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

Review on Speed Control Methods Of Induction Motor

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Abstract: *Induction motors are generally fixed-speed motors that do not operate at synchronous speeds. Mechanical loads in industries should not only be driven but they should also be driven at the desired speed. As a result, speed control methods for induction motors are required. There are several methods for controlling the speed of a motor with induction. The purpose of this paper is to review the literature on various speed control methods and their performance based on SPWM Inverter, harmonics reduction, and speed-torque characteristics to analyze the most effective techniques when harmonics are present, as well as the minimization of odd harmonics via an inverter.*
Keywords: *Induction Motor, VSI, PWM, MLI.*

I. INTRODUCTION

Induction automobiles with three stages are the maximum normally used for business manipulation and automation. They are frequently known as the workhorse of the motion industries due to their robustness, dependability, low upkeep, and high durability [1]. Induction Motor (IM) Control Techniques Variable frequency management techniques in IM have been classified: as scalar management and vector manipulation methods. V/F manage is some other name for scalar manage. The shape is simple, and its miles are normally used without speed comments. However, due to the fact, that the stator flux and torque are not directly controlled, this controller no longer achieves correct accuracy in each velocity and torque response [3]. The primary intention of this control approach, as with one after the other exited DC machines, is to govern the torque and flux; that is carried out through selecting a d-q rotating reference frame synchronously with the rotor flux area vector [4]. A voltage source inverter (VSI) must have a stiff voltage supply at the entrance, preferably with a zero Thevenin impedance. If the voltage source isn't stiff, a large capacitor can be linked to the input. (VSI) are electricity bridge devices with 3 output legs, each with two strength switches and two freewheeling diodes; the inverter is powered with the aid of a DC voltage source (either a battery or a diode-based bridge rectifier) via an LC or C filter [5]. The Space Vector Pulse Width Modulation (SVPWM) technique is a computationally intensive PWM method that may be the exception of all PWM techniques for variable frequency drive packages. When compared to different products, it has a high dc-bus voltage utilization and a low general harmonic distortion (THD). In the linear modulation range, SVPWM is greater suitable for virtual implementation and may grow the conceivable maximum output voltage with most line voltages coming near 70.7% of the DC hyperlink voltage [6]. In this paper, SVPWM is used to manipulate the PWM. A contrasting look at of the speed manipulating car's induction motor using V/F scalar vector and PI controllers is also shown. Many strategies, consisting of the scalar controller (V/F) and vector controller (Field orientated manage and direct torque manage) by the usage of a PI, clever controller, and so forth, may be used to improve the overall performance of an induction motor pressure. This section introduces a historic review of preceding studies on controlling the induction motor controller. Pabitra Kumar Behepresent, 2014[7] describes the design and implementation of a scalar control of an induction motor. This method allows you to control the frequency and amplitude of the stator voltage of an induction motor, resulting in a consistent V/F ratio. It also includes a contrast of open loop and closed loop V/F control induction motors. V/F manipulation is based on the emergence of stator voltage derivatives. Experiments and effects display that closed-loop V/F management of an induction motor gives better response and consequences than open-loop V/F control. The proposed Variable Voltage-Variable Frequency (V/F) base torque-speed control of a 3-phase induction motor fed with the aid of a PWM Voltage Source Inverter via Jay R. Patel and S.R. Vyas, 2014[1] could be simulated. The PWM approach shall be used, which includes modulating a conventional sinusoidal reference sign and a triangular provider to supply pulse width modulated output alerts which might be applied to Power Electronic Switches of a 2-Level Voltage Source Inverter driving a Three Phase Induction Motor. The performance of a three-segment induction motor fed by a PWM voltage supply inverter is simulated in terms of inverter segment modern, rotor and stator contemporary, velocity, and electromagnetic torque developed by using the inverter.

The simulation outcomes show the overall performance and efficiency of a regular V/F induction motor drive. The actual velocity is determined via the reference speed, and changes in velocity from high to low and coffee to high purpose modifications within the voltage and modern-day profiles. Nikhar Patel, and Devraj Jee, 2013[8] gift the need for Speed Control in Induction Motors. The most adaptable has been demonstrated to be V/F Control. The normal implementation scheme for V/F manipulation has been presented. The PWM Inverter is a primary requirement of this scheme. PWM Inverters have been modeled in this, and their outputs have been fed to the Induction Motor drives. The induction motor's uncontrolled brief and steady-state responses had been obtained and analyzed. A MATLAB code was written to successfully implement open-loop V/F control on a PWM-inverter-fed three-phase induction motor, and the torque become determined to be consistent across an extensive range of rotor speeds. It was observed that using a Closed-Loop scheme with a Proportional Controller provided a far superior approach to controlling an induction motor's speed even as maintaining a consistent most-speed torque.

II. LITERATURE REVIEW

M. H. Nehrir proposed a technique for controlling the rate of a three-phase induction motor using stator voltage management [19]. A. Munoz-Garcia proposed and analyzed a control scheme based totally on the well-known consistent volts in keeping with the hertz (V/f) method, which hired low-price open-loop modern-day sensors [20]. S.Doki et al. Proposed two techniques: slip frequency management, oblique vector control, and direct vector manipulation [25]. B.N. Singh et al. Proposed a complete analysis of a vector-controlled induction motor force using a sliding mode velocity controller primarily based on fuzzy common sense [32]. Bor-Ren Lin proposed a way for a three-section ac/dc/ac converter with a strength factor pre-regulator to enhance strength first-class on the entry side and a pseudo-random noise generator to lessen emitted acoustic noise and mechanical vibration for an ac/dc/ac converter induction motor drive [35]. Jae-Ho Choi et al. Proposed an indirect cutting-edge manipulation scheme for a PWM voltage supply converter [36]. G. Ivensky et al. Proposed ZCS collection resonant converters [37]. J.S.Lai et al. Proposed an induction motor force based totally on a progressed excessive-frequency resonant DC link inverter [39]. P.N. Enjeti et al. Proposed a manipulated approach to enhance the performance of a PWM AC to DC converter under unbalanced operating conditions [40]. José R. Rodrguez et al. Proposed regenerative rectifiers with reduced input harmonics and progressed energy aspect [43]. R.Ghoshet al. Proposed a split-capacitor topology for controlling a four-twine rectifier system. [44]. H. Fujita et al. Proposed and analyzed unified electricity satisfactory conditioners (UPQCs), which purpose to combine collection-energetic and shunt-active filters that catch up on voltage flicker/imbalance, in addition to reactive energy conditioners.

2.1 Literature Review Summary

Sr. No.	Author's Name	Converter	Method/Techniques	Performance
1	M. H.[19] Nehrir	3 Phase SPWM Inverter	Stator voltage control &Sine wave Variac voltage control	Speed of IM torque of IM
2	A. Munoz-garcia [20]	PWM Inverter	V/F method using Open loop current sensor with stator resistance drop and slip frequency	Stator current
3	S.Doki [25] et	SPWM Inverter	Indirect and direct vector control	All Performance Parameters of IM

	al		technology	
4	B.N. Singh etal [32]	SPWM using CSI	Vector controlled Technology with fuzzy logic	Speed of IM
5	Bor-online [35]	PWM Three phase ac/dc/ac converter	Space vector modulation with hysteresis current control	Power quality Acoustic noise Resonant vibration Reduction of torque
6	Jae-Ho Choi et[36]	PWM using VSI	Indirect & direct current control	Sinusoidal line current unity power factor ripple-free DC output voltage
7	Ivensky G. Et[37]	3 phase inverter	ZCS series resonant	Series resonant power converters RMS current
8	J.S.L et al. ai [39]	3-phase DC link inverter.	High-frequency resonant	Voltage overshoot Zero crossing failure problems
9	P.N. et Enjeti al. [40]	PWM AC-to-DC power converter	Under unbalancing and balancing conditions	Reduce lower- abnormal order harmonics
10	José R. Rodríguez, e tal. [43]	PWM AC-DC-AC power converter	Current harmonics injection method	Reduced input and harmonics improved power factor
11	R.Ghosh et al.[44]	Single-carrier-based & CSPWM Star connected rectifier system	Split-capacitor topology.	Peak-to-peak neutral current ripple
12	H. Fujita et al.[48]	UPQC	Different types of filters Two closed loop PI controllers	Voltage imbalance, Reactive power, current& Negative sequence harmonics.
13	Y.Pal et al. [50]	UPQC	Series-active filter and shunt-active filter	Power factor correction, Voltage regulation, Voltage and current harmonics mitigation, Mitigation of voltage sag, swell, and voltage dip
14	This Paper	SPWM and Five Two Level Inverter	Vector Control	Constant Speed with Constant Torque, Variable speed with Constant Torque, Comparison in THD

III. PROBLEM IDENTIFICATION

The issue is that terminal voltage has a restrict that, if handed, harms insulation and motor operation. The major drawback of the rotor resistance technique is its low efficiency because of additional losses because of resistance.

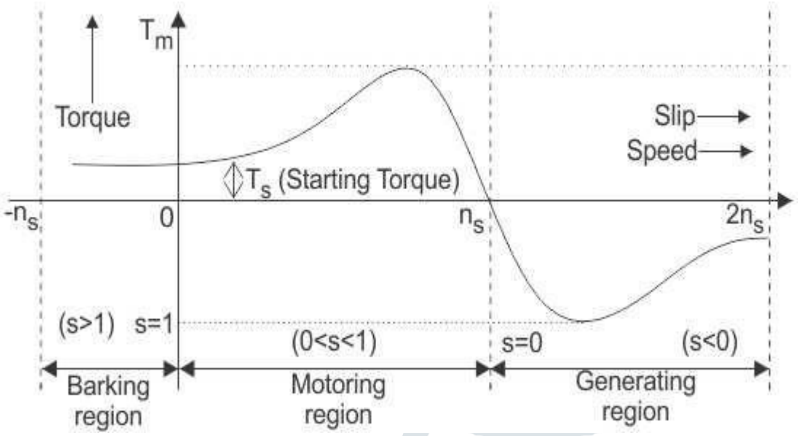

Fig.1 Speed Torque Characteristic for Induction Motor

The figure above depicts the IM speed torque characteristic. There are three regions shown in this namely the braking region, the motoring region, and the generating region.

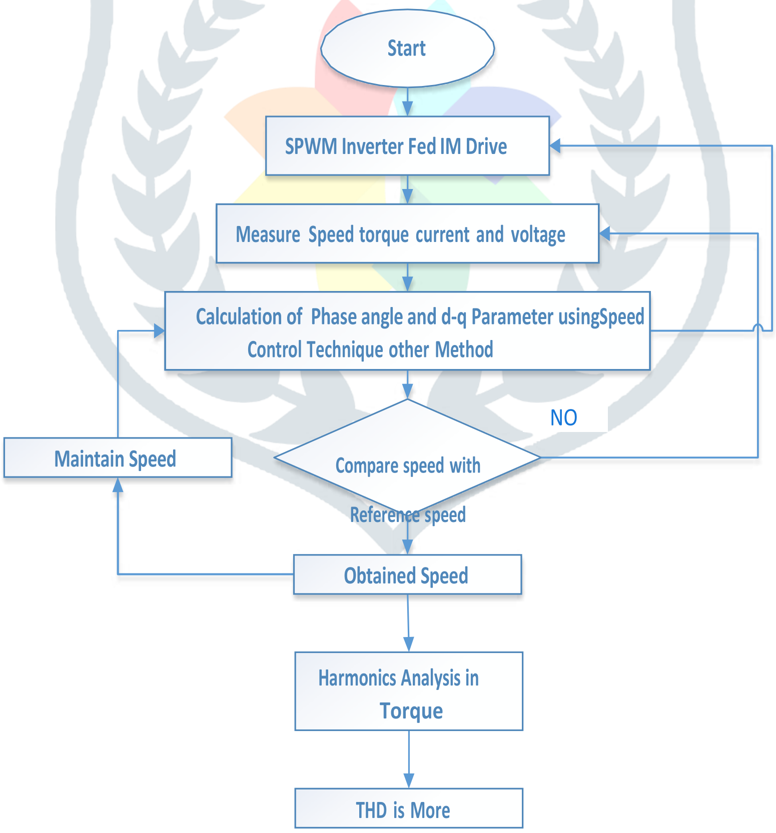

Fig.2 Flow Chart of Problem Identification

This waft chart depicts how to manage the velocity of an induction motor force and some methods for dealing with numerous styles of issues which are dynamic parameters as well as a slower-order harmonics factor in torque. Because of lower-order harmonics components, automobiles are unreliable for prolonged periods.

IV. PROPOSED METHODOLOGY

Vector Control or Field Orientated Control (FOC)

Figure four depicts the block diagram of the proposed manipulation scheme. Under step modifications in pace and load, the inverter controls the speed of the SCIM. The following is the manipulation scheme for the two-level SPWM inverter.

The squirrel cage induction motor force with vector or discipline-oriented manipulation presents high dynamics performance, and the closed-loop manipulation related to this derive ensures the system's lengthy-term stability. Induction Motor drives are utilized in a wide range of high-performance commercial and manner management programs. The motor velocity in excessive-performance pressure structures needs to intently observe a distinct reference trajectory regardless of load disturbances, parameter versions, or model uncertainties. Field-orientated manipulation of induction motor (IM) power is used to reap high overall performance. The controller layout of any such gadget, however, is crucial to device performance.

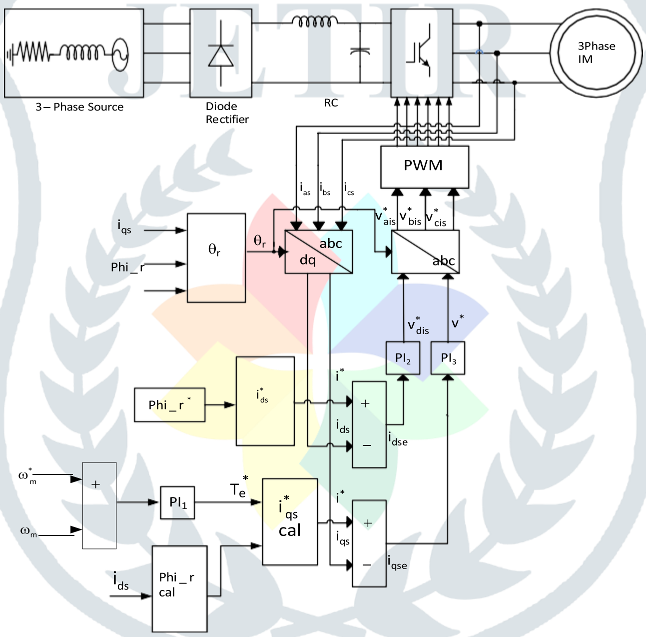

Fig.4. Block Diagram of Vector Control of SCIM

The decoupling traits of vector-controlled IM are harmed through motor parameter modifications. As a result, vector control is also known as an unbiased or decoupled control.

V. CONCLUSION

This paper presents an assessment of the literature on diverse authors' works on various strategies used for velocity management of IM drives, thru a literature survey and overview approximately pace management of induction motor various problems of their method such as speed versions, present-day and voltage ripple, or harmonics via scalar manipulate strategies. This paper describes the numerous troubles encountered in controlling IM due to complex controlling circuitry, as well as the proposed method) and compares specific pace control strategies.

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