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Structural Design Methodology of BLDC Motor Considering Response Time of Phase Current

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The Brushless DC(BLDC) motor is getting more widely used in home appliances, vehicle and industry for its easy control method and low cost. For proper control of the BLDC motor, it is designed to have trapezoidal Back-EMF wave form and the square wave current is applied to its phase current which has instantaneous switching in its wave form. Although, in low speed or low phase current, the instantaneous switching in phase current does not affect the performance of the motor, but, as the rotating speed of BLDC motor rises, it is getting difficult for the phase current to response the instantaneous switching of the square wave. And the distortion of phase current affects the performance of the BLDC motor, such as torque ripple and efficiency. The time constant of phase current in BLDC motor is proportional to the inductance and inverse proportional to the resistance of the motor.
To improve the response time of the phase current, the inductance is necessary to be decreased and the resistance is necessary to be increased. As resistance of motor is affected by the number of turns and dimensions of slots, these are important parameters in design of BLDC motor with fast response phase current. In the same way, as inductance of motor is affected by the number of turns, degree of magnetic saturation and the airgap, including magnet thickness, these are important parameters in design of BLDC motor with fast response phase current. In this study, the design methodology of BLDC motor with fast response phase current is proposed through the comparison between differently designed BLDC motor with same specification. Both motor has designed to have same performance in ideal current source but shows different characteristics in voltage source and PWM control whose phase current waveform could be distorted in instantaneous switching sequence.

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