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Using HBCC System Power Factor Correction of Three-Phase PWM AC Chopper Fed Induction Motor Drive System

Chaitra N. Panat[1], Kalpesh M. Mahajan[2]

PG Student [EPS], Dept. of EE, KCES'S College Engineering and IT, Jalgaon, Maharashtra, India[1]

HOD, Dept. of EE, KCES'S College Engineering and IT, Jalgaon, Maharashtra, India[2]

ABSTRACT: In this project I am going to improve Power Factor Of Three-Phase PWM AC Chopper supplied Induction Motor Drive System Employing HBCC Technique. The primary objective of the prospective control scheme is to gain input power factor improvement of the IM drive system under different operating conditions. PFI is obtained by frequently forcing the actual three-phase supply currents with the corresponding reference currents, which are developed in phase with the supply voltages, using hysteresis band current control (HBCC) technique. The planned ac chopper features a smaller number of active semiconductor switches, four IGBTs, with barely two PWM gate signals. As a result, the proposed system is easy, consistent, extremely proficient, and cost effective.

KEYWORDS: PWM, Three Phase PWM AC Chopper ,Hysteresis Band Current Control.

I. INTRODUCTION

AC voltage regulators, too call as AC voltage controllers, are used in a range of applications that necessitate a regulated AC voltage. Lighting control using dimmer circuits, domestic as well as industrial heating, speed control and soft starters for the induction motors are examples of such applications [1], [2]. Different methodologies with different control strategies of these regulators in single phase applications and also in three phase applications are presented. The reason of AC voltage controller is to vary the root mean square (RMS) value of its output that applied to the load circuit. There are three control strategies are obtainable to gain this objective; ON/OFF method, phase angle (PA) method and pulse width modulation (PWM) method. All three control methods can be implemented in both single- phase and three-phase applications.

II. LITERATURE SURVEY

In order to minimize drawbacks such as harmonics present at output voltage, discontinuity of power flow present at both supply and load side even for a resistive load, some another issues in driving dynamic loads such as electric motors, etc. arising from the inherent characteristics of the controller AC controllers can be replaced by PWM

AC choppers. In order to control the load current, HBCC among various PWM strategies is broadly used because of its inbuilt simplicity and fast dynamic response. Mohamed k. Metwaly , Haitham Z. Azazi , Said A. Deraz , Mohamed E. Dessouki and Mohamed s. Zaky "Power Factor Correction of Three-Phase PWM AC Chopper Fed Induction Motor

Drive System Using HBCC Technique." In this paper, an analysis and simulation of a Pwm ac Chopper fed induction motor drive system using HBCC technique is shown. Murat Kale, Murat Karabacak, Bilal Saracoglu "A Novel Hysteresis Band Current Controller Scheme For Three Phase AC Chopper." this paper presents the importance of using Hysteresis band current control scheme and their applications with model.

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1.Problem Definition:

In order to get regulated AC supply, AC choppers are generally used in the applications such as lightening control, industrial heating and soft starting of induction motors. The easiest way to control an AC chopper consisting of a pair of triacs is the phase angle control (PAC) because of its simplicity and the ability of controlling a large amount of power economically [33,34], which is termed as the conventional AC chopper. However, it has numerous limitations due to the inherent characteristics of the PAC. That is, a lagging power factor appears at the supply side even for a resistive load [35,36]. As a effect of PAC, the harmonic content of the output voltage and current of the AC chopper is huge, where requires a moderately large filtering stage [37]. Moreover, a discontinuity of power flow appears at both the supply and load sides of the AC chopper as well, which leads to another serious problem in driving dynamic loads such as electric motors [33]. In order to abolish these drawbacks arising from the inbuilt characteristics of these controllers, line commutated conventional AC controllers can be replaced by PWM AC choppers having superior overall performance such as sinusoidal supply current with unity power factor, fast dynamics and significant reduction in filter size [33]. By means of the high frequency switching devices such as IGBT and MOSFET, the supply voltage can be chopped by varying the duty ratio of the PWM modulation signal so as to normalize the load voltage [38].

III.PROPOSED METHODOLOGY

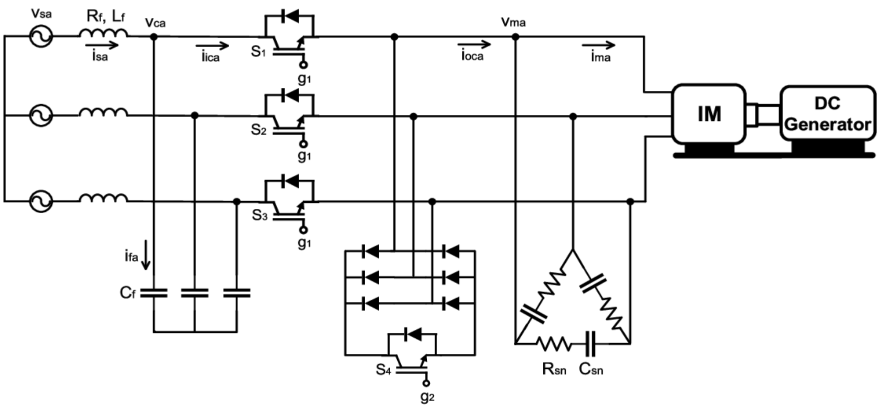

Fig.1. Power Circuit of the proposed three-phase PWM AC chopper fed an IM drive system

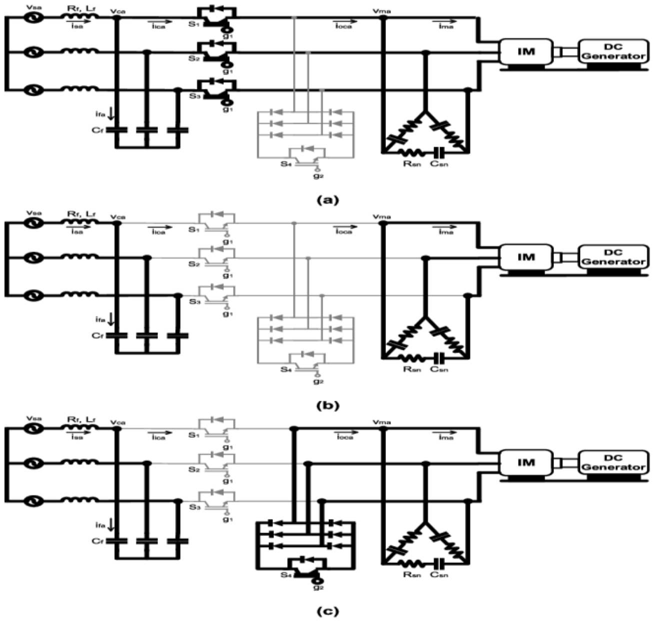

Fig.2. (a)Active stage, (b)Dead time stage, (c)freewheeling stage of the proposed PWM AC chopper fed IM

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Fig. 2. represents a schematic diagram of the proposed three phase PWM AC chopper fed an IM. The chopper is composed of four power electronics switches (S1; S2; S3 and S4). The three power switches (S1; S2 and S3) are series- connected with the motor. The series-connected switches are utilized to continuously connect and disconnect the motor to and from the AC supply, respectively. Hence, they regulate the delivered power to the motor. While, the power switch (S4) is parallel-connected via a poly phase bridge rectifier with the motor which offers a freewheeling way for discharging the energy kept in the motor windings when the series-connected switches are turned OFF. As series and parallel devices operate in a complementary way, a dead time is introduced to avoid the commutation problems. There are three operating stages: active, freewheeling and dead time. In dead time period, all four devices are turned OFF. Snubber circuit is used to lessen high voltage spikes at IM terminals due to switching of the chopper as well as provide the current path of IM during the dead time period. The input filter is poised of three inductors .The LC input filter is used with the proposed PFC technique in order to diminish the harmonics of the supply current due to switching of the chopper. The proposed control circuit only generates two PWM complementary gate pulses (g1 and g2) which are used to drive the chopper IGBTs in order to make available the three main tasks of the proposed control plan.

1. Simulation Model:

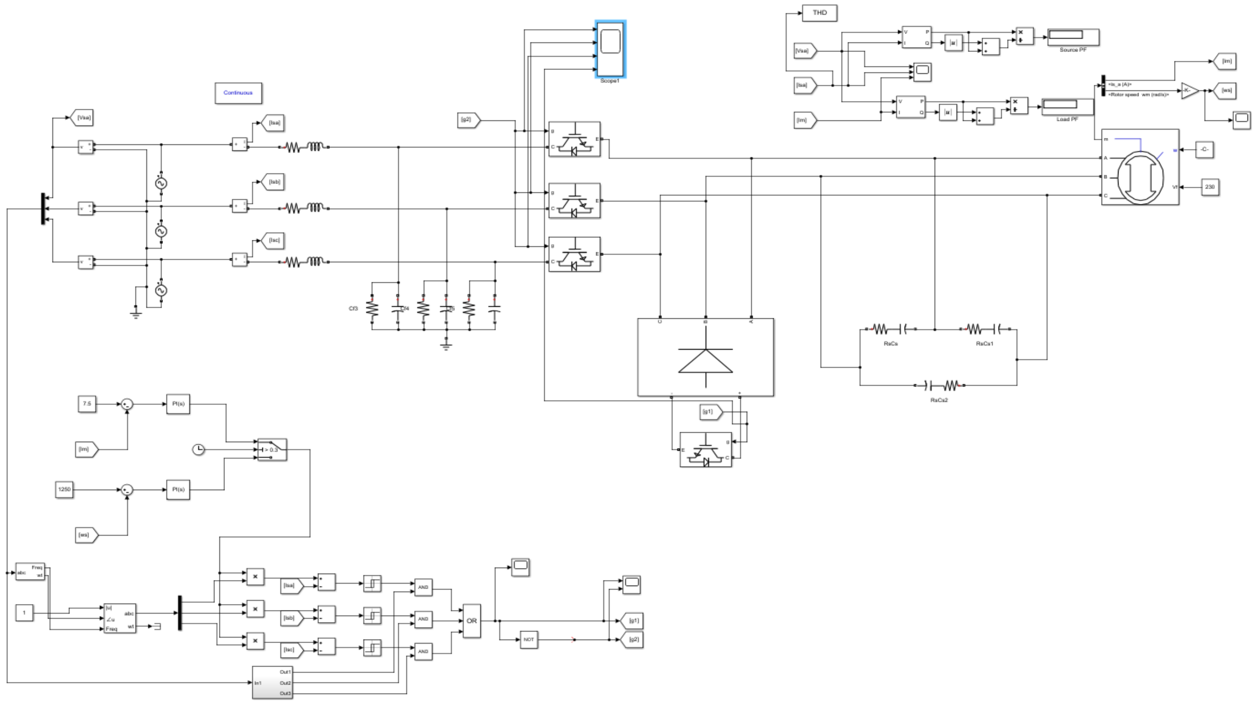

Fig.3. Simulation model of the proposed system

2. Specification:

1. Source Voltage: 300V
2. Source Current: 20 to 25 A
3. Load Current: 20 to 25 A
4. Speed: 1500 RPM

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3. Result and Discussion:

Case	Speed	Source PF	Load PF	THD
1	1500 RPM	0.97	0.0055	0.02%
2	1200 RPM	0.97	0.4726	0.02%
3	1000 RPM	0.97	0.0067	0.02%

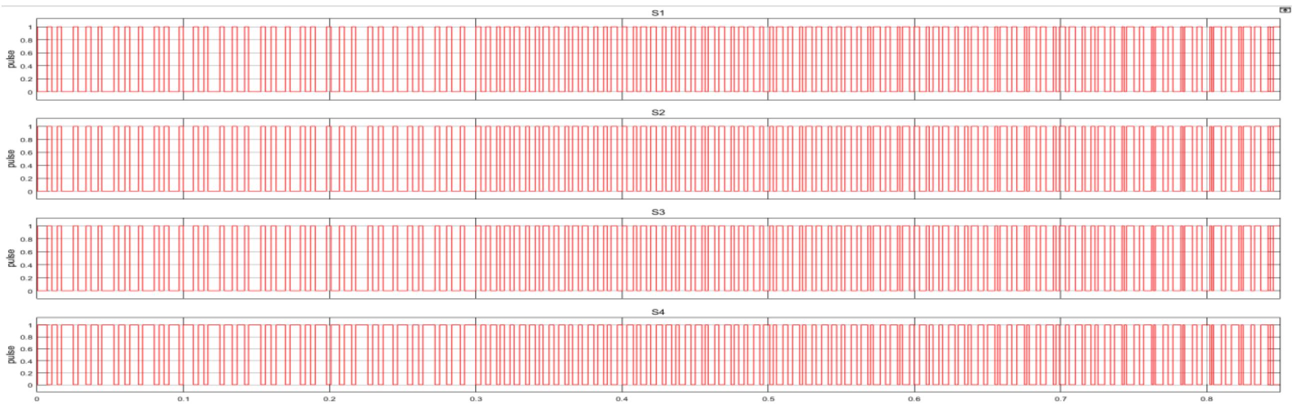


Fig.4. Switching signal obtained by minimum voltage algorithm

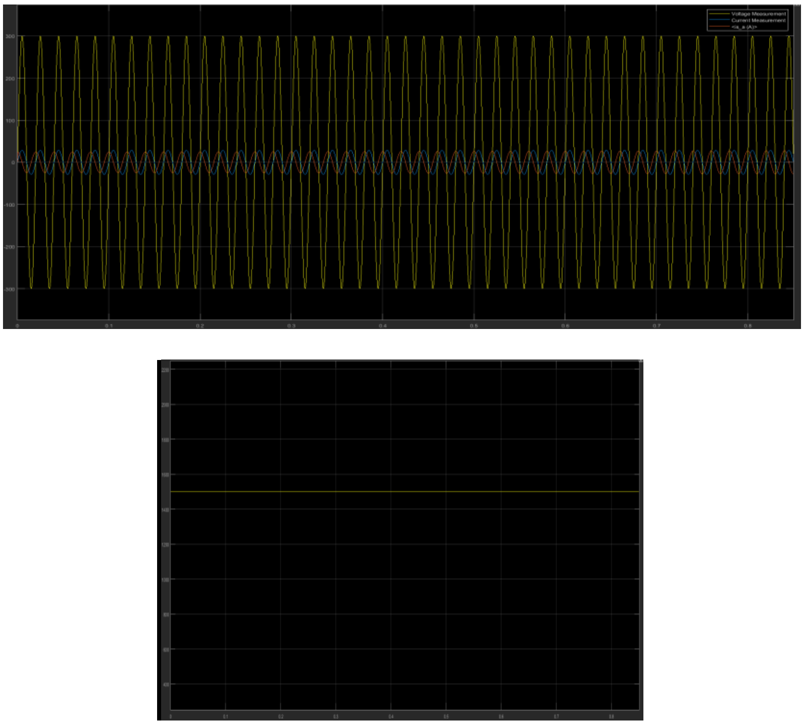
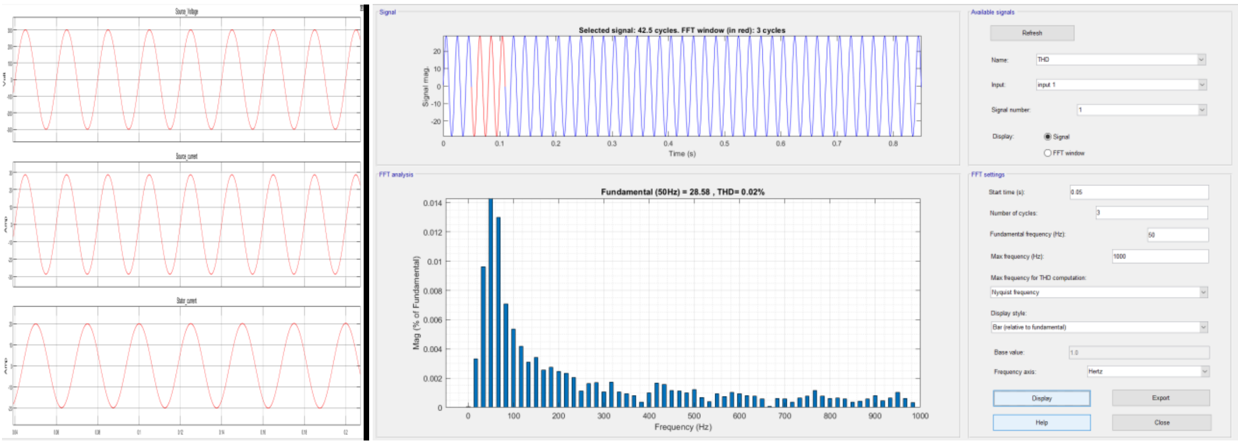


Fig.5.Variation of the motor speed, current and voltage with Input Current FFT Analysis `



IV. CONTROL TECHNIQUES

The planned control approach has three main control objectives: soft starting, speed control, and input power factor correction.

A. Soft Starting Mode

The function of the soft starting mode is to create the mention value of the supply current in a manner that confines the starting current of the IM at a predetermined value. The actual current of IM (Im) is calculated and its RMS value is evaluated by RMS detector. The preset value of the motor current (Im) and its actual value (Im) are compared. The assessment of resulted fault is passed into a proportional integral (PI) controller to make the command motor current (Is). Restraining the starting current provides a soft rushing and reduces the torque pulsations of IM throughout soft starting period.'

B. Speed Control Mode

There are numerous methods for calculating the speed of three-phase IMs. These methods can be divided into two main categories according to the control side of the IM:

a) speed control methods through the stator side such as changing the applied frequency, changing the applied voltage, changing the number of the stator poles and voltage/frequency (v/f) control, and b) speed control methods through the rotor side such as rotor resistance control and rotor slip power recovery. Variable frequency drives (VFDs) are the commercial drives. Speed control by VFDs is based on varying both the stator voltage and frequency of the IM. VFDs are extensively used for wide-range variable-speed IM applications. However, they are very expensive and hence not convenient when they are used for limited-range variable-speed IM applications. The task of the speed control mode is to create the reference current value (Is) in a way that makes the measured speed of IM follows the command speed Command and measured speed are compared and the difference is used as an input signal to a PI speed controller to generate Is.

C. PFC Control

In view of the fact that PWM AC/AC choppers can only alter the enormity of the applied voltage, they are normally negatively viewed; when they are used in IM drive systems, for their slight PF. As a result, the main role of the proposed control policy is to gain high PF in the region of unity as in case of resistive loads. The proposed PFC plan was implemented through starting and speed control operating modes of IM drive while using AC chopper. The principle of harmonic minimization of the planned control plan depends on using PWM technique. Whereas, the principle of reactive power management is to attain PFC depends on the projected current control technique; in which the actual supply currents are obligatory to follow their reference currents that are in phase with supply voltages. The function of PFC block is to incessantly correct the input PF during IM operation.

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V. CONCLUSION

The main control objective is to accurate the input PF with different operating conditions of the induction motor drive system. Input PFC is gain by forcing the actual currents of the chopper to track their reference currents that are in phase with the input voltages using HBCC technique. The future control strategy uses only two PWM signals for driving the active switches of the AC chopper. The proposed system is simple, reliable and low cost as it has only four IGBT switches. As a result it is obvious a very precise control performance is achieved. Above simulation results prove the corroboration and applicability of the proposed HBCC technique.

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