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

BRUSHLESS DC MOTOR SPEED CONTROL BY THE INTELLIGENT CONTROL TECHNIQUES

[1]Mrs. KATTOJU GNANESHWARI, [2]Mrs. G.P. MERLINE

1 PG Scholar in the Dept. of Electrical and Electronics Engineering, Holy Mary Institute of Technology & Science, Bogaram (V), Medchal District, Hyderabad, India.

2 Assistant Professor in the Dept. of Electrical and Electronics Engineering, Holy Mary Institute of Technology & Science, Bogaram (V), Medchal District, Hyderabad, India.

Abstract— An artificial Neural Network (ANN) is a simple network that has input, output, and hidden layers with a set of nodes. Implementation of ANN algorithms in electrical, and electronics engineering always satisfies the expected results as ANN handles binary data more accurately. Brushless Direct Current Motor (BLDC motor) uses electronic closed-loop controllers to switch DC current to the motor windings and produces magnetic fields. The BLDC motor finds more applications because of its high speed, less maintenance, and adequate torque capability. This motor is preferred to other motors due to its better performance and it is very easy to control its speed by Power Converters. The main contribution in this paper is applying ANN techniques for effective speed regulation of BLDCM in the absence and presence of external load. To give an inborn PFC at supply ac mains a converter based on buck boost type is intended to work in broken inductor current mode (DICM). The execution of the proposed system simulated in MATLAB/Simulink environment

Index Terms— Back EMF sensing technique, commutation instant, Permanent Magnet Brushless DC motor (PMBLDCM), sensor less operation, speed independent commutation function, virtual Hall signals, ANN.

I. INTRODUCTION

The sensor less operation of a PMBLDCM (Permanent Magnet Brushless DC Motor), is always an interesting research area among the researchers in past three decades. As the use of electronic Hall-Effect sensors for rotor position estimation needs extra wiring and circuitry, making the system costly and complex. Moreover, the Hall-Effect sensors are fragile and operate satisfactorily over limited range of temperature variation. Thus, these reasons have restricted the use of PMBLDC motor in low-cost industrial as well in home appliances. In the literature, many efforts have been made to overcome these demerits. The simple technique of position estimation of PMBLDCM is back EMF sensing technique [1-5]. In this technique, the commutation instants are decided by sensing the zero crossing of phase voltage with respect to virtual ground. However, the zero-crossing instant of the phase voltage is not the exact commutation instant. To achieve exact commutation instant, the zero-crossing instant needs to be phase shifted. Another method in this category, is based on the sensing of zero crossing of line voltages. Damodharan et al. [6-7] have shown that the difference in line voltages can be approximated as twice the –ve of phase back EMF. However, zero crossing of phase back EMF also gives the phase shifted commutation instant. The major drawback of these methods, is the poor performance at low speeds. As at low-speed, phase back EMF is too low to be sensed accurately, the effectiveness of the above-mentioned method is not good. In another method proposed by Becerra et al. [8] and Jahns et al. [9], the sensed back emf of silent phase is integrated till it reaches a prefixed threshold value. The integration starts at the zero crossing of the phase back emf and resets at the threshold value. The threshold value is decided at the value where virtual commutation instant exactly overlaps with exact commutation instant. This method also proves inefficient and less effective at lower speeds. Moriera et al. [4] and Shen et al. [10] have reported a novel method for sensor less technique in which three star connected resistor with neutral point n′ is connected to three phase balanced star connected windings with common node n. The frequency of the voltage between the two neutral points (Vnn′) is three times the frequency of trapezoidal back emf. That is why this method is reported as a third harmonic back EMF sensing technique. The Vnn′ waveform is integrated and the zero-crossing instant of it, decides the commutation instant. The zero crossing of Vnn′ is phase shifted by 300 from the exact commutation instant, however, an integration of this waveform exactly corresponds to the commutation instant. This technique needs the neutral point of the motor which is rarely available. In another technique [11], the current through the freewheeling diode of silent phase is sensed for commutation instant. Due to inductive winding of the motor, the current of silent phase freewheels through a diode. By sensing this current, the commutation instant is decided. The major drawback of this method is that it requires 6 current sensing circuits, which makes the system complex, costly and bulky. Kim et.al [1] have introduced a speed independent function for highly accurate commutation instant prediction. As the commutation instant is independent of speed, the authors have shown the sensor less operation of PMBLDC motor from very low speed to rated speed. In this technique, the control is divided into different modes of operation. However, for deciding the present mode of operation, an information about the previous mode is required. In the proposed technique, three speed independent H functions are generated to decide the commutation instant. These H functions are calculated by

sensing line voltages; hence, the neutral point is not required. As the PMBLDCM has three phase balanced windings, only two-line voltages are sensed and the third one is calculated using the other two. Due to the speed independency of the H functions, the proposed technique is used from zero speed to full rated speed. The three H functions independently control the commutation of each phase. The commutation instant and the switching pulse of three phase voltage source inverter (VSI) completely depend on the present value of the H functions. Therefore, this technique is used in increasing the reliability on the PMBLDC motor drive when operating with Hall sensors.
The major advantages of the proposed control technique are as follows.

1. Highly accurate and reliable operation of the drive over wide speed range.

2. It doesn't require any information of past states for deciding the commutation instant and switching pulses of VSI.

3. Only two-line voltages are required to sense and calculate H functions.

4. Digital filters are used for eliminating the commutation ripple and digital phase compensators are used to compensate for phase delay due to low pass filter. Therefore, no extra analogy filter or compensator circuit is required. This makes the system compact and cost effective.

5. This technique does not require huge computation. Thus it can be easily implemented on a low-cost DSP.

Main differences between the proposed method and the method [1] is listed here

1. In the proposed method, the rotor position is categorized in 6 intervals, and each interval is analysed separately for deciding the commutation instant. During the analysis of each interval, the symmetry in the waveform of phase back EMF and phase currents are used for simplified H function. However, Kim et.al [1] have proposed the commutation function, which are same for each and every rotor position.

2. Kim et.al [1] have proposed the G function to identify the commutation instant. The frequency of the G function is twice the frequency of the phase currents and the phase line voltage waveforms, whereas, the frequency of the proposed H function is same as that of the phase currents and the line voltage.

3. The implementation of the method proposed by Kim et.al [1] requires, two current sensors and one voltage sensor, whereas, the proposed method requires only two voltage sensors.

4. The proposed H functions are only the function of difference of the line voltages, whereas, the method proposed by Kim et.al [1] is a function of three phase currents as well as three-line voltages.

5. The estimation of the position of the rotor by the proposed method at any instant, only requires the present magnitude of the line voltage. However, the method proposed by Kim et.al [1] requires dc link voltage and three phase currents at present instant and the information of the phase current at previous instant. As the frequency of the G function is double the frequency of the phase current the waveform of the G function is same for positive as well as negative half of the phase currents. Therefore, information of the previous instant of the phase current is required to decide the commutation instant the waveform of the G function is same for positive as well as negative half of the phase currents. Therefore, information of the previous instant of the phase current is required to decide the commutation instant.

6. In the proposed method, the phase delay during sensing of the waveform has been taken care off.

II. PROPOSED SENSORLESS TECHNIQUE

Fig.1 shows the overall PMBLDC motor drive system. A three phase PMBLDC motor is fed through a three phase VSI. For external commutation of PMBLDC motor, line voltages are sensed and the Hall signals are generated using a DSP. The DSP is programmed through a personal computer.

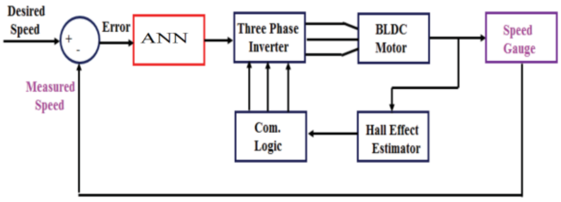

Fig. 1 Block diagram of proposed BLDC motor drive.

A. Mathematical Model for PMBLDC motor

A substantial literature has discussed about mathematical modelling of the PMBLDC motor [21-23]. The PMBLDC motor has concentrated windings on its stator and permanent magnets on the rotor and hence it operates in 1200 mode of VSI. Therefore, at any instant, the current enters one phase, exits from second and the third phase is open. Hence, only two phases are active at any instant and the third phase is silent. The phase to neutral voltage equation of phase 'a' is expressed as,

$$v_{an} = i_a R + L\frac{di_a}{dt} + \frac{d(\lambda_{af}(\theta))}{dt}$$

where, ia is phase 'a' current, R and L are phase resistance and phase inductance and, λaf(θ) is the rotor flux linking phase 'a' winding. The rate of change of rotor flux linking the phase windings is termed as the induced back EMF. Therefore, (1) is modified as,

$$v_{an} = i_a R + L\frac{di_a}{dt} + E_{an}$$

where, Ean is induced phase back EMF. Similarly, the voltage equations for other phases are expressed as,

$$v_{bn} = i_b R + L\frac{di_b}{dt} + E_{bn}$$

$$v_{cn} = i_c R + L\frac{di_c}{dt} + E_{cn}$$

As the neutral point is not accessible, therefore, line voltages are expressed as,

$$v_{ab} = v_{an} - v_{bn} = i_a R + L\frac{di_a}{dt} + E_{an} - \left(i_b R + L\frac{di_b}{dt} + E_{bn}\right)$$

$$v_{ab} = (i_a - i_b)R + L\frac{d(i_a - i_b)}{dt} + (E_{an} - E_{bn})$$

Similarly,

$$v_{bc} = (i_b - i_c)R + L\frac{d(i_b - i_c)}{dt} + (E_{bn} - E_{cn})$$

$$v_{ca} = (i_c - i_a)R + L\frac{d(i_c - i_a)}{dt} + (E_{cn} - E_{an})$$

These line voltages are accessed by sensing voltage at motor terminals. The difference in vab and vbc gives,

$$v_{abbc} = v_{ab} - v_{bc} = \left[(i_a - i_b)R + L\frac{d(i_a - i_b)}{dt} + (E_{an} - E_{bn})\right] - \left[(i_b - i_c)R + L\frac{d(i_b - i_c)}{dt} + (E_{bn} - E_{cn})\right]$$

$$v_{abbc} = (i_a + i_c - 2i_b)R + L\frac{d(i_a + i_c - 2i_b)}{dt} + (E_{an} + E_{cn} - 2E_{bn})$$

Similarly differences between vbc and vca, and vbc and vca are as follows,

$$v_{bcca} = (i_b + i_a - 2i_c)R + L\frac{d(i_b + i_a - 2i_c)}{dt} + (E_{bn} + E_{an} - 2E_{cn})$$

$$v_{caab} = (i_c + i_b - 2i_a)R + L\frac{d(i_c + i_b - 2i_a)}{dt} + (E_{cn} + E_{bn} - 2E_{an})$$

B. Mathematical Model of Proposed Method

Fig.2 shows the induced back emf and phase current of each winding. These waveforms are shown against the rotor position. From the figure it can be comprehended that the winding current depends on rotor position. Hence for excitation of the motor, the rotor position is inevitable. Each winding is excited for 1200. Therefore, based on the rotor position, the figure is divided in 6 different intervals. For any interval, only two phases conduct, and the third one remains open. Consider a interval I, current enters phase ‘a’ and returns from phase ‘c’, and the current in phase ‘b’ is zero. The back emf of phase ‘a’ is constant and positive whereas, back emf of phase ‘c’ is negative. Similarly in an interval II, current enters phase ‘c’ and returns form phase ‘a’, and the current in phase ‘b’ is zero.

For intervals I and II,

$i_a = -i_c$, $i_b=0$, and $E_{an} = -E_{cn}$

Hence, (10 - 12) are modified as,

$$v_{abbc} = -2E_{bn}$$

$$v_{caab} = -3i_aR - 3L\frac{di_a}{dt} - 3E_{an} + E_{cn}$$

$$v_{abbc} = 3i_aR + 3L\frac{di_a}{dt} + 3E_{an} + E_{cn}$$

From (18 - 20),

$$\frac{3E_{an} + E_{cn}}{-2E_{cn}} = \frac{v_{abbc} - 3i_aR - 3L\frac{di_a}{dt}}{v_{bcca}}$$

$$\frac{3E_{an}}{E_{cn}} = \frac{6i_aR + 6L\frac{di_a}{dt} - 2v_{abbc} - v_{bcca}}{v_{bcca}}$$

As, $i_a = -i_b$, $i_c=0$, and $E_{an} = -E_{bn}$

$$\frac{-3E_{bn}}{E_{cn}} = \frac{-6i_bR - 6L\frac{di_b}{dt} - 2v_{abbc} - v_{bcca}}{v_{bcca}}$$

$$\frac{3E_{bn}}{E_{cn}} = \frac{6i_bR + 6L\frac{di_b}{dt} + 2v_{abbc} + v_{bcca}}{v_{bcca}}$$

Similarly, for intervals V and VI,

$i_b = -i_c$, $i_a=0$, and $E_{bn} = -E_{cn}$

Hence, (10 - 12) are rewritten as,

$$v_{caab} = -2E_{an}$$

$$v_{abbc} = -3i_bR - 3L\frac{di_b}{dt} - 3E_{bn} + E_{an}$$

$$v_{bcca} = 3i_bR + 3L\frac{di_b}{dt} + 3E_{bn} + E_{an}$$

$$\frac{3E_{bn} + E_{an}}{-2E_{an}} = \frac{v_{bcca} - 3i_bR - 3L\frac{di_b}{dt}}{v_{caab}}$$

$$\frac{3E_{bn}}{E_{an}} = \frac{6i_bR + 6L\frac{di_b}{dt} - 2v_{bcca} - v_{caab}}{v_{caab}}$$

As, $i_b = -i_c$, $i_a=0$, and $E_{bn} = -E_{cn}$,

$$\frac{-3E_{cn}}{E_{an}} = \frac{-6i_cR - 6L\frac{di_c}{dt} - 2v_{bcca} - v_{caab}}{v_{caab}}$$

$$\frac{3E_{cn}}{E_{an}} = \frac{6i_cR + 6L\frac{di_c}{dt} + 2v_{bcca} + v_{caab}}{v_{caab}}$$

From (17, 24 and 31), commutation instant of any phase is estimated. However, these signals are symmetric about Y-axis and they have the frequency twice the frequency of phase voltage and current. For deciding commutation instant, these functions require information about previous commutation instant. To make the commutation instant independent of the previous states an extra term is added to the H-functions. These three signals are further modified as follows:

$$H_{ab} = sign(v_{abbc})\frac{6i_aR + 6L\frac{di_a}{dt} - 2v_{bcca} - v_{abbc}}{v_{abbc}}$$

$$H_{bc} = sign(v_{bcca})\frac{6i_bR + 6L\frac{di_b}{dt} + 2v_{abbc} + v_{bcca}}{v_{bcca}}$$

$$H_{ca} = sign(v_{caab})\frac{6i_cR + 6L\frac{di_c}{dt} + 2v_{bcca} + v_{caab}}{v_{caab}}$$

$$(6i_aR + 6L\frac{di_a}{dt}) << (2v_{bcca} + v_{abbc})$$

this difference is clearly illustrated in Fig.3. This figure shows the comparison between the two terms at 1300 rpm. From this figure, it can easily be comprehended that the first term is approximately equal to zero, and it has peaks at the instant of commutation. These peaks are reflected in the H functions, which may further cause false commutation. For detection of proper commutation instant, the first term is neglected from the H function. As the H functions are independent of the speed, the above assumptions work well for wide range of speed variation. This has been clearly demonstrated in section IV. However, the assumption is a function of the phase currents. The waveform of H functions depends on the phase currents. Therefore, the waveform of the H functions changes with variation in phase currents. This variation is self-explanatory from Fig.15 (a-b).

As $(6i_aR+6L\frac{di_a}{dt}) << (2v_{bcca}+v_{abbc})$ therefore, (32) is approximated as,

$$H_{ab} = sign(v_{abbc})\frac{-2v_{bcca}-v_{abbc}}{v_{abbc}}$$

Similarly, (33-34) can be modified as,

$$H_{bc} = sign(v_{bcca})\frac{2v_{abbc}+v_{bcca}}{v_{bcca}}$$

$$H_{ca} = sign(v_{caab})\frac{2v_{bcca}+v_{caab}}{v_{caab}}$$

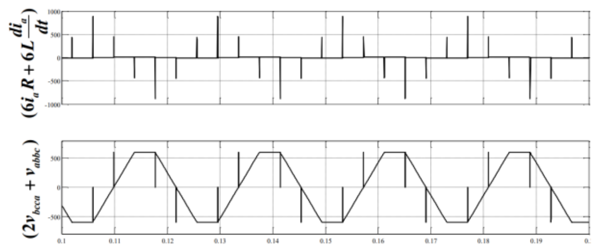

Fig. 2 Comparison between 6iaRa+6La(dia/dt) and (2vbcca+vabbc) clearly shows that first term is very small as compared to the second term at 1300 rpm.

Few assumptions are made while deriving the H functions and they are summarized as follows. 1. The permeability of the core material is neglected.

2. The permittivity of magnets are considered equal to the air. Therefore, phase inductance is independent of rotor positions.

3. The phase windings of the motor are considered balanced and identical.

4. Leakage flux and fringing effect are neglected.

III. BLDC SPEED CONTROLLERS

There are several controllers available nowadays like proportional integral (PI), proportional integral derivative (PID) ANN or the combination between them: Artificial-Neural Networks, Fuzzy Genetic Algorithm, Fuzzy-Ants Colony, Fuzzy-Swarm. But as within the scope of this paper the discussion on the PI and ANN Controller will be discussed as below. A. PI Speed Controller a Proportional Integral (PI) is a feedback control loop mechanism used in electrical control system. PI Controller finds its applications in many industrial processes where a controller attempts to correct the error between a measured process variable and reference set point. The algorithm involves a calculation and outputting of a corrective action which is done in order to adjust the process accordingly. The PI controller, as the name indicates, involves two separate modes that are: the proportional mode and integral mode. The proportional mode determines the reaction to the current error whereas the integral mode determines the reaction based recent error [6]. Due to its simple structure and ease of use; PI controller is widely used in industry. Fig. 3. describes the PI Controller based PMBLDC drive. The drive consists of speed controller, reference current generator, PWM current controller, position sensor, the motor and IGBT based current controlled voltage source inverter (VSI).

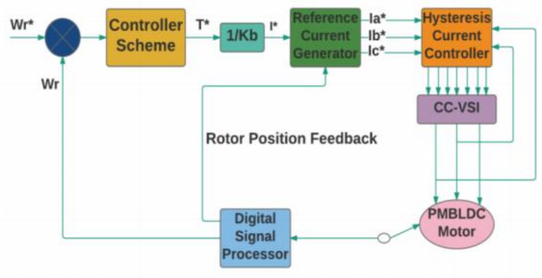

Fig. 3: Block Diagram of a BLDC Motor with Controller Scheme

The speed of the motor is compared with its reference value and the speed error is processed in proportional-integral (PI) speed controller. The flowchart in Fig. 3 shows the speed control algorithm of a BLDC Motor. The speed loop of the typical BLDC motor is generalized in this flowchart and is common for any type of controllers used [16].

SIMULATION RESULTS

The Simulink model of the BLDC motor [13]. The closed loop controller for a three phase brushless DC motor is modelled using MATLAB/Simulink [14] and [15] is shown in Fig. 7.1. Permanent Magnet Synchronous motor with trapezoidal back EMF is modelled as a Brushless DC Motor.

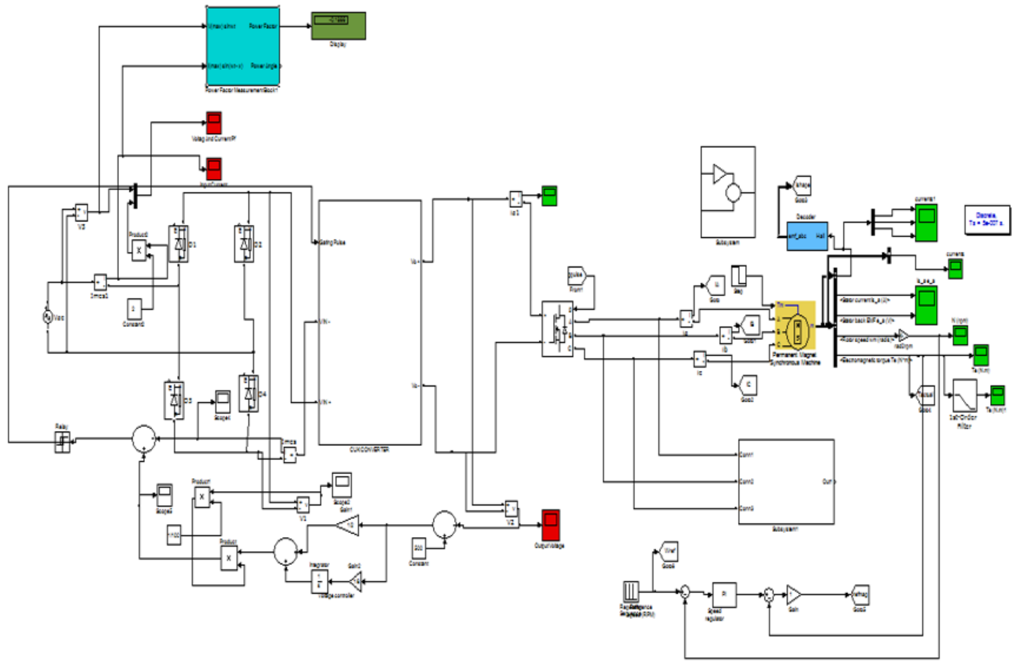

Fig4: Simulink model of the PFC based BLDC drive.

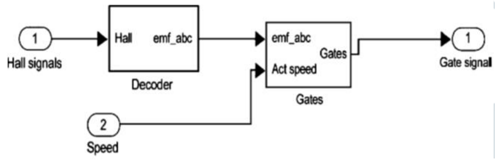

Fig 5: Modelling of the controller.

The model of the controller shown in Fig. 5, receives the Hall signals as its input, and converts it into appropriate voltage signals.

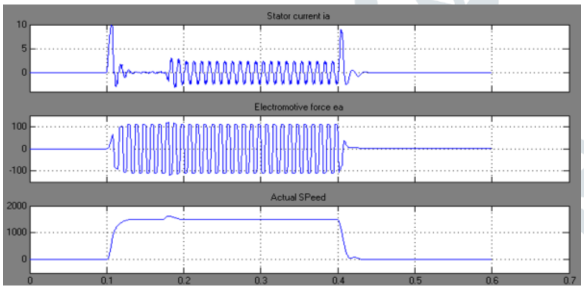

Fig 6. Output model of the Simulink: stator current, back emf, actual speed.

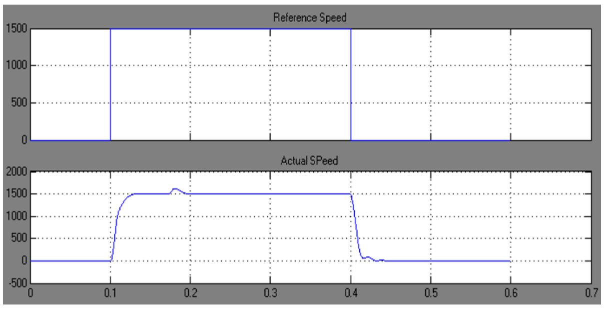

Fig: 7. Reference speed and actual speed in rpm.

The simulation results shown in Fig. 6 indicates that, when a negative torque is applied at time 0.6s, there is a peak overshoot in the actual speed, which means it aids the motor to run. At other times the speed is stabilized with the reference speed. The reference speed is 1500 rpm. The speed comparison between the actual speed and the reference speed is shown in Fig. 7.

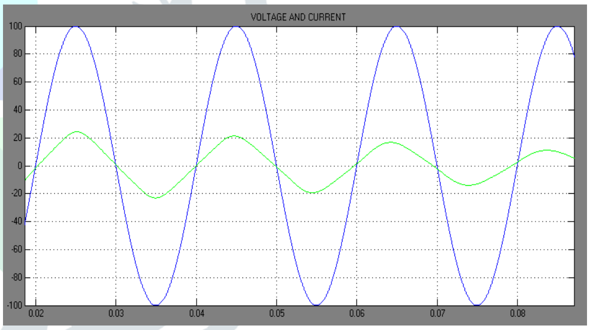

Fig: (a)

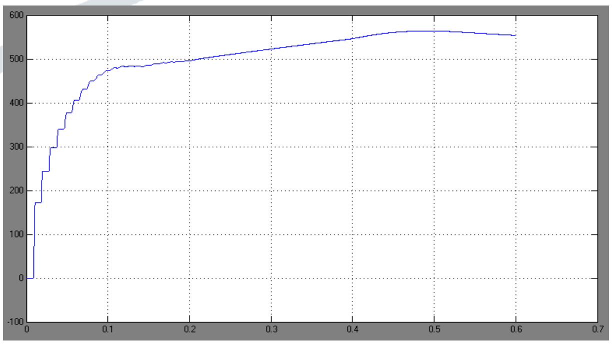

Fig:(b)

Fig:8 after connecting the cuk converter at the rectifier end (a) input voltage and current (b) dc output voltage

The capacitor is connected at the rectifier end. The input voltage and current waveforms as shown in fig 8(a) in the currents the ripples will appear and the voltage and currents are not maintained unity power factor so the output voltage at the rectifier end is not pure DC as shown in fig 8(b).

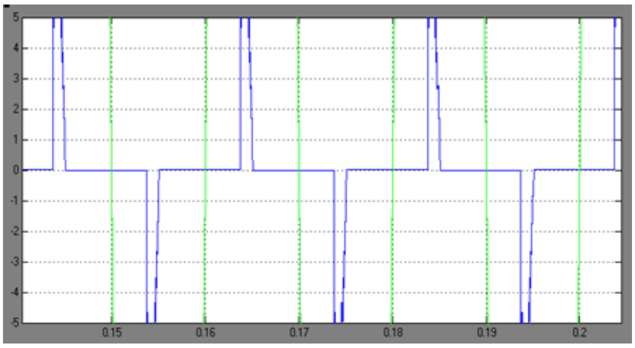

Fig:(a)

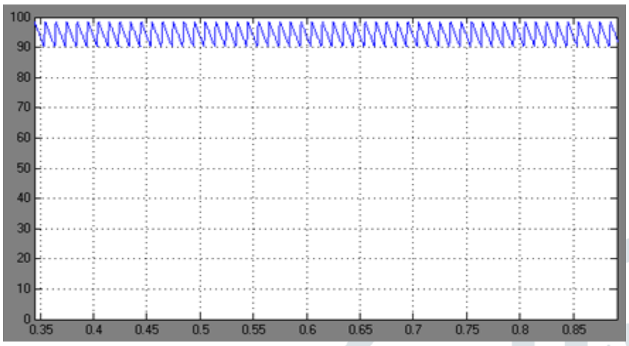

Fig: (b)

Fig: 9: Before connecting the cuk converter at the rectifier end: (a) input voltage and current (b) dc output voltage.

We are using cuk converter in the place of capacitor then the input side power factor maintained unity as shown in fig 9(a) and get the pure DC at the rectifier end the waveform as shown in fig 9(b)

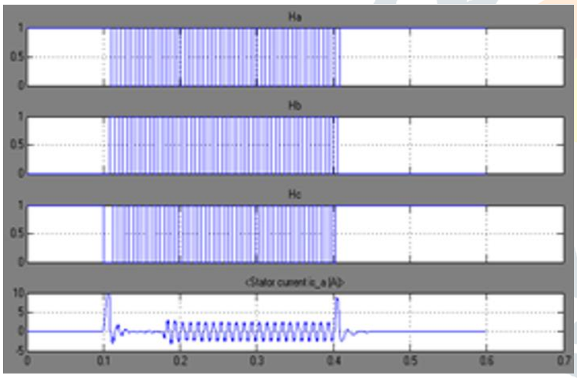

Fig: 10. Hall signals and stator current.

The hall signals and stator current are as shown in fig. 10. The hall signals are converted into emf signals then these signals are decided to activate the switches.

REFERENCES

[1] B. Tibor, V. Fedak and F. Durovsky, "Modeling and simulation of the BLDC motor in MATLAB GUI," industrial Electronics (lSiE). 2011 TEEE International Symposium on, Gdansk, 2011 , pp.1403-1407.

[2] W. Hong, W. Lee and B. K. Lee, "Dynamic Simulation of Brushless DC Motor Drives Considering Phase Commutation for Automotive Applications," Electric Machines & Drives Conference, 2007(lEMDC '07 TEEE international),in Antalya, 2007, pp. 13 77-1383.

[3] M. <;:ahin, H . I Bulbul, Z . Esen, U. Yavanoglu and I <;:olak, "Simulation study on BLDC motor drive system based on multisim and LabVIEW," Power Engineering. Energy and Electrical Drives (POWERENG), 20i3 Fourth International Conference,in Istanbul, 2013 , pp. 1060-1064.

[4] H. K. Samitha Ransara and U. K. Madawala, "Modelling and analysis of a low-cost Brushless OC motor drive," industrial Technology (lCiJ], 2013 TEEE International Conference on, Cape Town, 2013 , pp. 356-361.

[5] L. Zhao, X. Zhang and JunhongJi, "A torque control strategy of brushless direct current motor with current observer," Mechatronics and Automation (lCMA), 2015 TEEE international Conference, in Beijing, 2015, pp. 303-307.

[6] S. Rambabu "Modeling and control of a brushless DC motor" in PhD dissertion, National Institute of Technology Rourkela, 2007 pp.17-28.

[7] M. Harith, K. P. Remya, Kalady AS] ET, and S. Gomathy. "Speed Control of Brush less DC Motor Using Fuzzy Based Controllers" in International Research Journal of Engineering and Technology,voI.2 . pp. no. 875-881 , July 2015.

[8] Z. Ibrahim and E. Levi, " A comparative analysis of fuzzy logic and PI speed control in high-performance AC drives using experimental approach," in IEEE Transactions on Industry Applications, vol. 38, no. 5, pp. 1210-1218, Sep/0ct2002.

[9] M. Cheng, Qiang Sun and E. Zhou, "New self-tuning fuzzy PI control of a novel doubly salient permanent magnet motor drive," in IEEE Transactions on Industrial Electronics, vol. 53, no. 3, pp. 814-821 , June 2006.

[10] Sant and K. R. Rajagopal, "PM Synchronous Motor Speed Control Using Hybrid Fuzzy-PI with Novel Switching Functions," in IEEE Transactions on Magnetics, vol. 45, no. 10, pp. 4672-4675, Oct. 2009.

[II] T. C. Siong, B. Ismail, S. F. Siraj, M. F. N. Tajuddin, N. S. Jamoshid and M. F. Mohammed, "Analysis of Fuzzy Logic controller for permanent magnet brushless DC motor drives," Research and Development (SCOReD), 2010 iEEE Student Conference, inPutrajaya, 2010, pp. 436-441.

[12] G. Prasad, N. SreeRamya, P. V. N. Prasad, and G. Tulasi Ram Das. "Modelling and simulation analysis of the brushless DC motor by using MATLAB." Proceedings of IJiTEE 1, no. 5 (2012): 2278-3075. [6]

[13] Tashakori and M. Ektesabi, " A simple fault tolerant control system for Hall Effect sensors failure of BLDC motor," Industrial Electronics and Applications (ICIEA), 2013 8th IEEE Conference, in Melbourne, VIC, 2013 , pp. 1011-1016.

[14] H. S. EI-Sayed, F. M. EI-Khouly, M. M. Khater and A M. Osheiba, " Fuzzy Logic Based Speed Control of a Permanent Magnet Brushless DC Motor Drive," Electrical Engineering, 2007. ICEE '07. International Coliference,in Lahore, 2007, pp. 1-6.

[15] N. Parhizkar, M. Shafiei and M. B. Kouhshahi, "Direct torque control of brushless DC motor drives with reduced starting current using fuzzy logic controller," Uncertainty Reasoning and Knowledge Engineering (URKE), 2011 International Conference,in Bali, 2011 , pp. 129-132.

[16] S. P. and S. A , "Speed control of bru shless DC motor with PI and fuzzy logic controller using resonantpole inverter," innovative Smart Grid Technologies-fndia (ISGT india), 2011 iEEE PES, Kollam, Kerala, 2011 , pp. 334-339.

[17] M. Ahmed, Amr Ali-Eldin, Mohamed S. Elksasy, and Faiz F. Areed. "Brushless DC Motor Speed Control using

both PI Controller and Fuzzy PI Controller." international Journal of Computer Applications 109, no. 10 (2015): 29-35.

AUTHORS DETAILS:

Mrs.KATTOJU GNANESHWARI received the DIPLOMA in Dept. of Electrical & Electronics Engineering from KDR Government Polytechnic, Wanaparthy, Telangana, India in 2013 and B.Tech.in Department of Electrical & Electronics Engineering from Siddhartha institute of Engineering and technology, Hyderabad, Telangana State, India from **JNTUH** University in 2016, and Studying M Tech. in Electrical Power System at Holy Mary Institute of Technology & Sciences. Hyderabad Telangana, India.

Mrs.G.P.MERLINE received the B.TECH in Electrical and Electronics Engineering from Srinidhi Institute of Science and Technology, Yamnampet (V), Ghatkesar (M), Hyderabad, Telangana,India, From **JNTUH** University in 2011 and M. Tech.in Electrical Power System from Arjun College of Technology & Science, Batasingaram (V),Hayathnagar (M), Hyderabad, Telanagana,India From **JNTUH** University in 2015.She is currently working as Assistant Professor in Department of Electrical and Electornics Engineering at Holy Mary Institute of Technology & Sciences,Bogaram (V), Keesara (M), Medchal(D),.Hyderabad Telangana, India.