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# Design of Vernier Motor considering Irreversible Demagnetization in Permanent Magnet

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As demand for motors that are capable of high-torque direct drive operation is increasing, Vernier motor is gaining its importance. Vernier motor is a type of permanent magnet (PM) motor, which is specialized for low speed and high torque operation applications. Unlike conventional PM synchronous motor (PMSM), which generates torque mainly from fundamental flux component, Vernier motor utilizes magnetic flux harmonics to develop additional torque component with harmonic flux component. Moreover, the Vernier motor is also a flux modulation machine, which has operation characteristic analogous to that of the magnetic gear. The magnetic gear ratio of Vernier motor is determined by ratio of the stator winding pole pair number and the rotor pole pair number, which has effect on torque produced by the Vernier motor. For these characteristics, the Vernier motor is regarded as one of possible candidates for future motor applications. However, it is necessary that PM used in the Vernier motor does not suffer from irreversible demagnetization, as it has negative effect on the output performance of the motor. Therefore, it is requisite that analysis on the Vernier motor considering irreversible demagnetization of the PM is carried out, to examine how the motor output performance is influenced. Furthermore, design optimization considering design parameters should be carried out to prevent irreversible demagnetization on the PM, to guarantee performance of the motor. In this paper, the Vernier motor is analyzed under several operation conditions to observe how the motor output performance is affected by irreversible demagnetization of PM. Then, the Vernier motor is redesigned regarding certain design parameters to enhance irreversible demagnetization of PM. Finally, the output performance characteristic of enhanced Vernier motor is compared to that of the base motor.

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