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Design of Sepic Convetrer Controlled Bldc Motor for Electric Vehicle

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***Abstract*: This paper represents the design and analysis of the Brushless Direct current motor. The usage of brushless motor is increasing day by day in that the design aspects are more important and the customer satisfaction is important. Based upon the rating the needs brushless DC motor is designed. The design has been done with the controllers and the real time applications such as EV, the controllers had been used to get the proper design. The results are analyzed using the MATLAB simulink software.**

***Keywords* : Brushless Direct Current Motor(BLDC), Proportional Integral Derivative Controllers (PID), Voltage Source Inverter (VSI).**

I. INTRODUCTION

A Brushless Direct current motor is also as the permanent magnet brushless dc motor also as poly or many phase motor. This magnet cannot operate without its electronic controller. Therefore, a Brushless DC motor is a motor drive system that combines into one unit an AC motor, solid state inverter and a rotor position sensor. The solid state inverter uses transistor for low power drives and thyristor for high power drives. Rotor position sensor monitor the shaft sends the control signal for tuning on the controlled switches of the inverter in the appropriate sequence [1]. A Brushless DC motor is without brushes the Commutator and the carbon brushes is being eliminated in this motor. The problem of commutation is solved using the electronic commutation. The characteristics of the Brushless DC motor is more or less similar to the conventional DC motor, the commutation for the Brushless DC motor is done by sensing and switching which is of several types [2]. In these Brushless DC motor the sensing is done magnetically and switching by power transistors. Therefore, the mechanism of phase commutation and generation of torque ripple can be observed and analyzed in this model. A Brushless DC motor system should have the torque –speed characteristics of the conventional DC permanent magnet motors. The torque speed characteristics of a conventional DC motor hence the Brushless DC motor has the same characteristics [3]. The controllable AC motor systems depends on a variable frequency, variable ac voltage, which has to be coordinated with the short velocity to produce a controlled slip frequency current in the rotor windings, because the rotor-stator structure can be considered a transformer, it does not work well at low frequencies. This is the fundamental difference between the AC motors and Brushless DC motor [4]. Since the field torque is produced by the interaction of a magnetic field produced by a permanent magnet rotor, and magnetic field due to a Direct Current in a stator structure..In small machines the core rotor part is to get the direct torque the shaft is directly connected to it. The rotor has to equal with the usage of radial ducts in the ventilating ducts. The usage of axial ducts is to make the path flow for the radial ducts [5]. For the cooling purpose on the rings the thrust ring is used. The thrust ring is partially used in the axial ducts. The number of radial ventilating ducts providing in the ventilating ducts providing in the rotor is equal to that in rotor. Since there is no Commutator segments and carbon brushes we go for a permanent magnet rotor. The rotor is made up of solid cylindrical mild steel core upon which the magnets are being placed this whole structure forms the rotor. Instead of commutating the armature current using brushes, electronic commutation is used for this reason it is an electronic motor. This eliminates the problems associated with the brush and the Commutator arrangement[6,8]. From a controller standpoint, two styles of windings are treated exactly the same, although some less expensive controllers are designed to read voltage from the common center of star connected winding.

II.OPERATION OF BLDC MOTOR

The operation of the brushless Direct motor is consists of three parts they are (i) modelling (ii) controller (iii) inverter. The Proportional Integral and derivative controller is used in all the electronic application, if the system want to get the desired output and the accurate one then the Proportional Integral and derivative controller want to use carefully [7]. For tuning the system or process the PID controller is used mostly, the process involved in the controller is to get the three variables and the gain is to be achieved by tuning the modes the three variables are proportional, integral and derivative. Various control solutions methods are proposed for speed control design of BLDC Motor. However, PSO FOPID Controller Algorithm is an easy implementation, flexible & highly reliable. In this system or process, by the PSO approach the second order system and it is developed by using the fractional order proportional integral and derivative controller [8]. For controlling the speed of brushless direct current motor the fractional order proportional integral and derivative controller has been used.

In this the performance of the Brushless direct current motor using proportional integral and derivative controller is analysed and simulated.

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The performance of Brushless direct current motor as stator current, speed torque and stator voltage and the harmonics has been analysed and observed using the MATLAB Simulink software.

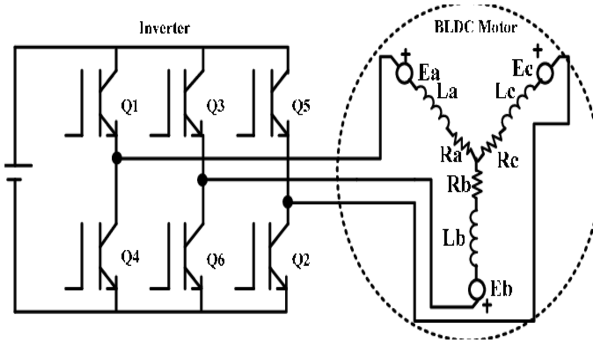

Fig.1 block diagram of Brushless Direct Motor

Normally the trapezoidal waveform and the quasi waveform will be the output of the Brushless DC motor in that it links with back emf (electromotive force), in that the Brushless Direct Current motor the back electro motive force will get induced, and its form as trapezoidal wave form and the constant part as stator will be quasi wave as it should be square waveform, in the normal asynchronous motor the emf will get induced and constant part will be the sinusoidal waveform.All the above mentioned control valves are controlled manually, which will be difficult for the workers to control. So this will affect the production of the paper. And if starch obtained is impure then the paper will have low smoothness and rigidity [9]. Thus the paper quality gets affected. In order to overcome this manual method automatic method is designed using PLC-S7 300.

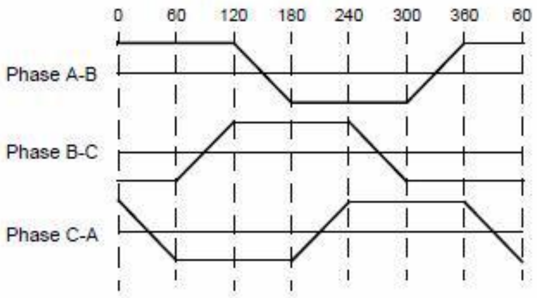

Fig.2 Normal trapezoidal waveform of Brushless DC motor

A. *Hall Sensor*

The hall effect sensing system is utilises the sensor which detects the magnitude and polarity of the magnetic field. The signals are amplified and processed to form logic compatible signal levels. The sensors are usually mounted in the stator side, where they used to sense the magnitude and polarity of the permanent magnet magnetic field in the air gap [10]. The output of the sensors control the logic function of the controller configuration to provide current to proper coil in the stator and the system can provide some compensation for armature reaction effects which are prominent in some more design.

The angular sensing is the electro optical switch, the photo effect transistor and the light emitting diode is the combination of the electrical optical switch. The light transmission of sensor and the transmitter is controlled by the shutter mechanism. The sensor voltage can be processed to supply logic signals to the controller.

B. *Proportional Integral and Derivative Controller*

To get the clear result from the closed loop system the proper result is needed so to get accurate result the proportional integral and the derivative combination is chooses and the performance will be efficient. The proportional integral and derivative in that the transfer function is needed and it is mentioned below,

$$C(s) = K_p\left(1 + \tau_d s + \frac{1}{\tau_i s}\right)$$

Based upon the global applicable the low order of controller only been choose, by the low order it can be applied in any of single input single output system the examples are time delay, nonlinear, linear etc. First the single input single output system form a loop and it is designed by the proportional integral and derivative controller, and then the multiple input m ultiple output loop is formed [10]. The main reason for using the proportional integral and derivative controller is huge one, so that also it is used in industries. In the particular application the process has to be tuned for various level for that the proportional integral and derivative controller has been used. The most important is that choosing the variables in PID controller and it should be an dependent one. If any process is went wrong the system stability will be change and it becomes irregular to the closed loop system [8].

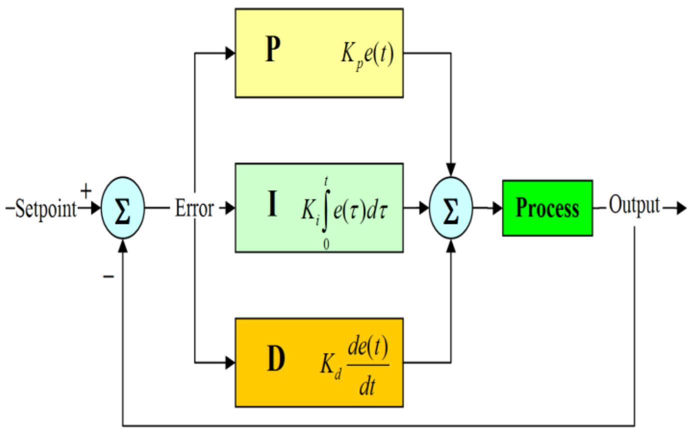

Fig.3 Proportional Integral Derivative Controller Diagram

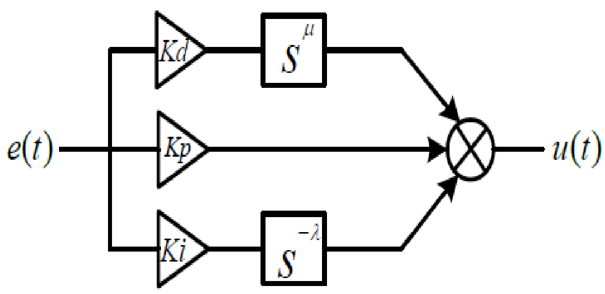

Fig.4 control Diagram of fractional PID

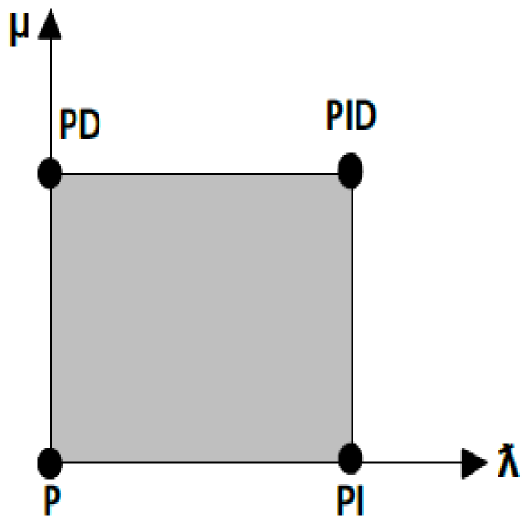

Fig.5 general diagram for fractional order PID

3. Simulation Diagram

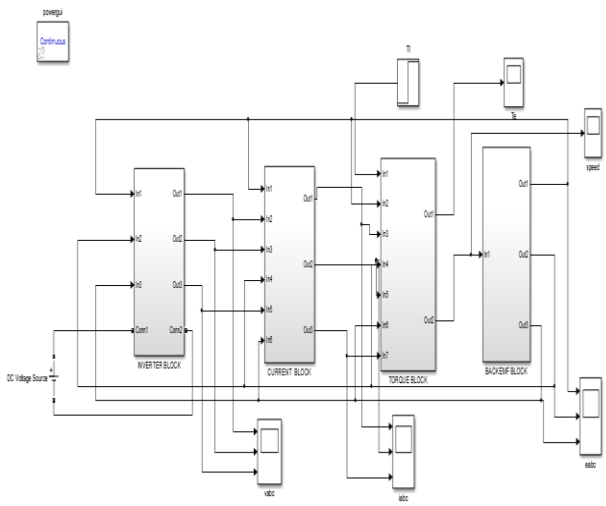

Fig.6 Simulation of Brushless DC motor

4. Simulation Result

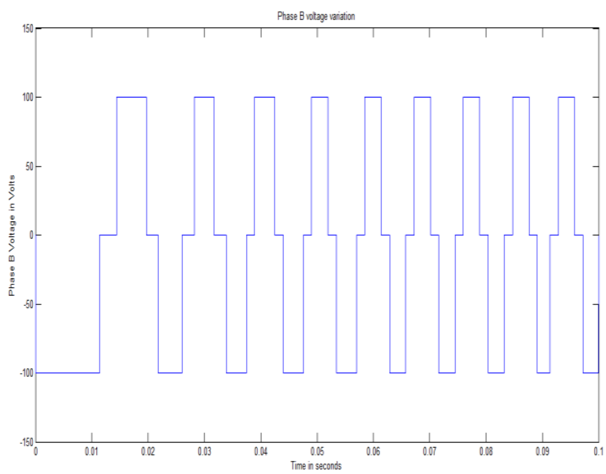

Fig.7 output of Brushless DC motor (phasor Voltage)

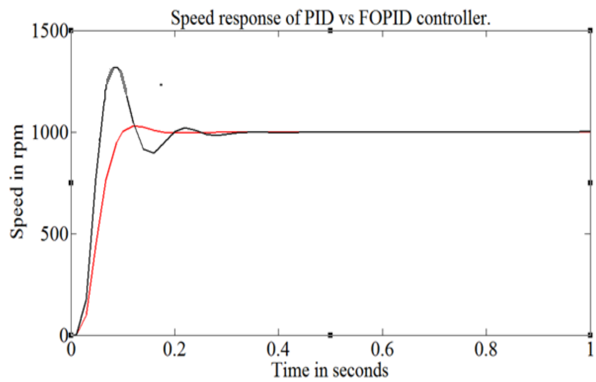

Fig.8 comparison of PID and FOPID controller

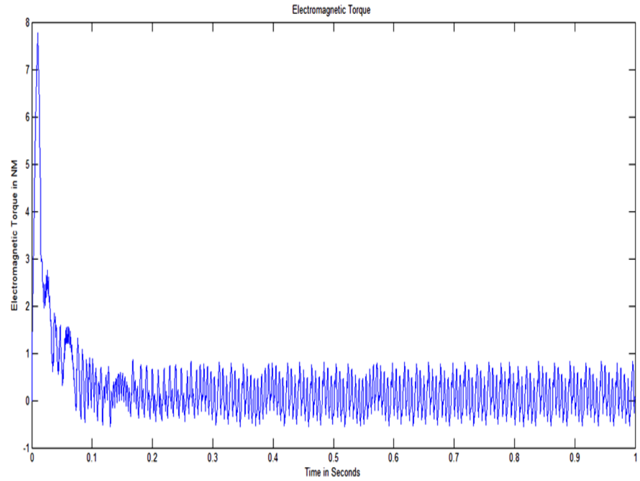

Fig.9 Torque of Brushless DC motor

II. CONCLUSION

This paper represents the design and analysis of the electronically commutated Brushless DC motor using the Proportional Integral Derivative Controller and Fractional order Proportional Integral Derivative Controller. Thus by comparing these two controllers the deviations created by the proportional integral controller is identified and it is cleared by the fractional order PID. The open loop and the closed loop system is used to tuning the controllers.

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