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Wed-Mo-Po.06-08: A New Rotor Permanent Magnet Flux-Switching Motor With V-shaped Magnetic Poles

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The rotors of conventional rotor flux switching permanent magnet (R-FSPM) motor are all fractured and require non-magnetic materials for support to avoid the permanent magnetic field being closed in the rotor, which will reduce the mechanical robustness of the rotor. In order to overcome the above limitations, a V-shaped combination of magnetic poles rotor permanent magnet flux-switching motor is proposed in this paper. The key innovation of the proposed motor is its new rotor topology with the unique arrangement of the auxiliary PMs based on combined magnetic poles to ensure that the flux produced is not short-circuited via the rotor core but rather contributes to the air-gap flux to maximize the output torque production. The PMs materials of proposed motor is composed of NdFeB and ferrite. It reduces the use of NdFeB materials and has the characteristics of high performance and low cost. Compared with the separated rotor parts, the proposed motor of embedded V-shaped can enhance the rotor-side flux linkage coupling, thereby increasing the amplitude of the air gap magnetic field density by adjusting the ratio to increase the air gap flux density. This paper first introduces the detailed working principle of the proposed motor, and analyzes the winding, feasible stator slot and rotor pole combination of the motor. The stator-slot filling factor analysis of the proposed motor is also presented. And then based on the analytical model of permeability-magnetomotive force, the air gap flux density of the 20/11 the proposed motor is calculated, and the dominant working harmonic order is analyzed. Under no load conditions, the proposed motor significantly increases the amplitude of the 9th and 11th effective working harmonics, and increases the amplitude of the 21st, 28th and 33rd higher-order working harmonics, thereby increasing the output torque.
Subsequently, Based on the multi-objective optimization, the sensitivity analysis of the structural parameters of the motor is carried out, and the response surface model is established. The optimization value of the structural parameters of the motor is obtained by the multi-objective genetic algorithm. Finally, a two-dimensional finite element model is established. In the optimization process, the number of PMs in the two configurations is limited to the same. Finally, compared with the conventional type , the proposed motor has improved power factor and efficiency. Specifically, the output torque is increased by 20.15 %, while the torque ripple is reduced by 2.57 %.

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