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Design strategy of interior permanent magnet synchronous motor for maintaining torque performance at flux weakening region

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Recently, various types of electric motor are applied to vehicle traction field because of strengthened environmental law. In general, Interior Permanent Magnet Synchronous Motor(IPMSM) has high power density and efficiency due to reluctance torque by adopting permanent magnet. By these advantages, IPMSM is widely used in Electric Vehicle(EV) traction motor.In case of EV traction motor, operating region varies from low speed region to high speed region. IPMSM has different performances at flux weakening region due to its center of voltage limit ellipse. In this paper, design method for maintaining torque performance of high speed region is proposed.
IPMSM of analyzed model has 8 pole and 72 slot. Hairpin winding is adopted for increasing power density by augmentation of slot fill factor. d and q axis current and phase angle of IPMSM is decided by its limitations not to exceed voltage limit. In flux weakening region, torque is continuously decreases by increasing rotating speed. By applying design method, torque of flux weakening region is maintained.
There's several methods for maintaining torque performance at flux weakening region. By changing various design parameters can improve torque performance of flux weakening region. For maintaining input condition, control factors of models are stator outer and inner diameter, air gap length and slot area. If portion of back yoke and teeth changes, also the torque of flux weakening region changes. If the length of stator teeth is decreased, magnetic flux density of MTPA region is increased and as a result, torque is decreased. But in flux weakening region, magnetic flux density is increased to proper level and torque performance is improved.

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