A Study on the Position Signal Compensation Control Technique of Hall Sensor Generated by Uneven Magnetic Flux Density

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Background

The BLDC motor is generally used a lot of 120degree energizing method using hall sensor.
When the hall sensor is used for control, the energizing period of the BLDC motor is determined by the position signals of the three hall sensors. These hall sensors detect the position of the rotor by attaching three hall sensors to the rotor at intervals of 120 degrees. However, there may be an error in the mounting position of the hall sensor. The incorrect energizing interval is caused by the mounting position error of the hall sensor.

Objectives

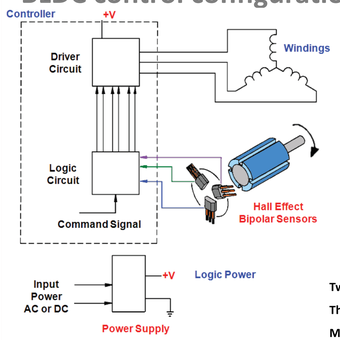
- The phenomenon of incorrect energizing interval due to the mounting position error of the hall sensor is analyzed.
- The value of this error is derived as an equation and an algorithm that compensates for the error value is studied.
- The maintenance of accurate energization interval is verified even though Hall sensor has the positional error.

Conclusion

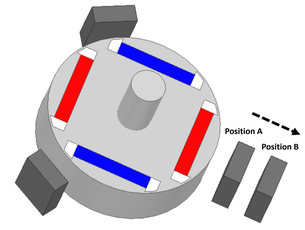
- the phenomenon of incorrect energizing interval due to the mounting position error of the hall sensor is analyzed.
- This inaccurate energizing interval causes an increase in current ripple and noise in controlling the motor.
- we propose a control method to overcome the above problems and verify that the efficiency improvement and the current ripple are reduced by experiments.
- These results are expected to greatly improve the efficiency of BLDC motors, which are widely used in the industry.

Methods

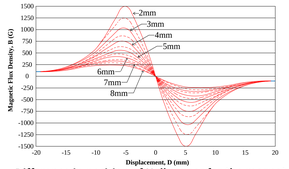
BLDC control configuration



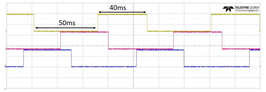
Hall sensor position error and problem phenomenon



Difference in position of Hall sensor for the magnet



Difference in position of Hall sensor for the magnet

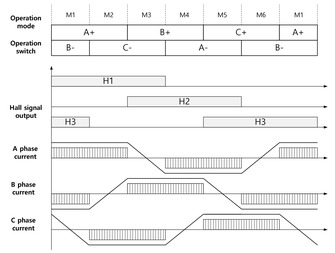


Invalid Hall signal output

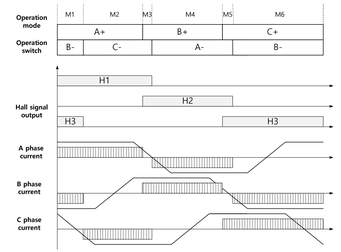
Two different case of hall sensor positions.
The position A is positioned far from the magnets, compared to the position B.
Magnetic flux density becomes smaller as the distance between the magnet and hall sensor increases.

phenomenon analysis

Analysis of energization due to position signal of hall sensor



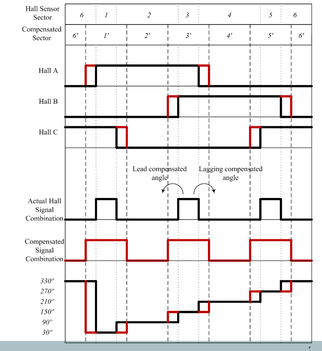
(a) Ideal switch drive using output signal of Hall sensor



(b) Switch drive using output signal of uneven Hall sensor

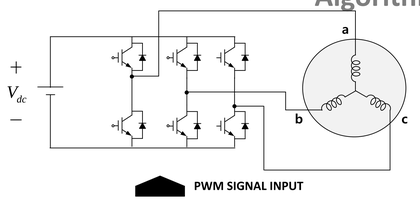
A combination of a hall sensor outputting an ideal signal and a switching mode of a hall sensor having a different signal interval

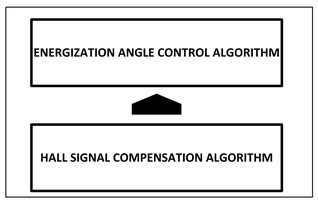
Problem solution

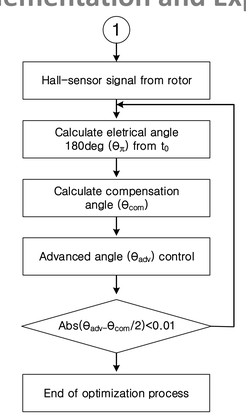


Results

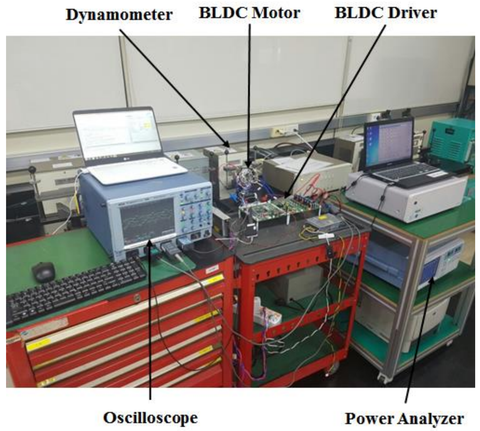
Algorithm Implementation and Experimental Results



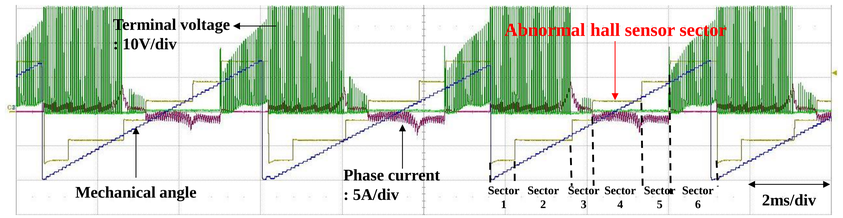


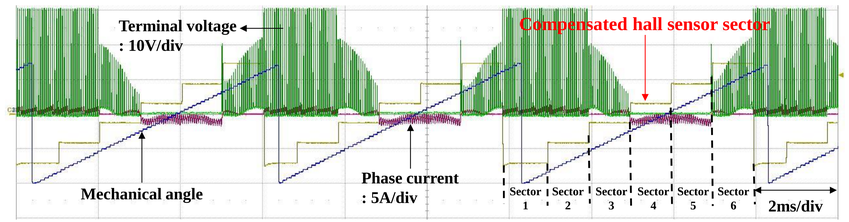


Compensation algorithm of hall-sensor signal



Output waveform through experiment





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