IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 1, January 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.122

9940 572 462 | 6381 907 438 | ijareeie@gmail.com | www.ijareeie.com

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 1, January 2021||

DOI:10.15662/IJAREEIE.2021.1001018

Review on Sensor less Speed Control of BLDC Motor

Vaishali Shinde[1], Prof. Patil B.A.[2]

M. Tech Student, Department of Electrical Engineering, Jawaharlal Nehru Engineering College - [JNEC] Aurangabad, affiliate with BATU lonere. Maharashtra, India[1]

Professor, Department of Electrical Engineering, Jawaharlal Nehru Engineering College - [JNEC] Aurangabad, affiliate with BATU lonere. Maharashtra, India[2]

ABSTRACT: In this paper there is review on "Sensor less speed control of BLDC Motor" Most of the electrical systems today required very high performance on efficiency. Brushless DC (BLDC) motors can achieve these because the high efficiency in comparison with induction motor, and purely powered by electricity. Brushless dc (BLDC) motors are very popular and are replacing other motors in different applications due to its better electrical characteristics and its simple construction. In this paper we are showingthe BLDC motor sensorless speed control system with fuzzy logic controller. These motors are generally controlled using a three phase power semiconductor bridge. For starting and the giving proper commutation sequence to set upon the power devices in the inverter bridge the rotor position sensors needed. this report based on brushless DC motor (BLDCM) driven by three-phase inverter, a sensor less speed control scheme by using Fuzzy logic is proposed to reduce the torque ripple and can be control without sensor. The sensor less techniques based on the back EMF sensing and the rotor position detection. Also the stator current can be easily adjusted by changing the pulse width of the switching devices during alignment which will reduce cost and complication of the drive system without compromising the performance. We will compare hardware results to the mat lab simulation of the topic mentioned

KEYWORDS:BLDC Motor, Fuzzy logic controller, misalignments of hall sensors, driver circuit for BLDC Motor, Application of sensor less BLDC Motor

I. INTRODUCTION

Brushless dc (BLDC) motors are preferred as small horse power control motors due to their high efficiency, silent operation, compact form, reliability, and low maintenance. Nonetheless, the problems are bump into these motor for variable speed operation over last many years hence resulting technology development in, an adjustable speed drivers control schemes, and power semiconductors have been combined to assure reliable, cost-effective method for a broad range of adjustable speed applications.

We can classify the BLDC motor control into three types as given below,

1. Constant load
2. Varying loads
3. Positioning applications

Brushless DC motors main circuit is mainly made up of AC power, a bridge rectifier and a bridge inverter. Firstly, we convert AC current into DC current& then altered by a bridge inverter this used to drive the BLDC motor. Regarding a single-phase AC power supply, the commonly used rectifier circuits are full-bridge rectifier circuit, a half-bridge rectifier circuit and a voltage-doubling bridge rectifier circuit, respectively. Practically, a boost rectifier circuit can be used to raise the DC voltage to meet the system's requirements if the above rectified voltages are still too low to drive the BLDC motor.Figure 1 shows the hardware system block diagram of a BLDC motor with fuzzy logic controller

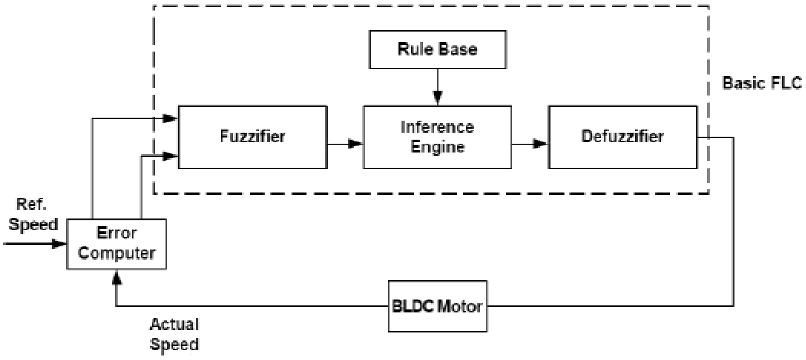

Fig.1. Block Diagram of BLDC Motor with FLC

Necessity

Current-ripple reduction is always an important issue in BLDC motor control systems. As in other motors, some phenomena like the cogging effect and the eddy-current effect cannot becompletely avoided in BLDC motor design. Current control can be restrained with good results by using fuzzy controller and it reduces cost and complexity of drive system.

II. LITERATURE SURVEY

.

Ramesh.M.V, Amarnath.J, Kamakshaiah.S and Rao.G.S, "Speed control of Brushless DC Motor by using Fuzzy Logic PI Controller", ARPN Journal of Engineering and Applied Sciences, Vol.6, No.9, September 2011.
According to this paper fuzzy, PI controller is needed for speed control of BLDC Motor. It uses 3 fuzzy controllers and 3 PI controllers. The BLDC motor is fed from Inverter with rotor position and current controller is input. In this paper, fuzzy logic Controller (FLC) is used for the governor of the speed of the BLDC motor

Nobuyuki Matsui, "Sensorless PM Brushless DC Motor Drives", IEEE Trans. On Industrial Electronics, Vol.43, No.2, pp.300-308, April 1996
The paper refers about the speed and position sensorless dc motor with a sinusoidal flux distribution. The starting process is also a very difficult problem under sensorless drives, as the sensorless drive algorithm habits voltage and current for estimation of rotor position, but no data is available before starting. The salient-pole brushless dc motor is able to solve this problem. Since the winding inductance is a function of the rotor position, the rotor position at standstill can be predictable by a proper recognition of the winding inductances. In the current model-based control, the estimated position and speed are corrected every sampling by a current error between the sensed and assessed values. As a result, the valuation is more steadythan that of the voltage model-based control.

Somanatham.R, Prasad.P.V.N, Rajkumar.A.D, "Modelingand Simulation of SensorlessControl of PMBLDC Motor Using Zero Crossing Back EMF Detection" Department Of Electrical Engineering, University College of Engineering Osmania University,Hyderabad – 500 007, A.P. (India)
According to this paper Modeling and simulation of a sensorless controlled Permanent Magnet Brushless DC motor is carried out at different loads. Initially the stator windings of the motor are excited with an inverter which operates in 120 mode conduction for a threshold period. When the motor reaches the minimum speed to facilitate zero-crossing Detection of back e.m.f, the control is transferred to zero crossing detection circuit. Then,a closed loop operation is carried out where a pair of stator windings of the motor is excited by the logical inverter.

Problem Statement

Main problem with asensored control is hall sensor misalignment. It must be placed at 120 degree from each other but due to some manufacturing defect it is not possible to get required alignment it results in an increase in torque pulsation, vibrations, and noise, and reduced electromechanical performance. Along with this it is not suitable to use the Hall sensors for high temperature applications because a sensor failure may cause unpredictability in the control system. More over most of the problem is associated with the conventional controllers that these controllers give difficulties under the conditions of nonlinearity, load disturbances.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 1, January 2021||

DOI:10.15662/IJAREEIE.2021.1001018

III. PROPOSED SYSTEM DEVELOPEMENT

Six switch inverter

The structure of six-switch driving circuit is shown in .BLDC motor modelling is aliketo three-phase Synchronous machine modelling. The model is obtained, in which the permanent magnet enclosed with the rotor And it contains different dynamic characteristics. Fig. 3 shows the Inverter BLDC motor-drive model. The BLDC Motor is nourished to a three-phase voltage source is not required to be sinusoidal or square wave can be applied. The peak voltage produced over there should not surpass the maximum voltage of the motor.

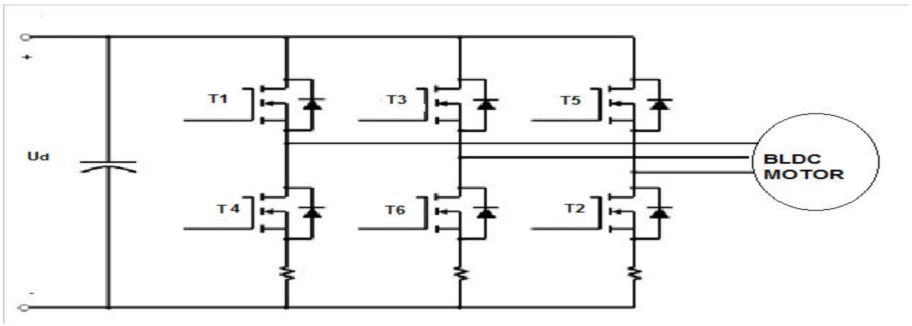

Fig.2. Six Switch Bridge Driving Circuit

The basic model of the armature winding for the BLDC motor is defined as

Va=Ria+Ldia/dt+ea- 1

Vb=Rib+Ldib/dt+eb- 2

Vc=Ric+Ldic/dt+ec- 3

Where, L and R are the armature self-inductance [H] and armature resistance [Ω] of the stator phase winding respectively, Va, Vb, Vc are terminal phase voltage [V], ia, ib, ic are motor input current [A] and Ea, Eb, Ec are trapezoidal motor back emf [V] of respective phases

The trapezoidal Back EMF of no conducting phases,

Ea=Kef(Øe)wr - 4

Eb=Kef(Øe-2π/3)wr -5

Ec=Kef(Øe+2π/3)wr- 6

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 1, January 2021||

DOI:10.15662/IJAREEIE.2021.1001018

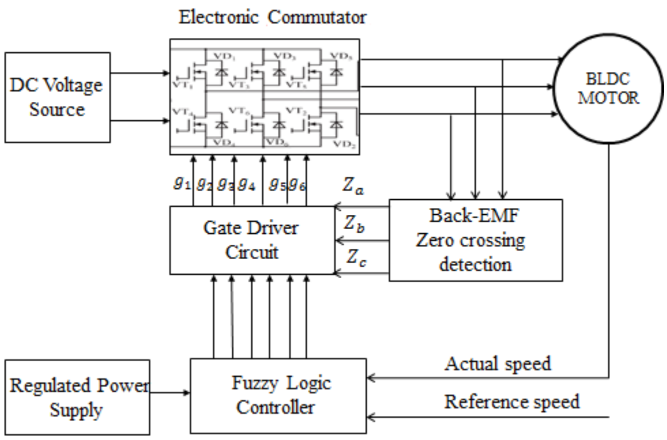

Fig.3. Proposed system Block Diagram

The projected method is based on the fact that rotor position can be spotted by using a trapezoidal Back-EMF of BLDC motors. Since Back-EMF of the BLDC motor is not measured directly, it is estimated by the comparator with zero crossing detection technique and fuzzy logic intelligent controller is used for efficient speed control as shown in the Figure 3The comparator with zero cross detection technique is achieved by sensing the back EMF. The back EMF sensing is based on the data that only two phases of a BLDC motor are connected at a time and the third phase is existing to note the back EMF voltage. Consider phase C as floating for a certain step,

Vc=Ec+Vn -7

Where, is the terminal voltage of the phase C, is the phase Back EMF and is the neutral voltage of the motor.

From Phase A, the term for neutral voltage is expressed as,

Vn=Vdc-VMOS-Ri-Ldi/dt-Ea -8

From Phase B, the equation emerge to be,

Vn=VMOS+Ri+Ldi/dt-Ea -9

Where, VMOS is the voltage drop on MOSFET

From equation (8) and (9),

Vn=Vdc/2 - (Ea+Eb)/2 -10

Considering a three-phase system by abandoning the third harmonics,

Ea+Eb+Ec=0 -11

In proposed method, the comparators are used for generating the gating signals, by comparing Va,Vb and Vc to Vn. If Va is greater than Vn, then the comparator outputs high level, else the comparator outputs low level, which is expressed as Zs as shown in Fig. 3 At the rising edge of Za, the MOSFET Q1 should be ON, and the MOSFET Q5 ought to be OFF, at the falling edge of Za, the MOSFET Q4 should be ON, and the MOSFET Q2 should be OFF. Correspondingly, according to the increasing and decreasing edge of Zb and Zc respectively, the other commutation instants should be gained. The gating signals ZaZbZc are generated from the every commutation instants. Subsequently the BLDC motor could work normally on the prior state which is available from the switching table. A sample fuzzy rule base is shown in following table no.1 which uses 49 rules.In this there are

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 1, January 2021||

DOI:10.15662/IJAREEIE.2021.1001018

seven membership function as Negative Big (NB), Negative Medium (NM), Negative Small (NS), Zero (Z), Positive Small (PS), Positive Medium (PM), and Positive Big (PB)

Change in error	**Error**						
	NB	**NM**	**NS**	**Z**	**PS**	**PM**	**PB**
NB	NB	NB	NB	NB	NM	NS	Z
NM	NB	NB	NB	NM	NS	Z	PS
NS	NB	NB	NM	NS	Z	PS	PM
Z	NB	NM	NS	Z	PS	PM	PB
PS	NM	NS	Z	PS	PM	PB	
PM	NS		PBZ	PS	PM	PB	PB
PB	Z		PB				

Table No.-01 FUZZY RULE BASE

IV. CONCLUSION

The main purpose for the proposition of Sensor less speed control of BLDC Motor is to minimise the hardware cost of system. As there is removal of hall sensor which carries very nice part of cost of total system. Another main issue with a hall sensor is that misalignment of sensors, ideally it should be placed at120 degree from each other but due to manufacturing defect it is always not possible to get ideal alignment it results in an increase in torque pulsation, vibrations, and noise, and reduced electromechanical performance. Hence by using sensor less technique we can remove all this possibilities and there will be no issue of misalignment of sensors. Againold control systems are based on mathematical models which have one or two differential equation in many cases; the mathematical model of the control process may not exist or may be too costly. Hence this six switch fuzzy control method will help us to achieve mathematical modelling of control system as well as BLDC Motor. Thissensor less method has less cost than sensored method; it will give very high dynamic performance compare to the old scheme. This motor has many useful and important applications like Computer hard drives and DVD/CD players, electric vehicles, hybrid vehicles, and electric bicycles, industrial robots, CNC machine tools, and simple belt driven systems, washing machines, compressors and dryers, fans, pumps and blowers etc. This proposed system has many benefit over sensored as far as implementations is considered.

REFERENCES

.
[1]Nobuyuki Matsui, “Sensorless PM Brushless DC Motor Drives”, IEEE Trans. on Industrial Electronics, Vol.43, No.2, pp.300-308, April 1996

[2]Somanatham.R, Prasad.P.V.N, Rajkumar.A.D, “Modelingand Simulation of SensorlessControl of PMBLDC Motor Using Zero Crossing Back EMF Detection” Department Of Electrical Engineering, University College of Engineering Osmania University, Hyderabad – 500 007, A.P. (India)

[3]Anjali A.R, Calicut University, “Control of Three Phase BLDC Motor Using Fuzzy Logic Controller”, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Vol.2, Issue 7, July 2013.

[4]Ramesh.M.V, Amarnath.J, Kamakshaiah.S and Rao.G.S, “Speed control of Brushless DC Motor by using Fuzzy Logic PI Controller”, ARPN Journal of Engineering and Applied Sciences, Vol.6, No.9, September 2011.

[5]Yan Wei-Sheng, Lin Hai, Li Hong,Yan Wei, “Sensorless Direct Torque Controlled Drive of Brushless DC Motor based on Fuzzy Logic”, IEEE Trans. on Ind. Elec. and Appl., Vol.23, No.4, July

[6]Wang, L. , Wang, Z., & Yang, R. (2012). Intelligent multiagent control system for energy and comfort management in smart and sustainable buildings. Smart Grid, IEEE Transactions on, 3(2), 605-617.

[7]Taeyeon Kim, Chungil Kim, JoonLyou, “A New Sensorless Scheme for a BLDC Motor Based on the Terminal Voltage Difference” IEEE Trans. on Industrial Applications, Vol.6, No.7, pp.1710-1715, September 2011.