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Mon-Mo-Po1.06-07 [69]: Demagnetization Analysis and Design Optimization of Permanent Magnet Synchronous Motor for Electric Power Steering Applications

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Abstract

With the increasing demand for electric vehicles, electric power steering (EPS) system is in the spotlight. The EPS system has high requirements for the driving motors, such as high torque density, high reliability and low torque ripple. Permanent magnet synchronous machines (PMSM) are suitable for EPS applications because they offer many advantages like high torque density and efficiency. Irreversible demagnetization of the faults permanent magnets (PM) is troublesome in permanent magnet synchronous motors since they may greatly reduce the performance. Demagnetization fault of PMSM is also one of the key factors affecting the reliability of EPS system.

This paper presents a study on demagnetization analysis method and design optimization of PMSM for EPS system. A demagnetization analysis method based on 2D and 3D finite element analysis (FEA) for PMSM of EPS system is proposed. Based on the computation of the distribution of magnetic flux density on the surface of PM, the demagnetization risk is evaluated. EPS systems are strict to cost while PM is the most expensive material, so it is necessary to restrain irreversible demagnetization under the condition of minimizing the amount of PM. Therefore, in terms of design optimization, the thickness of PM in magnetization direction is mainly optimized. The simulation results clearly show that the optimized PMSM design can meet the requirements of EPS system, which is also verified by experimental results.

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