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Tue-Mo-Po2.12-02 [100]: Optimization Design of Permanent Magnet Assisted Single Winding Bearingless Synchronous Reluctance Motor

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In the past two decades, a bearingless synchronous reluctance motor (BSynRM) was proposed and developed. Besides the advantages of the traditional bearingless motor, the BSynRM has the advantages of simple structure, low cost, low losses and can realize high speed operation using weak magnetic speed regulation. A permanent magnet assisted bearingless synchronous reluctance motor (PMa-BSynRM), which adopts a multi-layer flux barriers rotor with permanent magnets installed in, has advantages in torque density and power factor. Therefore, the PMa-BSynRM has broad application prospects in vacuum, high speed, high precision and many other industrial fields. However, as a result of the traditional PMa-BSynRM having torque windings and suspension force windings, the volume of the motor and the power loss and processing cost of the stator are increased, and the vibration of the traditional PMa-BSynRM is severe, which limit its scope of application in some degree.

To balance the contradictions mentioned above, a novel permanent magnet assisted single winding bearingless synchronous reluctance motor (PMa-SWBSynRM) with the skewed stator and rotor is proposed in this paper. Firstly, the basic structure and operation principle of the proposed motor is described detailedly. Secondly, the mathematic model of the radial suspension forces is derived with Maxwell stress tensor method. Then, the electromagnetic characteristics the motor is analyzed in detail through finite-element analysis (FEA). Following the electromagnetic analysis, the vibration of the PMa-SWBSynRM is discussed based on the model analysis and harmonics of the radial force. Finally, the experimental prototype platform was built and the FEA results were verified by the experimental measurement.

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