MT 26
International Conference on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **1159** Type: **Poster Presentation**

Tue-Mo-Po2.12-09 [107]: Proposed Commutation Method for Performance Improvement of Brushless DC Motor

Tuesday 24 September 2019 08:45 (2 hours)

Generally, brushless DC (BLDC) motors use three low-cost Hall sensors to obtain information regarding the position of the rotor and operate using a 120° commutation method. Furthermore, BLDC motors require an ideal trapezoidal back-EMF waveform owing to an input current. However, it negatively affects the motor performance owing to the notch phenomenon of current. In addition, torque ripple, core loss, and permanent magnet loss may result from current harmonics. Therefore, to minimize this effect, it is important that the back-EMF waveform of BLDC motor must be designed ideally sinusoidal. In addition, it is essential to control commutation via the BLDC drive to obtain a phase voltage that is ideally sinusoidal. Thus, the back-EMF and current waveforms must be sinusoidal, similar to those of a brushless AC (BLAC) motor, thereby increasing the efficiency.
This study focused on efficiency improvement of BLDC motors via reduction of torque ripple, core loss, and permanent magnet loss. To achieve this objective, we proposed an improved 150° commutation method for three-phase permanent magnet BLDC motors to improve the current waveform. Although the 120° commutation method is generally employed for a BLDC motor, the improved 150° commutation method is introduced in order to operate the BLDC with the same efficiency as a BLAC motor. Moreover, the improved 150° commutation is proposed to reduce the phase current harmonics. The study investigates the attributes of different commutation methods analytically and experimentally in order to determine the optimal commutation method. The result of this study indicates that the improved 150° commutation method is optimum in terms of harmonic attributes, and reduced torque ripple, thereby improving the motor's efficiency.

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Session Classification: Tue-Mo-Po2.12 - Motors VI