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Abstract
Drive Design of Brushless DC Motors
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A high-performance motion system must rely on sensors to offer the speed and position signals, close the relative loops, and display its excellent performance. The sensors of the system generally are Hall sensors and encoders. A brushless DC motor (BLDCM) provides the merits of a DC motor, such as large output torque, high performance, easy control, as well as without brush and commutator by performing electric communication. When the precise position control is not necessary, it would be better for a sensorless control of BLDCM drive that will have more applications and save cost without environmental constraints. When accurate position control is concerned, an encoder for the motor has to be supplied. However, the cost of an encoder is about half that of a motor rated below 1 hp. In order to reduce cost and increase the feedback signal resolution, it is necessary to explore high-fold interpolation technique to achieve the goal of saving cost.
Drive design of brushless DC motors is proposed in the thesis. On sensorless drive, after the motor runs at higher speed, the speed is synchronously estimated with PWM frequency such that the number of estimation will increase in the case of lower speed command. This will be more efficient on speed control than the algorithm by detecting the zero-crossing information of back electromotive forces from motor terminal voltages. In addition, the thesis proposes a novel method, frequency independence of phase delay for the square waves, in order to improve resolution to sixty-four times of the original signal through this method. The structure of the experiment system is realized in FPGA. Compared with the traditional methods, it provides the merits of resolution increasing, hardware circuit saving, without need of ADCs and limit of motor speed. It can be applied to the related control systems.
Finally, the DSP TMS320F240 and the FPGA EP2S60F672C3 are adopted to implement the proposed system in the thesis.
Keyword: Brushless DC motor, sensorless drive, encoder, high-fold interpolation technique, frequency independence of phase delay.
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