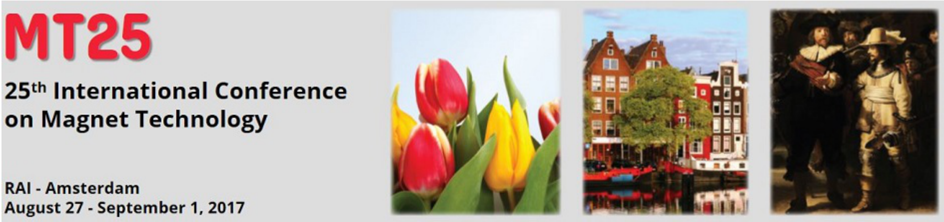

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Optimization Design of Bearingless Synchronous Reluctance Motor

Tuesday 29 August 2017 13:15 (1h 45m)

In the past two decades, a bearingless synchronous reluctance motor (BSynRM) was proposed and developed. Besides the advantages of the traditional bearingless motors, the BSynRMs have the advantages of simple structure, low cost, low losses and can realize high speed operation using flux weakening control. Therefore, the BSynRMs have broad application prospects in vacuum, high speed, high precision and many other industrial fields. However, the structure of salient pole rotor and the absence of permanent magnets in the BSynRMs lead to low torque density and low power factor, which limit its scope of application in some degree. To balance the contradictions mentioned above, a permanent magnet assisted BSynRM (PMa-BSynRM) 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 parameters of flux barrier layers, rotor air gap ratio, rotor rib width and permanent magnets are optimized. In order to compare the performance of the BSynRMs, based on the finite element analysis (FEA), the BSynRMs with salient pole rotor and the permanent magnet assisted rotor are designed respectively. The simulation results show that the torque density and power factor of the proposed motor increase about 14% and 26% compared with the one with normal rotor, while the average suspension force decreases about 4.6%. Finally, the permanent magnet assisted rotor is adopted to the prototype and new integrated 2x3 phase power inverters with digital controller are applied to build the experimental platform, and the relsults of the experiment validate correctness of the proposed theory.

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