VOLUME-2 ISSUE-2
ISSN : 2799-18

ANALYSIS OF PERFORMANCE ON LEG INVERTER FED BLDCM DRIVE

Dr Akashdeep Singh

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 characteristics 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.

1. INTRODUCTION

Modern methodology of static frequency conversion has liberated the induction motor from its historical role as a hard and fast speed machine. The inherent blessings of adjustable frequency operation can not be absolutely completed unless an appropriate management technique is utilized. The selection of technique is important in crucial the characteristics and performance of the drive system. Additionally the facility device has very little excess current capability; throughout traditional operation the management strategy should make sure that motor operation is restricted to the regions of high torsion per ampere, thereby matching the electrical converter ratings and minimizing the system loses. Overload or fault conditions should be handled by subtle management instead of over style.

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 PWM and space BLDC 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.

Using of Permanent Magnet in electrical machines have so many benefits and advantages then electromagnetic excitation machines these are zero excitation losses result in high efficiency, simple construction, less maintenance requirement , low cost and high torque or high output power per unit volume . Due to high power to weight ratio, high torque, good dynamic control for variable speed

VOLUME-2 ISSUE-2
ISSN : 2799-18

applications, absence of brushes and commutator make Brushless dc motor (BLDCM), good choice for high performance applications. Due to the absence of brushes and commutator there is no problem of mechanical wear of the moving parts [1], [2]. As well, better heat dissipation property and ability to operate at high speeds [3] make them superior to the conventional dc machine. However, the BLDC motor constitutes a more difficult problem than its brushed counterpart in terms of modeling and control system design due to its multi-input nature and coupled nonlinear dynamics. Due to the simplicity in their control, Permanent-magnet brushless dc motors are more accepted used in high-performance applications. In many applications, the production of ripple-free torque is of primary concern. Electrical motors are the part of industry and every year worldwide nearly five billion motors built. This cause the reason for need of low-cost brushless dc motors drives industrial applications [4]. Use of digital control concept is one method because cost of digital control is decreasing day by day. There are two different methods of implementing digital controller one is current mode control and second one is conduction angle control [5]. A zero-voltage- and zero-current-switching full-bridge (FB) converter with secondary resonance is another method in this primary side of the converter have FB insulated-gate bipolar transistors, which are driven by phase-shift control and secondary side is composed of a resonant tank and a half-wave rectifier [6]. Without an auxiliary circuit, zero-voltage switching and zero-current switching are achieved in the entire operating range. In this without using additional inductor, the leakage inductance of the transformer is utilized as the resonant inductor. It has many advantages, including high efficiency, minimum and number of devices this topology is attractive for high-voltage and high-power applications.

2. BLDC MOTOR DRIVE STRATEGIES

Fig. 1(a) shows the general BLDC drive system fed by inverter. Fig. 1(b) shows the trapezoidal back emf and corresponding currents for operation of BLDC drive system. For getting constant output power, current is fed through the motor at flat portion of the back EMF as shown in fig. 1(b). Using digital control each phase of motor is energized according to those sequences. Therefore the position of rotor is important for driving the motor. Here for sensing position of rotor hall sensors are used. The desired current profile is achieved by proper switching of voltage source inverter.

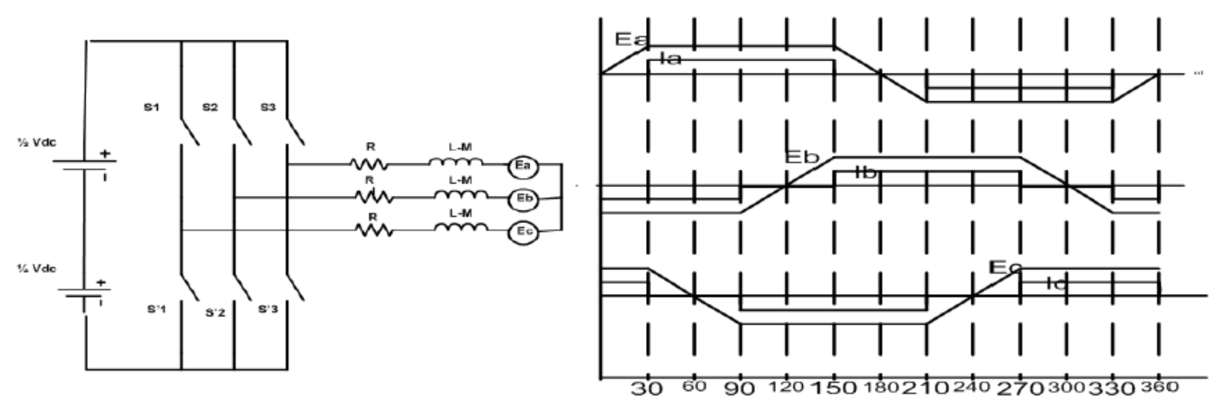

Fig. 1(a) BLDC Motor Drive System **Fig.1 (b)** BLDC Motor back emf

VOLUME-2 ISSUE-2
ISSN : 2799-18

And the motor phase currents Fig. 2 shows the closed loop speed control of conventional three leg inverter fed BLDC drive system using hysteresis current control scheme, in this we required three hysteresis current controller and we have to sense stator currents for this three current sensors are required. This method has following drawbacks, current sensors are bulky, heavy, expensive, and torque fluctuations is due to differences in current sensor sensitivities

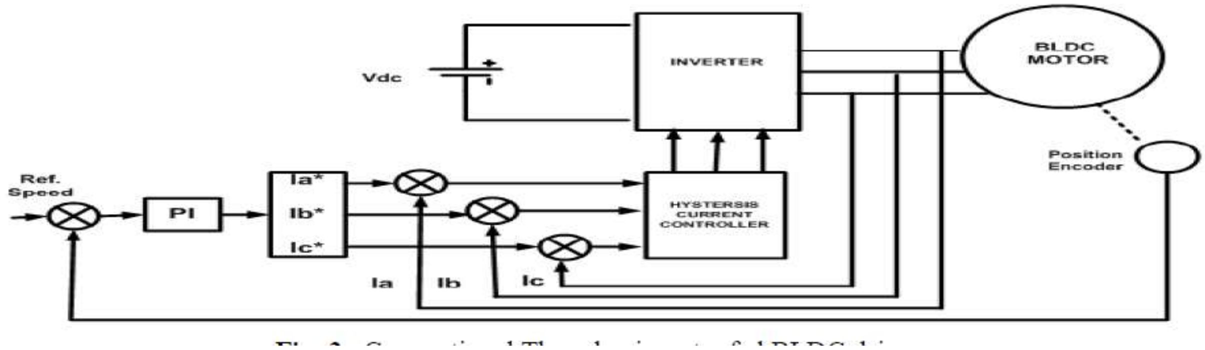

Fig. 2 Conventional Three leg inverter fed BLDC drive

Fig.3 shows the proposed schematic diagram of closed loop speed control of two leg inverter fed PMBLDCM drive with two input DC source. The advantage of this schematic is, in this two current sensors and four power electronic switches are used means low cost and less switching losses and the performance of the drive is improved i.e., reduced torque ripple, less voltage stress and fast dynamic performance of PMBLDCM drive

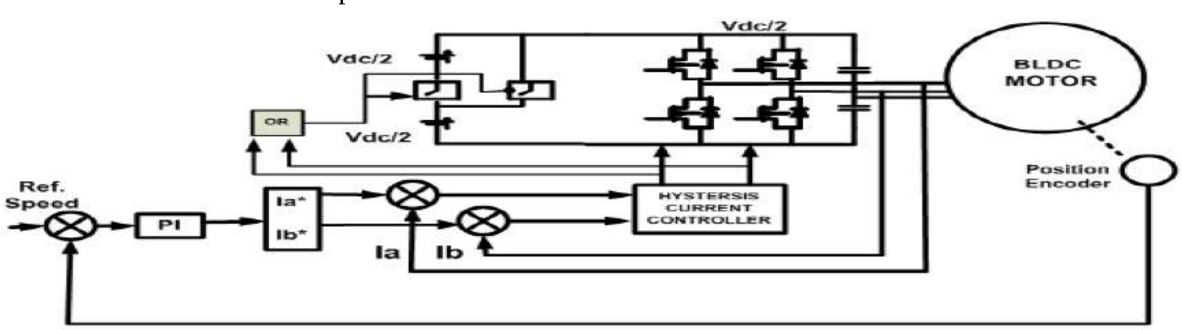

Fig.3 Schematic of proposed method

3. BRIEF THEORY OF BLDC CONTROL (FIELD ORIENTED CONTROL)

The control of separately-excited dc machines is straightforward due to the inherent decoupled nature between flux and torque. As a consequence, torque linearization can be obtained easily by armature current control with constant field flux .DC motors have been widely used in high performance domains such as robotics, rolling mills and tracking systems where fast dynamic torque control is required. AC machines are always preferable to dc machine due to their simpler and more robust construction; there are no mechanical commentators. However, the electrical structures of ac machines are highly nonlinear and involve multivariable inputs and outputs.

Therefore, additional effort is required to decouple and liberalize the control of these machines.

Speed Controlling

VOLUME-2 ISSUE-2
ISSN : 2799-18

Variable speed drive systems are essential in many industrial applications. In the past, DC, are require to high speed synchronous circuit because these improved efficiency of induction motor, since their control flux and armature current of induction motor. Dc motors have certain disadvantage they are totally depends for brushes and large current loss. That is, they have require for large periodicity of torque; they cannot be used in explosive or corrosive environments and they have limited commutator these properties are high speed and higher alternate current and rugged Structure of motor. That is providing high maintainability and good economy.

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.

Advantages Of Proposed Algorithem

- The sensors are eliminated.
- The dynamic performance of the indirect BLDC control is better than the direct BLDC control
- The cost factor is decreased.
- There is no drift problem as in direct BLDC control.

CONCLUSIONS AND FUTURE STUDY

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. The biggest advantage of this system is stabilizing properties are preserved, even in the presence of large disturbance signals. The dynamic behavior of the system may be tailored by the particular choice of switching function and the closed-loop response becomes totally insensitive to a particular class of uncertainty. Also, the ability to specify performance directly makes sliding mode control attractive from Design perspective.

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
[7] Proc. Euro. Con$ Power Electronic. App/. induction motor drive. (EPE), Vol. 2, (1987):pp. 599-604.
[8] 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.
[9] 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).