MT 26
International Conference on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **827** Type: **Poster Presentation**

Tue-Mo-Po2.11-04 [91]: Experimental Verification and Analytical Study of Influence of Rotor Eccentricity on Electromagnetic Characteristics of Permanent Magnet Motor

Tuesday 24 September 2019 08:45 (2 hours)

Permanent magnet synchronous machines (PMSM) are becoming an essential technology for applications such as home appliances, industrial tools, and electrical vehicles. Todays, consumer demands for noise and vibration of products are increasing, and studies on the noise and vibration characteristics of motors that generate power are actively being conducted. One of the factors contributing to noise and vibration is rotor eccentricity that could be shown in the manufacturing process of the motor. Rotor eccentricity indicates that the center of the rotor axis deviates from the center of the stator, meaning the air-gap is not uniform. The rotor eccentricity interrupts the uniform distribution of magnetic flux to the stator, resulting in an increased cogging torque and unbalanced magnetic force. Since the cogging torque and the unbalanced magnetic force are generated by the use of permanent magnets, the impact on the magnetic field distribution due to permanent magnets should be analyzed with a model in which eccentricity is applied.
In this study, we present an analytical model for the permanent magnet machines in which rotor eccentricity is applied. We simplified the analytical model through several assumptions and modeled the magnet according to the selected magnetization direction. Based on electromagnetic field theory and the perturbation theory, the governing equations were derived in the air-gap region. Further, the relationship between the magnetic scalar potential in each region and the appropriate boundary conditions is used to obtain the undetermined coefficients to derive the magnetic flux density characteristics in each region. The validity of the analytical results was verified by comparing them to the results of the two- dimensional finite element analysis and experiments. More detailed results, discussions, and desired effects will presented in the full paper.

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Session Classification: Tue-Mo-Po2.11 - Motors V