International Journal of MC Square Scientific Research Vol.10, No.1, 2018

Bridgeless Landsman Converter Based BLDC Motor Drive Using IFOC

khalid Ali khan
Lecturer
Department of Electronics and Communication Engineering, Mettu university
Ethipoia.
Email: sts.khalid@gmail.com

Abstract

This project proposed to improve performance of BLDC motor control using landsman converter sensor less vector control technique where the photovoltaic source is preferred for powering the motor. The sensor less control technique does not use position and speed sensors instead make use of voltage and current measurements. A simplified indirect field oriented control (IFOC) with back-EMF observer for speed estimation replaces the MB-PWM control technique which results in reduction of torque ripple and obtains a trapezoidal stator current waveform. It also results in reduction of total harmonic distortion in stator current of BLDC motor when compared with simple boost PWM. The improved performances of sensor less BLDC motor with various control techniques are verified. The dc link voltage, Speed and torque characteristics is achieved using indirect field oriented control method are verified using MATLAB/Simulink.

Keywords: BLDC, Back EMF, IFOC, PWM, DC link voltage.

1. Introduction

Single Construction of brushless DC motor (BLDC) is very basic and BLDC engine has high productivity and high thickness because of its roughness. Consequently it is favoured in extensive scope of applications like car industry, footing gadget as well as crossover EV. Be that as it may, the shut circle BLDC speed control engine needs the speed and the position of rotor. Anyway the engine causes vibrations which lessen the exactness of speed estimation utilizing position sensors and optical encoders at low and high speeds [1-3]. Position Sensor less control for the new pattern investigates at BLDC engine control applications. Sensor less control techniques has two significant orders: strategy of position estimation and speed depend the flux and EMF and the other approach depends on infusing high recurrence utilizing engines striking impact [4]. Solar powered motor drives are recent trend is compared to conventional grid fed motor drives [5-6]. Conventional motor control system involves two stage of power conversion,

converting three phase ac supply from grid to DC and converting DC to AC using voltage source inverter. Landsman converter is another choice for controlling an unregulated info control supply, similar to an ease divider mole. The essential capacity of a DC–DC Landsman converter is to streamline the power yield of SPV cluster and it additionally gives the protected and delicate beginning of the BLDC engine with a suitable control. Among different DC–DC converters, Landsman converter meets the ideal execution [7-9].

The objective of this paper is to extract efficient PV power for sensor-less BLDC motor and to improve motor characteristic performance. The BLDC motor drive is powered from a low voltage photovoltaic source through a boost converter and voltage source inverter. In the proposed system a speed estimation technique is used without speed sensors. The motor performance is observed with different pulse width modulation (PWM) control techniques. For extracting efficient and high power from PV source, different MPPT techniques were applied. The indirect field oriented control method is improved using landsman converter for reducing the harmonics of stator current.

2. Proposed System

The proposed block diagram shown in figure 1 consists of PV source, landsman converter, DC link capacitor, three phase inverter, BLDC motor, IFOC control with vector control for three phase inverter and PI controller is used for landsman converter to maintain DC link voltage.

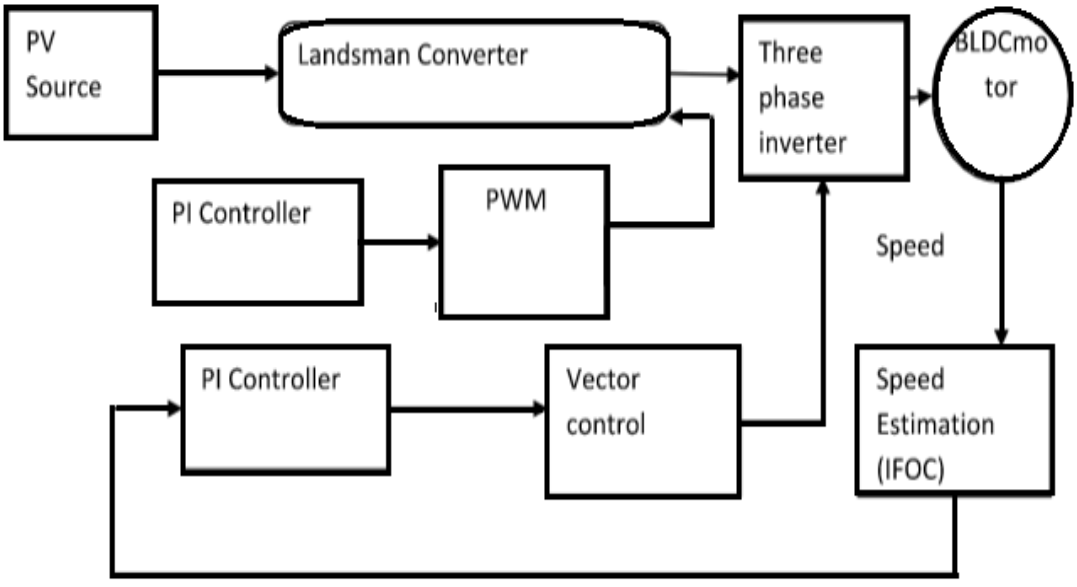

Figure. 1 Block Diagram of the Proposed System

3. Landsman Converter

This paper use the landsman converter topology is illustrated in figure 2. From an input voltage the LC supplies a positive output and the LC requires a series capacitor with two inductors. PFC bridgeless with LC with setup intended for functioning in DICM for integral PF improvement at alternating current supply.

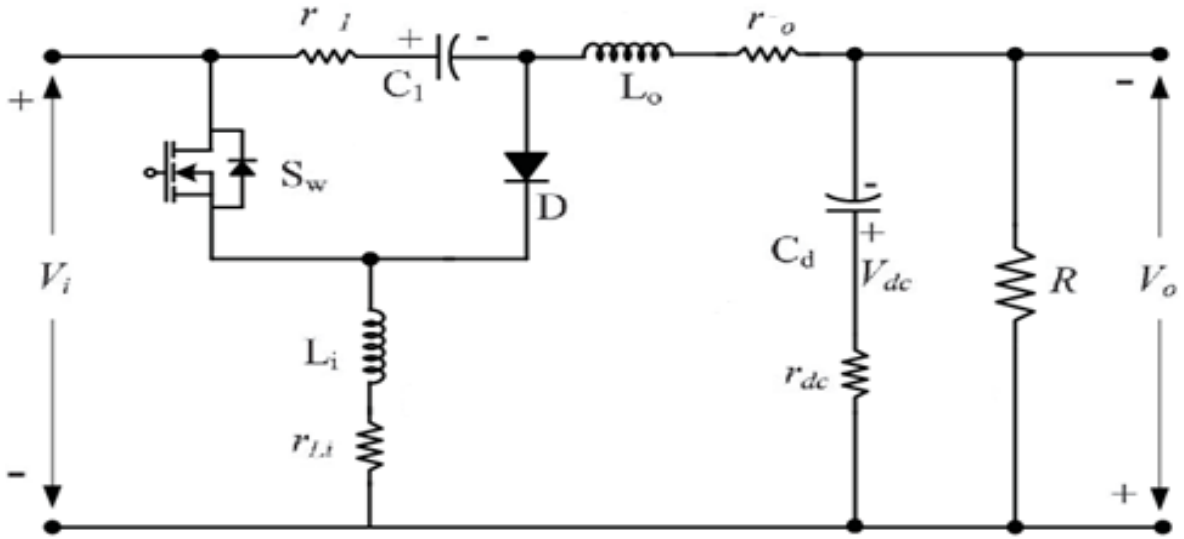

Figure. 2 Circuit Diagram of Landsman Converter

4. BLDC Motor

Brushless DC motors belong to a typical class of electric motors which are not self-starting, and commutation is governed electrically based on position sensors. A controller unit comprised of the micro controller or a digital signal processor is required to operate a BLDC motor in a safer zone during starting. BLDC motor is operated based on six step commutation sequence or 120o degree conduction mode to generate switching pulses for power switches in an inverter. In general driving circuit of a BLDC motor is three phase inverter as shown in the figure 3. From the table 1, one can observe that at any instant only two switches conduct and each switch conducts for an interval of 120o.

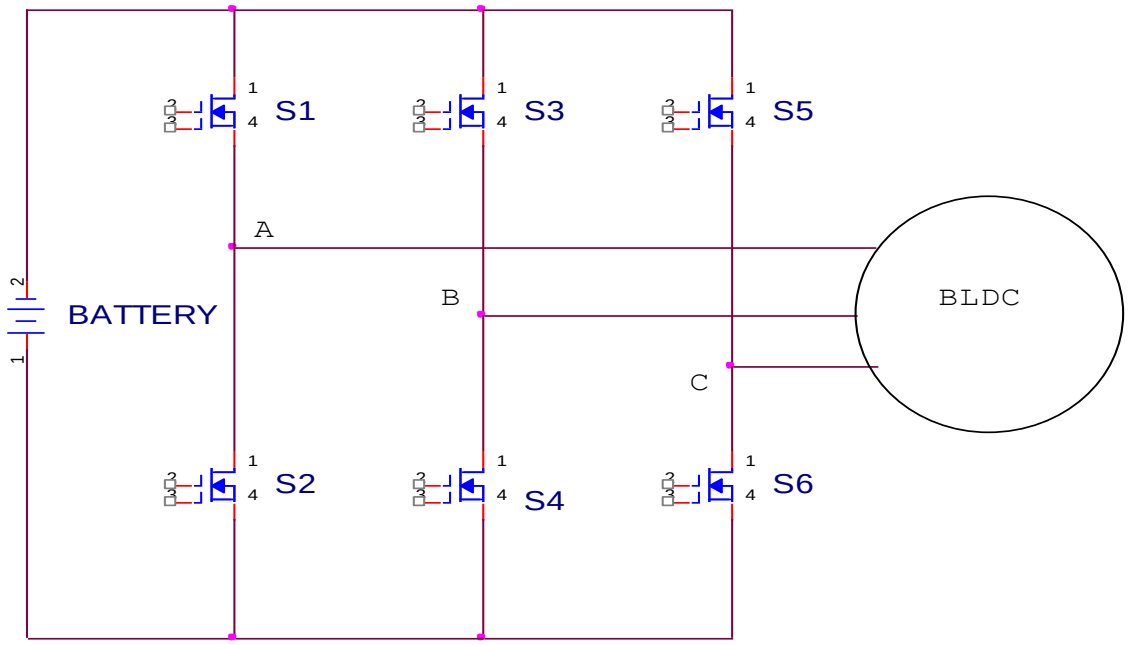

Figure. 3 Circuit Diagram of Landsman Converter

Table 1. Switching Table of Inverter

Hall Signal			ON Switches		Line current Sign		
A	B	C			Phase A	Phase B	Phase C
0	0	1	S1	S6	+	Off	-
0	0	0	S1	S4	+	_	Off
1	0	0	S4	S5	Off	-	+
1	1	0	S2	S5	-	Off	+
1	1	1	S3	S2	-	+	Off
0	1	1	S3	S6	Off	+	-

5. BLDC Motor

The speed of the drive is evaluated from stator voltage reference and assessed basic current as proposed. This evaluated speed is utilized as speed input for speed controller. Sensor less drive does not use either position or speed sensors and involves only sensing voltage and current motors. Sensor less motor drive can estimate the rotor position by a simple back EMF and phase current sensing. Back EMF integration method uses the back EMF of an unexcited phase of BLDC motor at any instant of time. The advantage of this method is that the area of integration of back EMF is similar to all speeds of the motor from low to high. When the unexcited back EMF's crosses zero integration is performed, and a threshold value is set for finding the commutation point using back EMF integrated value. Bloc diagram of back EMF method is shown in figure 4. Aberrant vector control of the rotor flows can be actualized utilizing the accompanying information: Instantaneous stator stage flows, ia, ib, and ic, Rotor mechanical position, Rotor electrical time consistent. The engine must be furnished with sensors to screen the three-stage stator flows and a rotor position criticism gadget. An encoder is typically mounted on the pole rotor for this reason however so as to have a less expensive arrangement is conceivable to utilize a speed input gadget, for example, a tachometer.

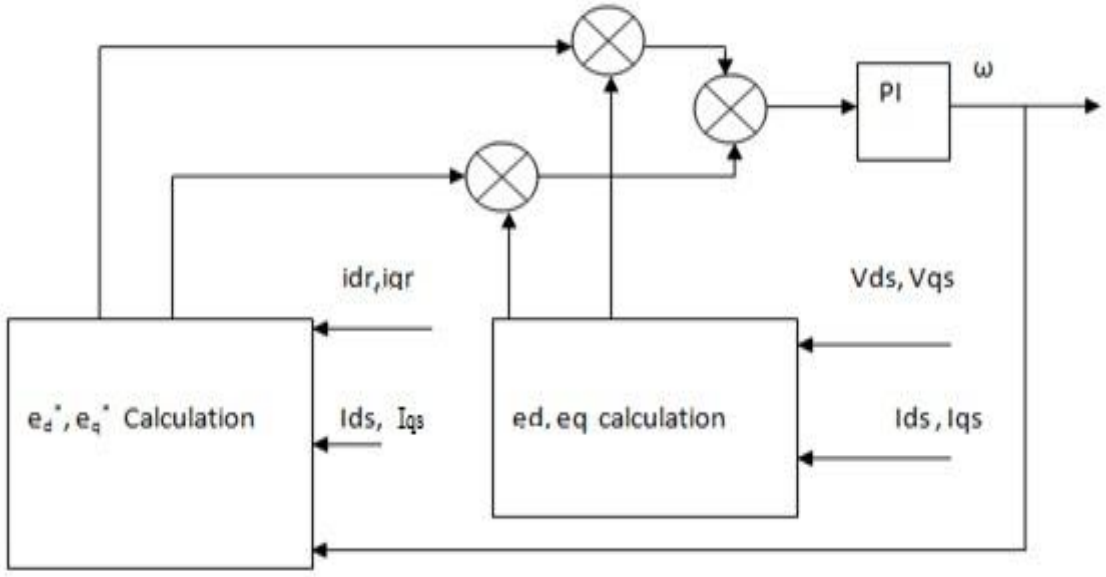

Figure. 5 Block Diagram of Back EMF

6. Simulation Results and Discussion

The Simulink model of proposed system is represented in figure 5 the PV source is connected with landsman converter which improves the source voltage and the supply to maintain dc link voltage in capacitor. Then three phase inverter is inverting dc link capacitor voltage. Finally three phase filter is reducing the ripples and transfers to BLDC motor. PV system is producing DC voltage which is 110v and it shows in figure 6. Figure 7 shows the DC link voltage of the proposed system is 120V. The output speed of BLDC proposed system is 600rpm as shown in figure 8. The output BLDC torque is shown in figure 9.

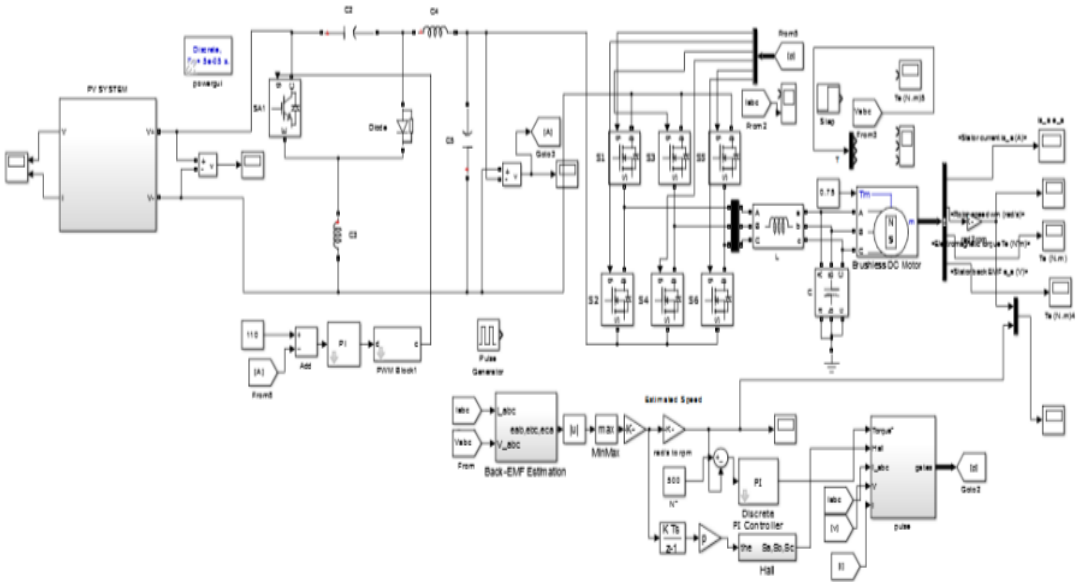

Figure. 5 Simulink Model of the BLDC Motor Drive

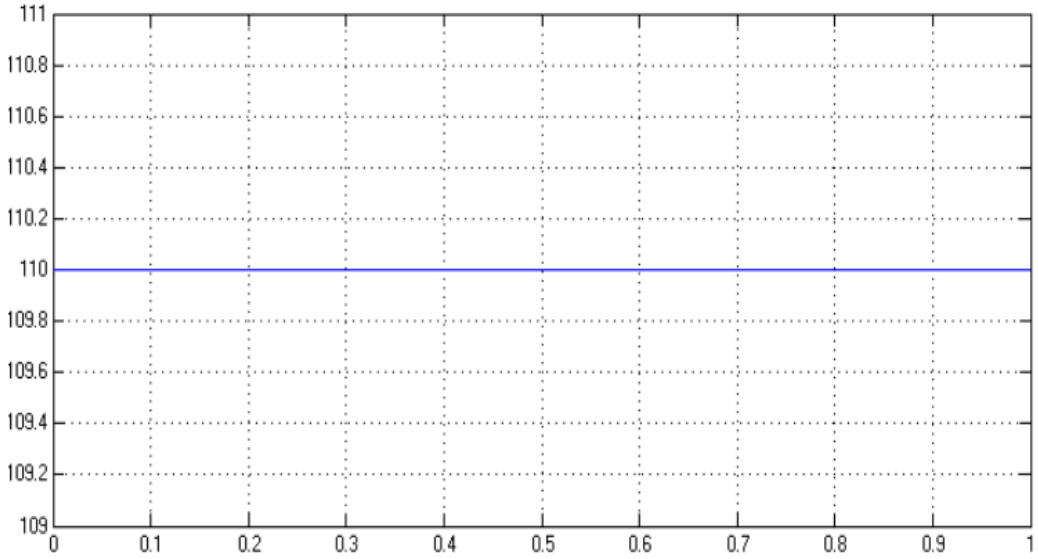

Figure. 6 Input Voltages from PV

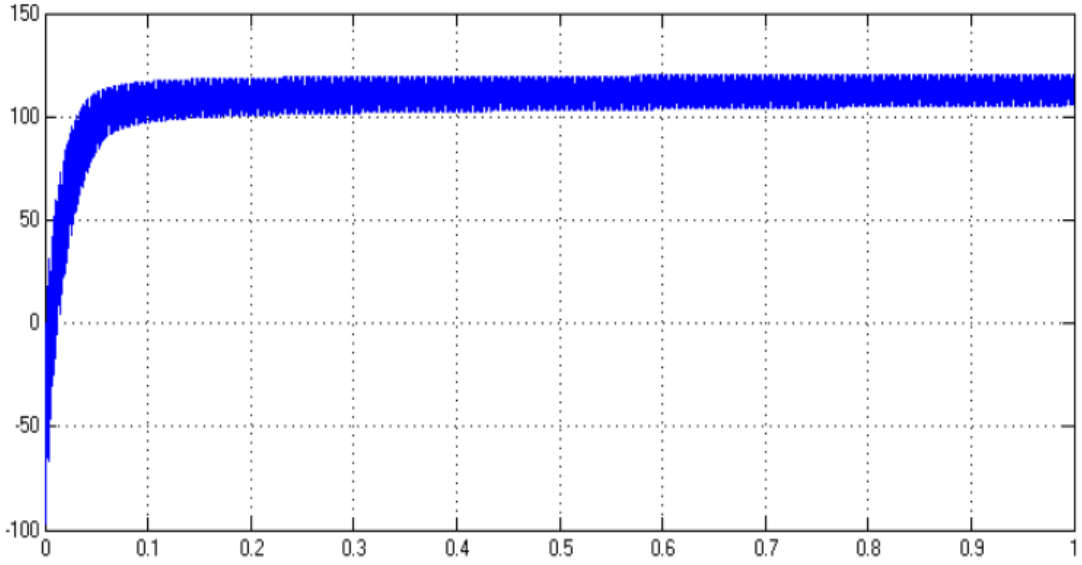

Figure. 7 DC Link Voltage

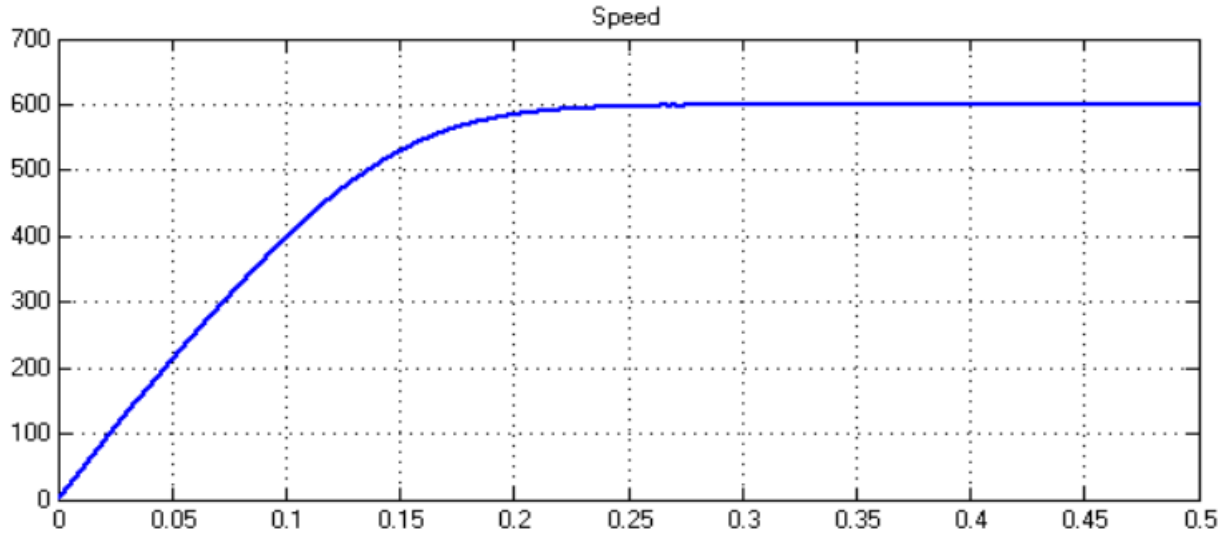

Figure. 8 Speed Waveform of the BLDC Using IFOC

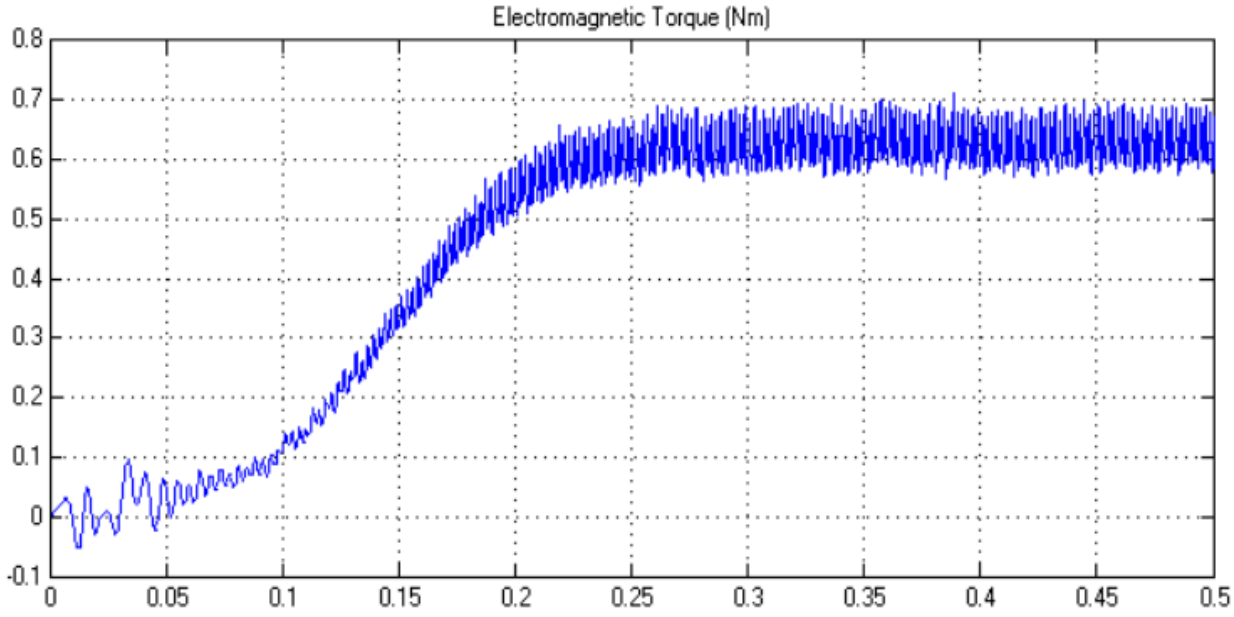

Figure. 9 Electromagnetic Torque Waveform of the BLDC Using IFOC

7. Conclusion

This paper presented a speed controller using a PI controller for indirect field oriented control (IFOC) of BLDC drives fed by a landsman converter from DC supply. The project describes the landsman converter supplied IM drive. To control the speed of the BLDC motor Voltage Source Inverter (VSI) and Current Source Inverter (CSI) are used due to this, it can diminish the capacitor voltage stress of quasi Z-source network and thus capacitors in low-voltage are elected to reduce the volume and inverter cost and increasing speed response of sensor-less BLDC.

References

1. Kumar, R., & Singh, B. (2014, December). Buck-boost converter fed BLDC motor drive for solar PV array based water pumping. In 2014 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES) (pp. 1-6). IEEE.

2.Morey M, Virulkar V. Rotor Flux Observer for Speed Sensorless IFOC Induction Motor at Low Speeds. In2018 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES) 2018 Dec 18 (pp. 1-6). IEEE.

3.Mishra S, Sinha SK, Pandey AS. Desight and Analysis of SPV array fed Water Pumping System using BLDC motor with different Converter Topologies. In2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON) 2018 Nov 2 (pp. 1-7). IEEE.

4 El-Samahy, Adel A., and Mohamed A. Shamseldin. "Brushless DC motor tracking control using self-tuning fuzzy PID control and model reference adaptive control." Ain Shams Engineering Journal 9, no. 3 (2018): 341-352..

5. Varshney, Akash, Deeksha Gupta, and Bharti Dwivedi. "Speed response of brushless DC motor using fuzzy PID controller under varying load condition." Journal of Electrical Systems and Information Technology 4, no. 2 (2017): 310-321.

6.Puviarasan D, Venkatesh C. One stage solar photovoltaic fed brushless DC motor operated water pump

7. Jaya, A., Purwanto, E., Fauziah, M.B., Murdianto, F.D., Prabowo, G. and Rusli, M.R., 2017, September. Design of PID-fuzzy for speed control of brushless DC motor in dynamic electric vehicle to improve steady-state performance. In 2017 International Electronics Symposium on Engineering Technology and Applications (IES-ETA) (pp. 179-184). IEEE.

8. Jaber, A.S., 2017. A novel tuning method of PID controller for a BLDC motor based on segmentation of firefly algorithm. Indian Journal of Science and Technology, 10(6), pp.1-5.

9.Verma V, Pal NS, Kumar B. Speed Control of the Sensorless BLDC Motor Drive Through Different Controllers. InHarmony Search and Nature Inspired Optimization Algorithms 2019 (pp. 143-152). Springer, Singapore.8. S.P. Thiruvadi and S. Bhuvaneshwari, "Hybrid PV-Wind-Battery Based System for Household Applications Using DC-DC Converter, " IJMSR, 2017, 9(1), 54-65.