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PROPORTIONAL LEARNING OF SOFT SWITCHING AND HARD SWITCHING FOR BRUSHLESS DC MOTOR

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ABSTRACT

A brushless dc motor can be delineate as AN inverted brush dc motor with its magnet being the rotor and its stationary windings forming the mechanical device. This design provides several benefits over the brush dc motor. The operational characteristic of a motor is important for its management, modelling and deriving optimum performance. In this paper we compare the soft and arduous change for Brushless DC motor Drive.

1. INTRODUCTION

In this paper we propose a simulation model for a complete BLDC motor drive and its actual implementation. In this model the trapezoidal back voltage waveforms area unit sculptural as a perform of rotor position, so that position may be actively calculated per the operating speeds. Moreover, the switching function concept is adopted to model the PWM inverter. This in turn results in obtaining the detailed voltage and current waveforms and calculating the design parameters, such as average/ rms ratings of components .The developed model can produce a precise prediction of drive performance during transient as well as steady-state operation. Therefore, the mechanism of phase commutation and generation of torque ripple can be observed and analyzed in this model. In particular, the proposed model is made into several functional modular blocks, so that it can be easily extended to other ac motor applications with a little modification, such as the induction motor, the permanent magnet ac motor and the synchronous reluctance motor. 2. Permanent Magnet DC Motors The permanent magnet machines have the feature of high torque to size ratio. They possess very good dynamic characteristics due to low inertia in the permanent magnet rotor. Permanent magnet machines can be classified into dc commutator motor, permanent magnet synchronous motor (PMSM) and permanent magnet brushless dc (PMBLDC) motor. The permanent magnet dc commutator motor is similar in construction to the conventional dc motor except that the field winding is replaced by permanent magnets. The PMSM and PMBLDC motors have similar construction with polyphase stator windings and permanent magnet rotors, the difference being the method of control and the distribution of windings. The PMSM motor has sinusoidal distributed stator windings and the controller tracks sinusoidal reference currents. The PMBLDC motor is fed with rectangular voltages and the windings are distributed so as to produce trapezoidal back EMF. 3 .Brushless Motors Electric motors are classified into two main categories, namely brush dc and ac brushless motors. Brush dc motors are made up of stators consisting of poles produced by permanent magnets or dc excited magnets, which give rise to static magnetic fields across the rotor. The rotor of these brush dc motors consists of windings connected to mechanical commutators to facilitate the application of a dc power source. Current flow through these rotor windings takes place through carbon brushes which make contact with the commutators, thereby producing a magnetic field and a current vector which remains in a relatively fixed position relative to the stator. The relatively stationary current vector of the rotor interacts with the stationary magnetic field of the stator, developing electromagnetic torque. There are two types of brushless DC motors called the in-runner and out-runner. The in-runner motor has permanent magnets located on the inside of the stationary electromagnets. An out-runner motor has the permanent magnets located on the outside.

3.1 In-runner Motors In-runner motors are good when high speeds are needed. They are more efficient than out runner motors the faster they spin. However, due to the gearbox, it makes the motor more susceptible to parts failing. The characteristics of in-runner motors are:

- High R.P.M
- Low torque
- Requires gearbox

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Noise 3.2 Out-runner Motors Out-runner motors spin slower but output more torque. They are easier to use since a gearbox is not required and run very quiet. The characteristics of out-runner motors are:

- Low RPM
- High torque
- Quiet

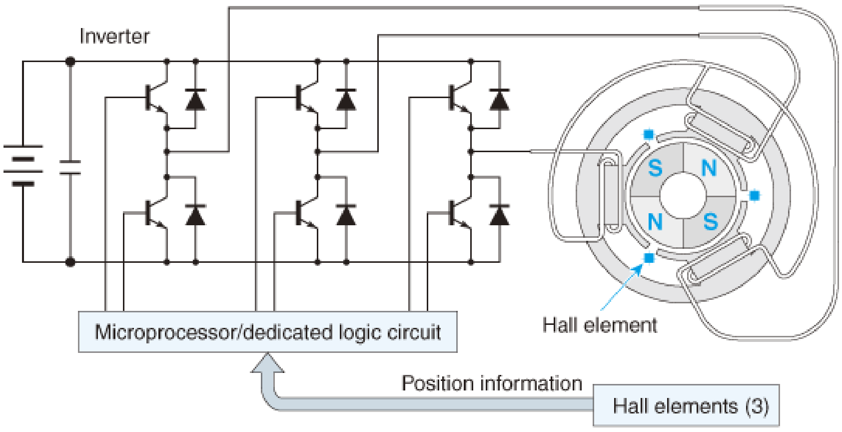

Fig:-1 Basic Diagram of Brushless Dc Motor

2 .HARD SWITCHING

This is the simplest method of switching. It requires less no. of power inductors/capacitors in the circuit. This means we reduce the cost, complexity and power loss of the circuit. The output voltage is load independent. By moving switching frequency far off the resonant frequency and using a simple buck type voltage converter, we have been able to make a switching converter with very low output impedance. By accepting inherent switching losses, the buck converter's output voltage is accurately controlled by 'pulse width modulation '(PWM) of the switching transistors. One of the biggest challenge connected to hard switching is certainly connected to electromagnetic noise generated in the switching moment ,especially in hard switching circuits the problem is exaggerated by a desire to shorten the switching moment to minimum .The shorter the switching moment ,higher the frequency of the noise As the frequency goes up, the more apparent the noise problem and the challenge of controlling the noise increases .This is the main reason why many design engineers choose a 'soft switching' design.

3. SOFT SWITCHING

In order to minimize the size of necessary reactive power components, we have used relatively high switching frequency: 20 kHz in on module and 35 KHz in another module .By using latest technology within IGBT's we have been able to reduce the switching loss. Hard switching is opposed to soft switching. When we make soft switching circuits we start out with hard switching circuit and than add circuitry (power components) to make it soft. Soft means to achieve smooth current /voltage transitions in the switching moment. By 'hard Switching we simply means that no special circuitry is added to make the circuit soft. In order to get smooth transitions, the fundamental principle for all 'Soft Switching' techniques is to switch in a moment at zero voltage and zero current, in the main switching devices. At high switching frequency soft switching techniques (ZVS or ZCS) are used to achieve good efficiency and reduced switching stress. In Zero-Voltage Switching (ZVS), the voltage across device is zero just before turn – on. On the other hand in Zero-Current Switching (ZCS), the current through device is zero just before turn-off. Fig 3 (a) and Fig 3 (b) illustrate the ZVS and ZCS switching trajectory.

4. DIFFERENCE BETWEEN

Soft and Hard Switching Semiconductors utilized in Static Power Converters operate in the switching mode to maximize efficiency. Switching frequencies vary from 50 Hz in a SCR based AC-DC Phase Angle Controller to over 1.0 MHz in a MOSFET based power supply. The switching or dynamic behavior of Power Semiconductor devices thus attracts attention especially for the faster ones for a number of reasons: optimum drive, power dissipation, EMI/RFI issues and switching-aid-networks. Soft switching is another possibility to reduce losses in power electronic switches. Actually, the operation of power electronic switches in ZVS-mode (zero-voltage-switch) or ZCS-mode (zero-current-switch) is called "soft switching" Soft commutation techniques have been of great interest within the last few years in switching power supply applications for high power applications (above 1KW)IGBT s are preferred when compared

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with power MOSFET's which present much higher conduction losses. With SCR's forced commutation' and 'natural (line) commutation' usually described the type of switching. Both refer to the turn-off mechanism of the SCR, the turn-on dynamics being inconsequential for most purposes. A protective inductive snubber to limit the turn-on di/dt is usually utilized. For the SCR the turn-off data helps to dimension the 'commutation components' or to set the 'margin angle'. Conduction losses account for the most significant part of total losses. Present day fast converters operate at much higher switching frequencies chiefly to reduce weight and size of the filter components. Fig 4 provides the distinction between the soft and arduous change.

As a consequence, switching loses currently tend to predominate standard PWM power converters once operated in a switched mode operation, the Power Switches got to bring to an end the load current within the stimulation and turn-off times underneath the arduous change conditions. Hard change refers to the nerve-wracking change behavior of the power electronic devices the change mechanical phenomenon of hard-switched and soft switched power devices. During the stimulation and turn-off processes, the power device needs to withstand high voltage and current at the same time, resulting in high change losses and stress. Dissipative passive snubbers are sometimes additional to the ability circuits so the dv/dt and di/dt of the power devices may be reduced, and the switching loss and stress be amused to the passive snubber circuits. However, the change loss is proportional to the switching frequency, thus limiting the most change frequency of the ability converters. Typical converter change frequency was twenty rate to fifty rate. The stray inductive and capacitive elements in the power circuits and power devices still cause substantial transient effects, which in flip make to magnetic force interference issues. The transient ringing effects are major causes of EMI. Soft-switched converters that combine the benefits of standard PWM converters and resonant converters are developed. These soft-switched converters have switching waveforms similar to those of standard PWM converters except that the rising and falling edges of the waveforms area unit "smoothed with no transient spikes in contrast to the resonant converters, soft-switched converters usually utilize the resonance in a controlled manner. Resonance is allowed to occur just before and throughout the stimulation and turn-off processes thus on produce ZVS and ZCS conditions. Other than that, they behave just like standard PWM converters. With simple modifications, many made-to-order management integrated management circuits designed for standard converters will be used for soft-switched converters. Because the change loss and stress have been reduced, soft-switched converter will be operated at the terribly high frequency (typically five hundred rate to some Mega-Hertz). Soft-switching converters also give AN effective resolution to suppress EMI and are applied to DC-DC, ACDC and DC-AC converters.

5. Conclusion

Soft change victimization IGBT provides low switching losses, higher efficiency, reduce force ripples and improves speed as compared to arduous change. The waveforms for stator current, rotor speed, torque and voltage for the BLDC motor drive with soft change area unit a lot of effective than arduous change. Soft switching device provides "smoothed wave shape with no transient spikes. It reduces switching losses and stress. Soft -switched converter will be operated at the terribly high frequency. These converters also give AN effective resolution to suppress EMI.

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