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Z SOURCE NETWORK BASED SENSOR LESS BLDC MOTOR WITH MINIMIZED COMMUTATION TORQUE RIPPLES USING DTC METHOD

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ABSTRACT: In industrial conceptual an electronic drives plays vital role to make the energy as efficient. Recently the process made in the industries are using a brushless DC motor (BLDC) has enhancing the overall system efficiency. Therefore the process should made excellent operation by using BLDC which is controlled by z source network and voltage source inverter (VSI).BLDC has more features such as low inertia and friction, low radio interference, high reliability and high efficiency. Due to the absence of brushes, it requires practically no maintenance. Since it has some drawbacks are high cost, low starting torque compared to conventional DC motor and it has no flexibility control, because the absence of field winding. Hereby it can be overcome the above drawback Direct Torque Control (DTC) is introduced with BLDC for improving its efficiency, compared to other conventional control techniques. By using DTC technique ripples produced from torque can be reduced. Due to this reduction in ripple torque,the motor has enhances the speed and increases the speed torque curve. Hence the system is optimised by using z-source network and sensor-less technique to energise the BLDC motor. Here, simulation of the z-source network based DTC for BLDC is performed by using MATLAB/simulink and the results are validated according to the theoretical analysis.

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KEYWORDS: Direct Torque Control, Brushless DC motor , Z- source network.

1.INTRODUCTION:

A drive is an electronic device that harnesses and *controls* the electrical energy sent to the motor. The drive feeds electricity into the motor in varying amounts and at varying frequencies, thereby indirectly controlling the motor's speed and torque. The speed of rotation of an electrical machine can be controlled precisely by implementing the concept of drive. The main advantage of this concept is, the motion control is easily optimized with the help of drive. In very simple words, the systems which control the motion of the electrical machines are known as electrical drives. This drive system is widely used in large number of industrial and domestic applications like factories, transportation systems, textile mills, fans, pumps, motors, robots etc. Drives are employed as prime movers for diesel or petrol engines, gas or steam turbines, hydraulic motors and electric motors. In this thesis the drive system is used to control the speed of the brushless DC motor.

High speed brushless dc (BLDC) motor as a core component of the high-speed maglev blower can be directly connected to the high-speed mechanical equipment and effectively improves system efficiency . The back-electromotive-force (EMF) technique as a sensor-less strategy with profound has become a research focus recently. Which is a scheme estimating the rotor position indirectly by using the zero-crossing point detection from the terminal voltage . It has been used for wide-speed-range control of BLDC motor .

In recent years, variable speed drivesequipped with BLDC motorshave been extensively integrated in various applications. Dealing with BLDC motor control strategies, it is quite commonly believed that they are based on the current and torque control approaches. However, since the torque is not directly controlled, its fast dynamic could not be achieved. [5] presented a brief outline on Electronic Devices and Circuits which forms the basis of the Clampers and Diodes.

Furthermore, the implementation of such strategies requires expensive

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position sensors. However, the proposed control strategy requires several transformations in order to synthesize the optimum reference currents, Which complicates the control scheme without an effective direct control of the torque.

They allow a direct control of the electromagnetic torque and the stator flux through the application of suitable combinations of the inverter control signals. Such a strategy exhibits a vector selection table simply reduced to the torque control with a two phase conduction mode. Although a notable attenuation of the torque ripple has been gained using this strategy.

2.DESCRIPTION:

The sensor-less low-current start-up strategy is based on an amplification circuit; a low pass filter circuit and a signal modulate circuit. The amplification circuit is used to amplify the amplitude of back EMF for detecting the rotor position in low speed, the low pass filter circuit is used to remove high frequency disturbances, the signal modulate circuit is used to get rotor position signal.

A hysteresis control strategy is proposed to against the load disturbance in start-up stage. Experimental results show that the proposed Sensor-less Start-Up strategy can realize a Low-Current Start-Up.

3.BRUSHLESS DC MOTOR:

Abrushlessdcmotorisdefinedasapermanentsynchronous machinewithrotorpositionfeedback.Thebrushlessmotorsaregenerally controlledusingathreephasepower semiconductor bridge. The motor requires a rotor position sensor for starting and for providing propercommutationsequencetoturnonthepowerdevicesintheinverterbridge.

Basedontherotorposition,thepowerdevicesare commutatedsequentiallyevery60degrees.

Insteadofcommutatingthearmaturecurrentusingbrushes,electroniccommutationisused forthisreasonitisanelectronicmotor.Thiseliminatestheproblemsassociatedwiththe brushandthecommutatorarrangement,

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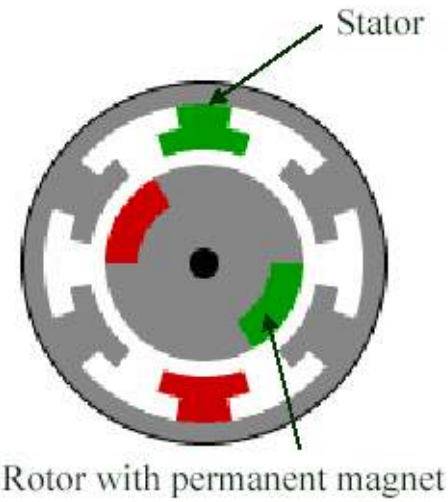

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Thebrushlessdc motor consists offourmainparts:powerconverter, hall sensors,andcontrolalgorithm.Thepowerconvertertransformspowerfromthe sourcetotheBLDC whichinturnconvertselectricalenergytomechanicalenergy.Oneof thesalientfeaturesofthebrushlessdc motoristherotorpositionsensors,based ontherotor position andcommandsignalswhichmay beatorquecommand,voltagecommand,speed commandandsoonthecontrolalgorithmsdeterminethegatesignaltoeachsemiconductor inthepowerelectronicconverter.

Thestructure ofthecontrolalgorithmsdeterminesthetype ofthebrush lessdcmotor ofwhichtherearetwomainclassesvoltagesource baseddrivesandcurrentsourcebased drives. Bothvoltage sourceandcurrentsourcebaseddriveuseddwithpermanentmagnet synchronousmachinewitheithersinusoidalornon-sinusoidalbackemfwaveforms.Machine withsinusoidalbackemfmaybecontrolledsoastoachievenearly

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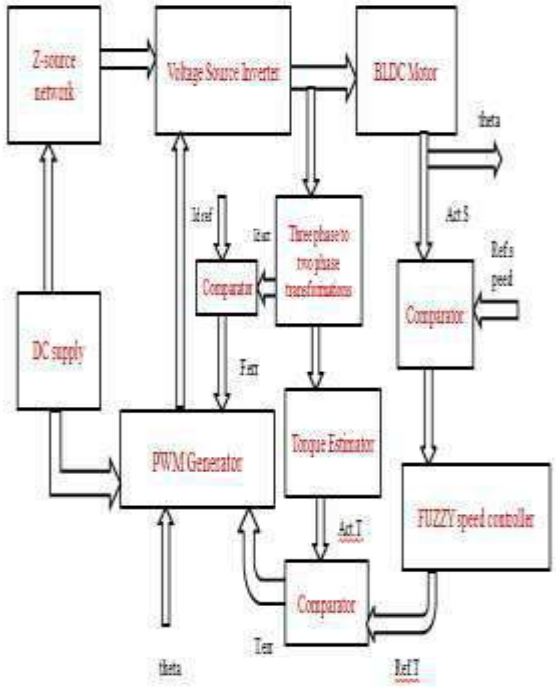
constanttorque.
However,machinewithanonsinusoidal backemfofferreducesinvertersizesand reduceslosses forthesamepowerlevel.

4.BLOCK DIAGRAM:

The block diagram of the fuzzy logic controlled Z-source fed DTC-PMBLDC motor as shown below



Block diagram of proposed system

Theinverter is fed with the dc supply through the Z-source impedance network. The output of the voltage source inverter is given to the BLDC motor. The three phase to two phase conversions are carried out in the transformation block. The torque estimator utilizes the necessary dq axis current, voltage and the necessary parameters to estimate the actual torque value. The speed error is given as the input to the fuzzy controller to generate the reference torque value. The rotor position is obtained through the back emf sensing method. The direct axis current reference and actual value are compared to obtain the flux error. The flux error, torque error and the rotor position are given as the control signals to the PWM generate to generate the gating pulses for the inverter.

4.1Z-SOURCE NETWORK:

It is an impedance network coupled between the inverter and the power source. Its unique feature is to boost up the voltage from the battery without the need of boost converter or the step-up transformer. This impedance source network includes a combination of two inductors and two capacitors.

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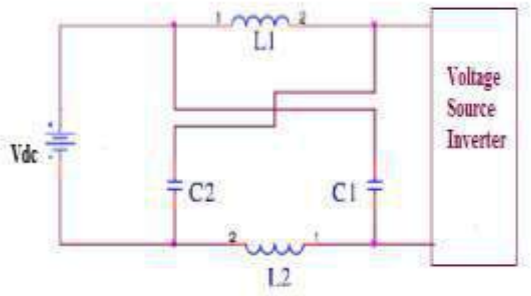

Z-source network connection

This combined circuit network works as the energy storage element. two inductors of same values and two capacitors of same values are used.

4.2 VOLTAGESOURCE INVERTER:

The voltage source inverter acts as an electronic commutator. It consists of six switches and operates in 120 degree conduction mode. The output of the Z-source network is given as the input to this inverter.

The speed of the PMBLDC motor is controlled by varying the switching frequency of the switches. The inverter's output is given to the stator windings of the motor. The space vector modulation technique is used to vary the switching of the inverter switches.

4.3 FUZZY LOGIC CONTROLLER:

Fuzzylogic has rapidly become one of the most successful of today's technologyfor developing sophisticated controlsystem.Withitaidcomplexrequirementsomaybe implementedinamazingly simple,easilymintedandinexpensivecontrollers.

Fuzzy logic controller can model nonlinear system: Thedesignofconventional controlsystemessentialisnormally basedonthe mathematical modelofplant.ifanaccuratemathematical modelisavailablewithknown parametersitcanbeanalysed.

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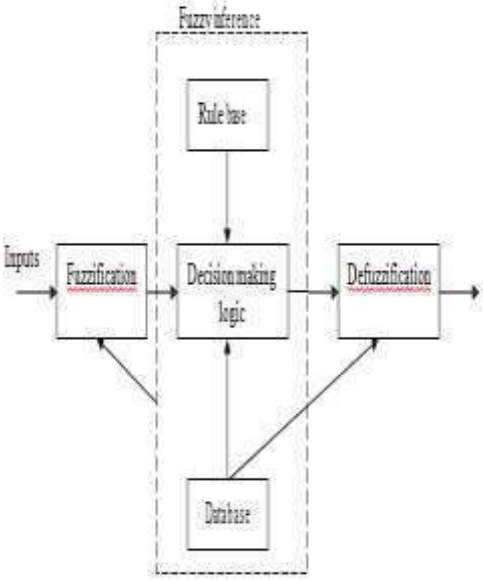


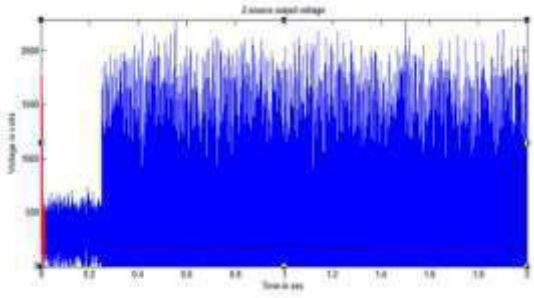
BlockDiagramofFuzzy logic control

Forexample bybodeplotsornyquistplot,andcontroller canbedesignedforspecificperformances.suchprocedureistimeconsuming.Fuzzylogiccontrollerhasadaptivecharacteristics: The adaptivecharacteristicscanachieve robust performance to system with uncertaintyparametersvariationandloaddisturbances.

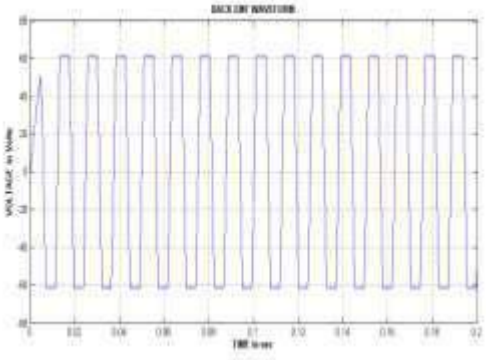
5.SIMULATION RESULTS:

Z source network based DTC BLDC with controller MATLAB simulation

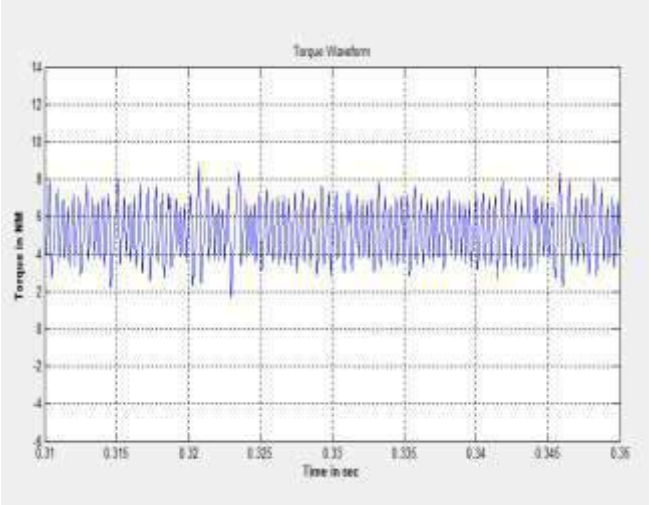
The results obtained by the usage of the Networks with the BLDC are given below Figure



Z SOURCE NETWORK OUTPUT DC VOLTAGE



BLDC MOTOR BACK EMF WAVEFORM



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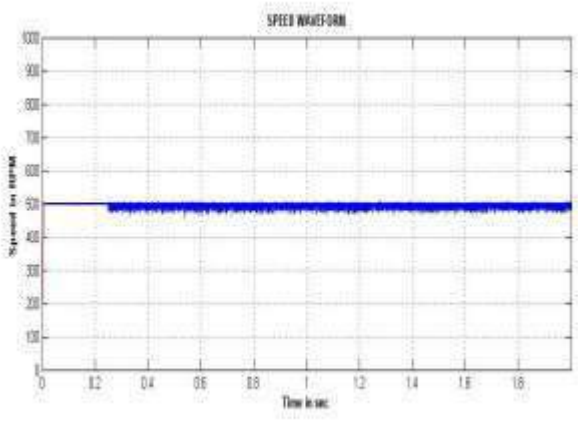
BLDC Motor stator torque waveform with Z-source network



BLDC Motor speed waveform using FLC controller

6.CONCLSIUON:

Hence, in this project, the DTC for brushless DC motor(BLDC) has been studied. The BLDC is modelled by using MATLAB/ simulink. Due to the simplicity of the control algorithm, the DTC is used for analysing the BLDC behaviour in dynamic conditions. It is an effective scheme for reducing the torque ripple and improving the efficiency of the machine. So the simulation of Z-source network is done using this DTC concept with the help of voltage source inverter. In order to improve the torque ripple reduction controllers are implemented and results are verified. The result shows the clear picture of reduction in torque ripples with reduced harmonic content. In future The hybrid integrator back stepping controller is proposed for robotic manipulators. However, thestudy ofthecontrolofrobotsactuated bytheBLDCMwasrelatively recent. Therefore ripple content produced from motor reduced upto5.2N-M by using BLDCM.

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