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Tue-Af-Po2.20-10 [62]: Optimization Design and Performance Analysis of Bearingless Flux Switching Permanent Magnet Motor with Multi-tooth Structure

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The bearingless flux switching permanent magnet (BFSPM) motor integrates the advantages of magnetic bearings with no mechanical wear, no lubrication, high speed and high precision, long service life, etc., as well as inherits some merits of flux switching permanent magnet motors with fast heat dissipation, low demagnetization risk, high critical speed and so on. In recent years, it has important scientific research and application value in centrifuge, sealed pump, flywheel energy storage, semiconductor industry and other special electric drive fields. However, the structure of doubly-salient pole and the excessive use of permanent magnets in the BFSPM lead to high torque ripple and high cost, which limit its application range to some extent.
In order to solve these problems above, a BFSPM motor with stator multi-tooth structure is proposed in this paper. Firstly, the basic structure and operation principle of the motor are analyzed in detail. Then, the key dimension parameters of stator and rotor are deduced according to the empirical formulas. Then, based on the finite element analysis (FEA) software, the performance of the motor, such as back EMF, flux linkage, inductance parameter, harmonic characteristic and cogging torque, is simulated respectively, and the simulation results are compared with that of the traditional BFSPM motor. Finally, the simulation results show that compared with the traditional BFSPM motor, the cogging torque and torque ripple of the multi-tooth bearingless flux switching permanent magnet (MT-BFSPM) motor proposed in this paper, are significantly reduced by around 56.4% and 13.6%, whereas the suspension force is increased by around 5% after parameter optimization.

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