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Investigation the optimum performance of the surface-mounted PMSM under different magnetization patterns

Absract

This paper investigates the influence of different magnetization patterns on the performances of the surface-mounted permanent magnet synchronous machines (SMPMSMs). Three magnetization patterns are employed, which are radial, parallel, and ideal Halbach magnetizations. These magnetization patterns are applied to 9-slot/10-pole and 15-slot/4-pole permanent magnet (PM) machines. The PM machines are designed and simulated by using Opera 2D finite element. The performances of three PM motors, such as airgap flux density, phase back-EMF, and cogging torque, are evaluated under the influence of different magnetization patterns. The total harmonic distortion of phase back-EMF (THDv) for the motors are investigated. The PM motors with ideal Halbach magnetization provide the lowest cogging torque and the lowest total harmonic distortion of phase back-EMF. Besides that, the optimum setting of the magnet pole-arc can reduce the total harmonic distortion of phase back-EMF and achieve lower cogging torque. The optimum magnet pole-arc produced by radial magnetization in 9-slot/10-pole motor is 24.8 mech., with cogging torque of 0.45 Nm, and THDv of 2.69 %. Meanwhile, the optimum magnet pole-arc produced by parallel magnetization in 9-slot/10-pole motor is 26.0 mech., with cogging torque of 0.41 Nm, and THDv of 2.00 %.