ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A COMPARITIVELY ANALYSIS OF BLDCM TECHNIQUE TO INCREASSING EFFICIENCY OF TIME REDUCTION ALGORITHEM

Abhilash Soni[*1], Lavkesh Patidar[2]
[*1]Mtech student Department of Electrical & Electronics Engineering,
[2]Asst.Pro. in JIT Borawan (M.P)

DOI: 10.5281/zenodo.827480

ABSTRACT

In small scale and large scale applications like automobile industries, domestic appliances such as Refrigerators, washing machine and air conditioning units which use conventional motor technology. These conventional motors have a chacterstics of Low torque, high maintenance and low efficiency. The usage of BLDCM enhances various performance factors ranging from higher efficiency, higher torque, high power density, low maintenance and less noise than conventional motors. The main drawback is high cost. In this paper a two leg inverter fed BLDCM drive is proposed which uses only four switches and two current sensors compared with six switches, three current sensors in case of three leg inverter fed BLDCM drive. Less number of switches and current sensors means less switching loss and low cost. In this paper a two leg inverter fed BLDCM drive with two input DC source is proposed. The proposed PMBLDCM drive is modeled and its performance is simulated in MATLAB / SIMULINK . This proposed method is a simple, low cost and enhanced performance of dive is obtained i.e., reduced torque ripple, less voltage stress, Low current THD and fast dynamic performance of PMBLDCM drive.

I. INTRODUCTION

Brushless DC motor is a permanent magnet synchronous motor which is powered by dc-voltage through the inverter that produces the ac electric signal to drive the motor. The torque-speed characteristics of the BLDC motor are similar to the BRUSHED DC motor, that's why the name BLDC came. The commutation is done in BLDCM is electronically instead of brushes.

It is easily controlled through the rotor position sensors and performs well especially in speed/torque. With these advantages, the motor will spread to more applications. The applications of BLDCM are increased and its competing with the induction motors and dc motors. The output voltage and output frequency of the inverter are dependent on the switching state of the inverter. The controlling of the inverter switches is done by using various PWM techniques, among these sine PWMand space vector PWM methods are mostly used today due to many advantages. SVPWM is easy to digitalize and having lower switching losses and consists lesser harmonics and the better utilization of the dc-bus voltage in comparison with SPWM method. With these advantages the use of SVPWM microcontroller become most important PWM methods for inverters. The speed of the BLDC motor is controlled using SVPWM inverter have many advantages such as the pulsating torque will be minimised, the THD of the current and voltage waveforms of the motor are reduced, and it utilization of dc bus voltage will be better.

II. PERMANENT MAGNET BRUSHLESS DIRECT CURRENT (PMBLDC)

Advantages

Permanent magnet Brushless direct current (PMBLDC) motors have more advantages than any other motors like induction motors, dc motors due to compact size, higher efficiency, noiseless operation , higher dynamic response, longer life, and electronic commutation [1]. BLDC motor has trapezoidal back EMF and phase current is rectangular waveforms which gives zero torque ripple [2]. The BLDC motor is controlled using three phase voltage source inverter. This VSI feeds power to the motor. Inverter controls the output voltage and the frequency by varying ON/OFF of the switching devices. Each switch is operating 120 degrees [8]. In BLDC motor only two phase windings are energized at a time and the third phase kept opened. These two phase windings are connected to the two switching devices of the inverter. Each phase is conducting 120 degrees the

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

commutation happens for every 60 degrees. The commutation of the BLDC motor is depends on the rotor position of the motor [3]. The rotor position can be determined by placing hall sensors on the stator of the motor at each phase which are displaced by 120 degrees. Pulsating torque and its minimization techniques are studied [3]. The speed control of BLDC motor with SVPWM inverter gives better utilization of dc link input voltage, lesser switching losses, and lesser total harmonic distortion than the other PWM techniques [4]. SVPWM inverter can be digitalized easily. The concept of space vector is derived from the rotating magnetic field theory of induction motor. By using Clark's transformation three phase voltages are converted to two phase voltages for easy analysis and computations [9]. The implementation of SVPWM inverter is done using MATLAB Simulink software and results are compared with SPWM inverter [4]. Therefore SVPWM inverter control is more suitable to the BLDC motor than SPWM inverter [12, 13]. Various types of topologies of PMBLDC motor with voltage source inverter (VSI) are studied [5]. The mathematical modelling of BLDC motor analysis has been studied [6, 7]. The transfer function of BLDC motor and DC motor are same and the difference is only mechanical time constant and electrical time constant values will be varied. By using this transfer function the speed controller of the BLDC motor is designed [10]. The PID controller tuning design can be done in many ways, which are Ziegler Nicholas tuning method, lead-lag compensator design method, and Routh Hurwitz array method etc. For better accuracy the Kp, Ki, and Kd values are designed by using Ziegler Nicholas method [11]. The implementation of SVPWM inverter with BLDC motor is done in MATLAB Simulink software and the results are compared with the basic BLDC motor control with the commutation sequence of 120 degree inverter.

III. FUNDAMENTAL OF BLDC TECHNIQUE

The usage of BLDC motors are increased in the industries, automobiles, due to better torque speed characteristics, compact size, higher efficiency, wide speed range and longer operational life. In permanent magnet synchronous motors (PMSM) the stator winding back emf is sinusoidal, but in BLDC motor the shape of the back emf is trapezoidal waveform, so that copper saving is more in BLDC motor than the PMSM. The phase current in the BLDC motor is rectangular so that it gives the zero ripple torque ideally. The speed control of the motor is done by using three phase voltage source inverter (VSI) which feeds power to the motor. There are so many pulse width modulation techniques to give better inverter output voltage and the frequency, out of which SPWM and the SVPWM techniques are desirable. The SVPWM technique have many advantages than the SPWM method. In SVPWM only one switch is operating at a time. So switching losses are less. SVPWM inverter provides 15.5% dc-link input voltage to the BLDC motor and total harmonic distortion is lesser. And also the switching frequency of the inverter is less in the SVPWM inverter so that the efficiency of the inverter is more. SVPWM inverter can be digitalized easily and also the implementation in micro controller is easier. Therefore the SVPWM inverter is more suitable to the speed control of BLDC motor.

IV. ISSUE OF OLD ARTICLE

Akin Acar: High dynamic performance, which is obtained from dc motors, became achievable from induction motors with the recent advances in power semiconductors, digital signal processors and development in control techniques. By using field oriented control, torque and flux of the induction motors can be controlled independently as in dc motors. The control performance of field oriented induction motor drive greatly depends on the correct stator flux estimation. In this thesis voltage model is used for the flux estimation.

Sobha Chandra Barik: Sliding Mode Control (SMC) is a robust control scheme based on the concept of changing the structure of the controller in response to the changing state of the system in order to obtain a desired response. A high speed switching control action is used to switch between different structures of the controller and the trajectory of the system is forced to move along a chosen switching manifold in the state space.

Shoeb Hussain: With the application of intelligent controllers for a BLDC controlled induction motor drive, it is possible to achieve high dynamic performance drives. In this paper an Artificial Neural-Fuzzy Inference System (ANFIS) is implemented for a BLDC controlled induction motor. The efficiency of the system is also improved using an optimization algorithm wherein the rotor flux weakening is done as the system stability is reached.

Vijity Kinnares: this paper presents sensor less speed BLDC control of a two-phase induction motor (TPIM) based on model reference adaptive system (MRAS). With this method, the speed is controllable over a wide range. The proposed technique employs both main and auxiliary winding currents or d-axis and q-axis currents,

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

respectively for feedback control, flux estimation and speed estimation. Carrier-based space BLDC pulse width modulation is used for a three-leg voltage source inverter to provide balanced and unbalanced phase voltages. This flux and speed estimators can be satisfactorily operated in a wide range of speed. The dynamic performance of the proposed method is verified by simulation results.

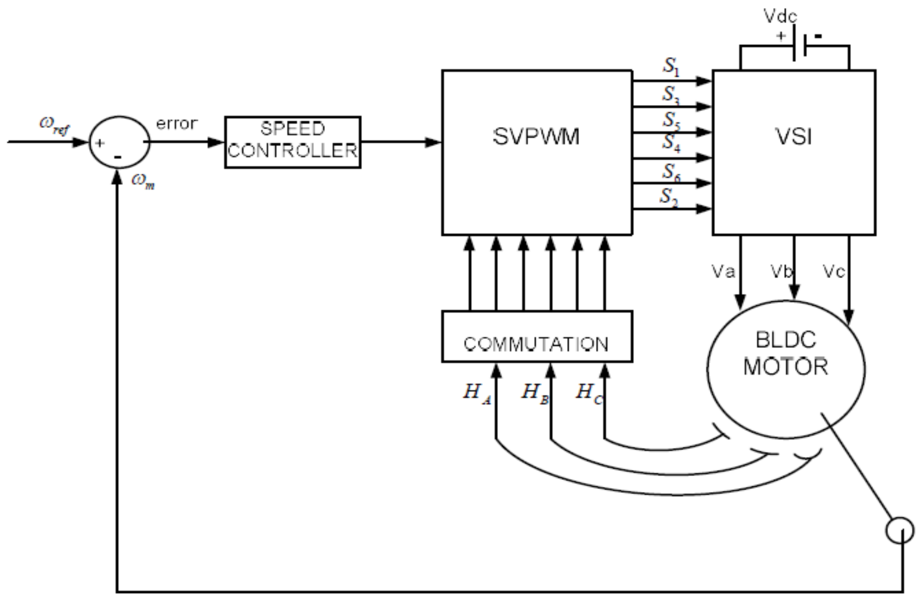
V. OBJECTIVES OF TO DESIGN OF BLDC

The objectives of the speed control of the BLDC motor with SVPWM inverter for electric vehicle are

- To implement the SVPWM inverter in MATLAB Simulink software.
- To design the speed controller of the BLDC motor.
- To implement the BLDC motor with 120 degree switch on mode inverter using MATLAB Simulink software. To implement the BLDC motor with SVPWM inverter using MATLAB Simulink software.

VI. WORK DONE OF THE SPEED CONTROL OF THE BLDC MOTOR WITH SVPWM INVERTER

The block diagram of the speed control of the BLDC motor with SVPWM inverter is shown below. The BLDC motor is energized by the three phase VSI inverter. The DC voltage Vdc applied to the inverter. The rotor position of the BLDC motor is sensed by hall sensors which are placed on the three phase stator winding coils, and the hall sensors are displaced by 60 degrees apart. The commutation sequence is determined by using rotor position. The actual speed of the motor is sensed and it is compared with the reference speed so that the error is taken as input to the speed controller. Here the speed controller is PID controller which gives the desired output by choosing Kp, Ki, and Kd values. The best PID controller tuning technique is Zigler-Nicholos tuning method which gives the suitable Kp, Ki, and Kd values. The output of the speed controller is gives the peak voltage.



Fig(1)Controlling technique.

The three phase voltages * *a V* , * *b V* and * *c V* are generated by taking the inputs which are inverter output frequency, clock time and the peak voltage which comes from the speed controller. By using the Clark's transformation method the three phase voltages * *a V* , * *b V* and * *c V* are converted to the two phase voltages *V*· and *V*· in the stationary reference frame. The two phase voltages *V*· and *V*· gives the reference voltage Vref and the angle. By using this angle the sector number N is determined. These are the inputs Vref, sector number N, the switching frequency fs and the sampling time Tz which generates the space vector PWM pulses. These SVPWM pulses are multiplied with the commutation sequence so that each switching device conducts

120 degrees and the commutation occurs at every 60 degrees. These multiplied PWM pulses are given to the three VSI inverter. In this way the speed control of the BLDC motor is done.

VII. CONCLUSION

the first chapter describes the brief introduction, literature review, motivation, objective and the work done of the speed control of the BLDC motor with SVPWM inverter is described. The second chapter describes the principle and implementation of the SVPWM inverter. The third chapter describes the BLDC motor principle, the mathematical modelling and the pulsating torque in the BLDC motor.the fourth chapter describes the controller design of the BLDC motor.

The fifth chapter describes the simulation results and the discussions. The sixth chapter describes the conclusion and the future work.

VIII. REFERENCES

[1] Shraddha v. “ Sensorless BLDC And indirect Torque Control ” , Oxford University Press, 1998.
[2] Qian cheng lei yuan, Lipo, T.A. , “BLDC Control And Dynamics Of AC Drives”, 1992.
[3] Akin acar, A. E. , Kingsley C. , D. Umans Jr. Stephen , “ Electric -Hill, 1983
[4] Sobha Chandra barik, “Stator Alan Akısı Üzerinden Asenkron Motorun Rotor Akısı Yönlendirmesi _çin Bir Yöntem” ,Doktora Tezi, Fırat Üniversitesi, 1994.
[5] Shoeb hussain, “Implementation Of BLDC Control For Induction Motors” , Msc. Thesis, METU, 1999.
[6] Vijity kinnares, Tranner, R. and Zwicky, R. “A rotor speed detector for DCutilizing rotor slot harmonics and active three phase injection.” in 2nd Proc. Euro. Con$ Power Electronic. App/. induction motor drive. (EPE), Vol. 2, (1987): pp. 599-604.
[7] Xingang fu, M. and Naunin, D “A conception for a sensorless speed control of the squirrel cage induction motor.” in Proc. Power Electron. Appl. Conf., (1985): pp. 3.51- 3.55.
[8] Ieroham s. baruch, B. W., Goodfellow, J. K. and Green, T. C. “Sensorless speed measurement of inverter driven squirrel cage induction motors.” in Proc. IEEE 4th Int. Con$ Power Electron. Variable Speed Drives, (1987)..

CITE AN ARTICLE

Soni, Abhilash , and Lavkesh Patidar. "A COMPARITIVELY ANALYSIS OF BLDCM TECHNIQUE TO INCREASSING EFFICIENCY OF TIME REDUCTION ALGORITHEM." ***INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*** **6.7 (2017): 247-50. Web. 15 July 2017.**