF** rule is to create circuits that are voltage generators but has a frequency coefficient. The capacitance is changed when the voltage is adjusted, so it matches the control frequency of the circuit to change its oscillation. The VVF system prevents over- or under-heating of motors by adjusting the frequency and boost voltage to match the needs of different applications.

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