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A MODIFIED CONVERTER DESIGN FOR BLDC MOTOR WITH CURRENT FEEDBACK STRATEGY

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ABSTRACT

The paper deals with the director que control (DTC)of brushless DC(BLDC)motor drives fed by four-switch inverters(also known as B4-inverters)rather than six-switch inverters(also known as B6-inverters) in conventional drives. The B4-inverter could be regarded as are configured topology of theB6-inverter in case of as witch / leg failure which represent sacrucialre liability benefit for many applications especially in electric and hybrid propulsion systems. The principle of operation of the BLDC motor is firstly recalled considering both cases of B6- and B4- inverters in the armature, with emphasis on the two-and three-phase conduction modes. Then, the DTC of B4- inverter –fed BLDC motor drives is treated considering three strategies, such as:1)DTC-1:a strategy inspired from the one intended toB6-inverter-fed BLDC motor drives; 2)DTC-2: a strategy that considers a dedicated vectors election sub table in order to independently control the torques developed by the phases connected to the B4-inverter legs during the iris mutinous conduction; and 3) DTC-3: a proposed strategy that elm in a test he torque dip penalizing DTC-2during sector-to-sector commutations. Following the design of the corresponding vector selection tables and sub tables (if any), an experimentally based comparative study of the three DTC strategies is carried out considering, in the first step, the BLDC motor steady-state operation under DTC-1and DTC-3.Then, the comparison is extended to the BLDC motor features during sector-to-sector commutations, under DTC-2 and DTC-3.The experimental results clearly validate the predicted performance of the proposed DTC strategy.

Index Terms — B6 and B4 inverters, brushless DC (BLDC) motor, direct torque control (DTC), sector-to-sector commutations, two-and three-phase conduction modes.

INTRODUCTION

Direct torque control (DTC) is one method used in variable frequency drives to control the torque (and thus finally the speed) of three-phase AC electric motors. This involves calculating an estimate of the motor's magnetic flux and torque based on the measured voltage and current of the motor. Space vector modulation (SVM) is an algorithm for the control of pulse width modulation (PWM).It is used for the creation of alternating current (AC) waveforms; most commonly to drive 3 phase AC powered motors at varying speeds from DC using multiple class-D amplifiers. There are various

$$V_{L1-N} = \sin(\theta) * V_P$$

$$V_{L2-N} = \sin\left(\theta - \frac{2}{3}\pi\right) * V_P = \sin\left(\theta + \frac{4}{3}\pi\right) * V_P$$

$$V_{L3-N} = \sin\left(\theta - \frac{4}{3}\pi\right) * V_P = \sin\left(\theta + \frac{2}{3}\pi\right) * V_P$$

variations of SVM that result in different quality and computational requirements. One active area of development is in the reduction of total harmonic distortion (THD) created by the rapid switching inherent to these algorithms. In a star (wye) connected topology, with rotation sequence L1 - L2

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- L3, the time-varying instantaneous voltages can be calculated for each phase A,C,B respectively by:

Where:

V_P is the peak voltage,

$\theta = 2\pi f t$ is the phase angle in radians

t is the time in seconds

f is the frequency in cycles per second and

Voltages L1-N, L2-N and L3-N are referenced to the star connection point.

EXISTING METHODOLOGIES

➢ DTC Direct Torque Control method is used to design an inverter for BLDC motor.

➢ Does not require any current regulator, co-ordinate transformation and PWM signals generator.DTC allows a good torque control in steady-state and transient operating conditions.

➢ In a design of B-4 inverter fed BLDC motor, three strategies of DTC were found.

➢ The strategies are DTC 1-Which tells the control of B6 inverter fed BLDC motor drives.

➢ DTC 2-Independently control the torques by the phases connected to the inverter legs. DTC 3-To eliminate the torque dips penalized during DTC2.

DISADVANTAGES OF EXISTING METHOD

➢ Difficulty to control torque and flux at very low speed

➢ High current and torque ripple

➢ Variable switching frequency behavior High noise level at low speed

➢ Lack of direct current control

PROPOSED METHOD

BLOCK DIAGRAM

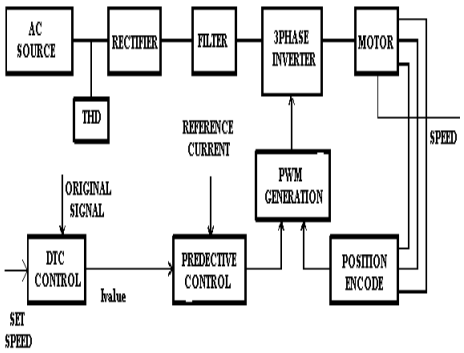

Fig 1.1 Block diagram of proposed method

BLOCK DIAGRAM EXPLANATION

➢ Ac source is converted into dc source by using rectifier

➢ Inverter is used to convert the output (i.e single phase to three phase) to run the BLDC motor.

➢ A back emf is induced from that current is calculated by using the current sensor.

➢ pulse-width modulation (PWM), is a modulation technique that controls the width of the pulse

➢ Direct torque control (DTC) is one method used in variable frequency drives to control the torque (and thus finally the speed) of three-phase AC electric motors. This involves calculating an estimate of the motor's magnetic flux and torque based on the measured voltage and current of the motor.

ADVANTAGES

➢ Reduced number of switches

➢ THD value is high

➢ Output is more efficient

➢ Very fast response

CONCLUSION AND FUTURE WORK

The Predictive control strategy for BLDC motor under speed control condition has been proposed in this paper. To maintain lower THD value, total harmonics distortion is feedback to the power source. Lower THD helps to reduce peak current,

heating, emissions, and core loss in motors. Predictive control is the fact that it allows the current timeslot to be optimized, while keeping future timeslots in account. This is achieved by optimizing a finite time-horizon, but only implementing the current timeslot and also it has the ability to anticipate future events and can take control actions accordingly. Position encoder used to sense the motor position whenever it crosses the limits.

Direct torque control (DTC) strategy is used in variable frequency drives to control the torque of three-phase inverter. This involves calculating an estimate of the motor's magnetic flux and torque based on the measured voltage and current of the motor. PWM generates the duty cycle according to the feedback comes from position encoder and predictive control strategy.

Both simulation and experimental results based on the IPM motor drive application verify the effectiveness of the proposed method. I have planned to design a hardware module for this proposed work in phase II.

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