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Tue-Mo-Po2.11-09 [95]: Unbalanced magnetic force and vibration analysis of dual mechanical port flux switching PM machine considering rotor eccentricity

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Dual mechanical port flux-switching permanent magnet (DMP-FSPM) machine with high power density, high torque density, and wide operation range has potential application prospect in electric vehicles (EVs). The DMP-FSPM machine is consist of inner rotor, outer rotor and middle stator which can be regarded as the combination of two conventional flux-switching permanent magnet (FSPM) machines. The stator is sandwiched by the two rotors, in which the PMs and two sets of armature windings are mounted. The flux barrier is located on the middle stator yoke. Due to the topology of the dual mechanical port, the rotor eccentricity, which causes asymmetrical air-gap filed and unbalanced magnetic force, often occurs in the complex multi-mode operation conditions. In this paper, the electromagnetic and vibration characteristics of the DMP-FSPM machine is investigated in the multimode operation conditions. The main works are listed as follows.
Firstly, the topology of the DMP-FSPM machine is introduced, and the initial design of the DMP-FSPM machine is given. Secondly, in the rotor eccentricity conditions, the influences of the parameters, such as stator teeth width, arc of the PMs, etc., on the radial and tangential magnetic force are studied by the finite element method (FEA). The unbalanced magnetic force of the two air gaps are also analyzed in the different operating modes, and the harmonic components of the radial and tangential unbalanced magnetic force are compared. Then, based on magnetic-solid coupling analysis method (MCAM), the electromagnetic vibration is discussed. The relations between the vibration which causes by the rotor eccentricity and torque performances of the DMP-FSPM will be given. Finally, in order to reduce the effects of vibration, the optimization design will be done by the sensitivities analysis method. The results will be compared with that of the initial design, and it will also verify the correctness of theoretical analysis.

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