

CLOSED LOOP BEHAVIOUR BACK EMF BASED SELF SENSING BLDC DRIVES

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Abstract:

The brushless dc machines are widely used in nowadays for many industrial applications because of their high efficiency and power density but the torque reduction of the motors is based on their drive. It's one of the main drawbacks of these drives. These reduction are occurred due to the delay in current commutation between the phases. In Bldc machines sensors are used to detect the speed torque and current sensing applications. In existing system self-sensing backemf based method is used to detect flux position by back emf symmetrical method. But it has some demerits are achieving low speed operation with back-emf based self-sensing methods is more difficult because of the low signal-to-noise ratio of the speed-induced back-emf and open loop self-sensing methods is reduces the burden on the speed-controller

to guarantee stable speed operation. So, in this proposed system we are used the closed loop speed controller and pic controller. In this controller used to giving the current amplitude to stator due to delay in current commutation. It will reduces the torque reduction and the closed loop gives the accuracy values.

KEY WORDS: Sensor Less Control, Closed loop, Pic controller, Brushless Machine.

I. INTRODUCTION

The permanent magnet brushless DC drive, briefly called bldc is widely used in many different field of application such as the industrials area, household application, Automotive and Aerospace the reason of interest in this type of

devices is that they have significant advantage such as high efficiency and high power density. In existing system speed control can be obtained by the open loop backemf based self-sensing methods of zero crossing back emf based self-sensing and symmetrical tracking method [5]. The symmetrical method indicating the moments at which the rotor current should commute between the rotor phases [1]. In open loop system of the detection of current commutation by the speed induced back emf signal based on the flux position between the rotors [2]. It produce the following demerits are: Produce the speed variation, achieving low speed operation with back-emf based self-sensing methods is more difficult because of the low signal-to-noise ratio of the speed-induced back-emf [7]. And open loop self-sensing method is reduces the burden on the speed-controller to guarantee stable speed operation. These demerits can be neglected or reduce by the closed loop speed controller and Pic controller algorithms. The Fig: 1 graph shows the torque loss of existing system. Robustness against speed variations increases. This means also that the effort of a speed control loop to keep the

BLDC drive operation stable is lower when using the threshold tracking method.

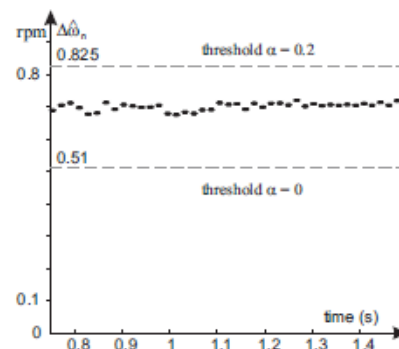


Fig. 1: Torque loss in open loop self-sensing system of symmetrical tracking method. (For 500rpm rotor speed differences control in the region of stability of 0.825rpm.)

II. Demerits of Existing system

- Low speed operation in open loop backemf self-sensing method is too difficult.
- Speed variations are often occur based on inertia of bldc motor.
- There is no accuracy in measurements.
- Even a small phase alignment of the current (commutation) waveform respect to the backemf wave form,

the electromagnetic torque will be reduce.

- It reduce the quality of speed controller to give stable speed operation.

III. PROPOSED SYSTEM:

The rotor speed of BLDC drives for different back-emf based loop. The effect self-sensing methods is presented when operating the drive in a closed speed control of estimation errors in the current commutation instants on the rotor speed is analyzed and verified. The dynamical behavior of a back-emf based self-sensing method can be studied and improved before the design and tuning of the speed control in closed loop. In proposed system the closed loop and the pic controller added to get the accuracy output and reduce the torque reduction in bldc machine is given by $T_n = t_n - t_{n-1}$. And giving the current amplitude to the rotor by usage of pic controller. In sensor control of bldc machine phases are commutated once every 60° electrical rotation of the rotor.

Block Diagram of Proposed System

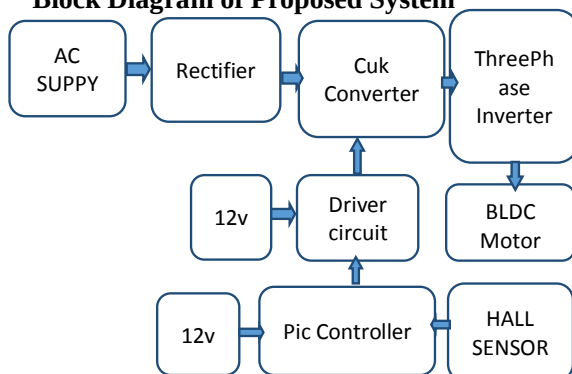


Fig 2: Block Diagram of Closed-loop control of self-sensing Bldc drive

III. HARDWARE AND SOFTWARE DESIGN

The project tries to provide a good accuracy in measurement of bldc motor. It can be obtained by the method of closed loop speed controller with pic controller. Initially the single phase AC supply voltage is applied to the filter circuit where the circuit separates some frequencies from other within mixed-frequency signals after the filter process the voltage applied to the Cuk converter. Cuk converter convert the DC voltage level by storing the input energy temporarily and then releases that energy at different voltage output. Then the boosted AC voltage applied to the three phase inverter or average-value, full-wave, six-pulse rectifier. It converts instantaneous three-phase AC voltages to DC voltage. And the AC power demand is equal to the sum of the fixed power loss and the DC power demand. Then the dc voltage applied to the bldc motor. Due to the motor is running the emf will be produce between the rotor poles. The flux position can be sensed by the most commonly used sensors are hall sensors. Hall sensors work

on the hall-effect principle that when a current-carrying conductor is exposed to the magnetic field, charge carriers experience a force based on the voltage developed across the two sides of the conductor. If the direction of the magnetic field is reversed, the voltage developed will reverse as well. For Hall-effect sensors used in BLDC motors, whenever rotor magnetic poles (N or S) pass near the hall sensor, they generate a High or Low level signal, which can be used to determine the position of the shaft. Then the programmed pic controller. It's used to give the current amplitude to the stator due to delay in current commutation.

- Input supply: - 230V AC Supply.
- Filter: -Specifically to remove unwanted frequency components from the signal.
- Cuk converter: - To Convert the DC voltage level by storing the input energy temporarily and then releases that energy at different voltage output.
- Three phase inverter: - It converts instantaneous three-phase AC voltages to DC voltage.

- Hall sensor: - The Hall effect sensors that are used to detect the position of the rotor are also used to detect speed by measuring the time it takes for the sensors to switch.
- Pic Controller:- (PIC 16F877A) they can be programmed to be time based operation, It's used to give the current amplitude to the stator due to delay in current commutation.

IV. SIMULATION RESULTS

The control scheme used to simulate the behaviour of the Closed-loop self-sensing BLDC drive is shown in Fig 3. From the voltages measured at the terminals of the three-phase machine, the voltage is taken that corresponds to the open circuited phase. This voltage equals the back-emf and is used to estimate the current commutation moments. With the observation that the closed-loop self-sensing method is a particular case of the symmetrical threshold tracking method wherein $\alpha = 0$, therefore mentioned methods can be described by the same control scheme. Besides the commutation moments, this set value for the stator current is given to

the power convertersteering module. The fig: 3 shows the motor speed variations for respective time duration. Then the fig: 4 shows the dc link voltage variations based on the time taken to reach delay current commutation in stator

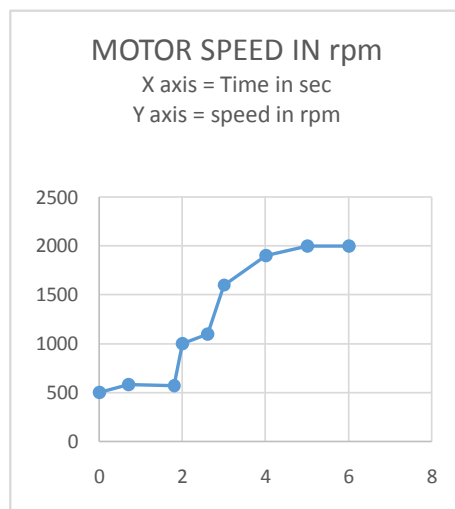


Fig. 3: Simulation results at $\omega_m = 2000$ rpm for Closed loop method. Minimum Rotor speed variations.

In above fig.3 shows the graph of motor speed of bldc motor using closed loop drive with pic controller. Here the speed of the motor based on the time duration of delay current commutation in stator current. Then the respective dc link voltage can be obtained by the self-sensing method. Based on increasing in delay current the dc link voltage reach the steady state in short time

when compared to the self-sensing open loop method of bldc drive.

The time reduction can be obtained by the usage of pic controller to give the current amplitude to the stator.

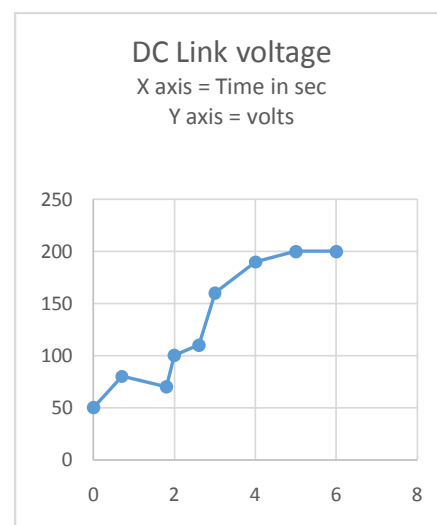


Fig. 4 Simulation results at DC link voltage of Bldc machine. (0V to 200V)

From this simulation it follows that by using Closed-loop method of using pic controller the robustness against speed variations increases. This means also that the effort of a speed control loop to keep the BLDC drive operation stable in when using the closed loop method. The detection of delay current in commutation can be obtained by the backemf self-sensing method and delay current torque reduction can be increased by the giving current amplitude from pic controller.

VI. CONCLUSION

The rotor speed of BLDC drives for closed loop back-emf based self-sensing methods is studied when operating the drive in an open speed control loop. The effect of estimation errors in the current commutation instants on the rotor speed is analyzed and verified with simulations. With the analysis given in this paper, the dynamical behaviour of a back-emf based self-sensing method can be studied and improved before the design and tuning of the speed control loop. However, from the analytical expressions, it follows a speed drift at zero acceleration occurs when the difference in the average speed between succeeding periods crosses a threshold. Such speed variations should be avoided as this demands a higher steering force of the speed control loop. Therefore mentioned threshold can be computed and increases with the drive inertia as well as rotor speed and decreases with the electromagnetic torque. Hence, achieving low speed operation

With back-emf based self-sensing methods is more difficult not only due to the low signal-to-noise ratio of the speed-induced back-emf, but also due to a less robust dynamical behaviour of the self-sensing method at lower speed. However, for a given speed, torque and inertia, a better dynamical behaviour can be obtained by

using a back-emf closed loop speed control method instead of a symmetrical tracking back-emf self-sensing method.

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