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Tue-Af-Po2.20-06 [58]: Research on the cost-effectiveness for a flux-biased flux-modulated permanent magnet motor

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Flux-modulated permanent magnet (FMPM) motors have been considered as a promising candidate in the direct drive application due to the superior torque performance in the low speed condition. Yet, the output torque capability of the FMPM motor generally relies on the expensive rare earth permanent magnet (REPM), which is same to the conventional permanent magnet motor. It greatly limits the sustainable development of the FMPM motors, especially the unstable supply of the REPM material. Thus, the motor cost-effectiveness has become a hot topic in the researches of FMPM motors. In this paper, a flux-biased dual-airgap flux-modulated permanent magnet (FBAD-FMPM) motor is proposed, where the relative position of the double rotors is fixed with the 90deg of electrical angle in the operation. The key of the motor is to introduce the flux-biased concept to effectively improve the torque performance with a relatively less REPM. Meanwhile, the leakage flux generated by the REPM in the stator is reduced by the special design of dual-airgap, which has great influence on the improvement of permanent magnet utilization. Thus, a high cost-effectiveness is achieved in the proposed FBAD-FMPM motor. In order to clearly demonstrate the potential performance features of the FBDA-FMPM motor, a regular double airgap flux-modulated permanent magnet motor is selected and compared, which possesses the same motor sizes and similar topology for fair comparison. The results show that the PM cost of FBDA-FMPM motor is reduced by 30% while the output torque capabilities of two motors are same. It denotes that the proposed FBDA-FMPM motor possesses higher cost-effectiveness. Finally, a prototype is manufactured to verify to the rationality and performances advantages of the proposed motor.

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