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Design Consideration of Back-EMF Constant for 3-D.O.F. Spherical PM Motor

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3-D.O.F. spherical PM motor has 3 degrees of freedom (3-D.O.F.) in its motion by tilting and rotating of shaft, which can be applicable in various fields. Back-EMF is proportional to the field flux and angular velocity. The back-EMF constant is clear in the conventional rotating machine. By the way, back-EMF constants of coils are different with tilting in the spherical PM motor. So consideration of back-EMF constant may useful to design 3-D.O.F. spherical PM motor precisely. So back-EMF constant of spherical PM motor is considered with generality in this paper.

Index Terms— design, back-EMF constant, 3-D.O.F., spherical PM motor.

BQ16

Optimal Design of Magnetizing Yoke Shape for PM of Brushless PM Motor

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Several researchers have studied design technique to reduce cogging torque and the harmonics of back-emf as a main cause of the undesirable vibration and noise in a brushless permanent magnet (PM) motor [1]. Arc-shaping PM or arc-shaping stator teeth were used to reduce these effects by making a sinusoidal air-gap magnetic flux density. However, this increases manufacturing cost and effort [2]. Thus, in this paper, the design of magnetizing yoke shape is proposed to make a sinusoidal magnetic flux density in air gap to reduce manufacturing problems. It can effectively reduce the cogging torque and harmonics of back-emf. The design of magnetizing yoke pole requires many design variables, and complex responses are also expected in the performance of motor. The Kriging model [3] and the latin hypercube sampling (LHS) [4] are utilized to address the complex response and the optimum point. Fig. 1 (a), (b) show the initial model and selected design variables. The yoke pole shape is drawn by spline curve through the path of sampling points obtained by the LHS. The expected response surfaces of object functions and optimized model are respectively shown in Fig. 1 (c), (d). As a result, an optimized model can effectively reduce the cogging torque as 30.57[%] and increases the fundamental component of the back-emf as 4.16[%] compared with the initial model.

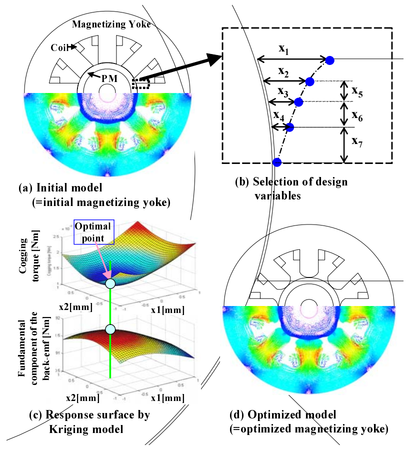

Fig. 1. Optimization of magnetizing yoke in PM motor.

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