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GP-07. Thrust force of a novel PM transverse-flux linear oscillating actuator with moving magnet. *Q. Lu* [1], M. Yu[1], Y. Ye[1] and Y. Fang[1] *1. College of electrical engineering, Zhejiang university, Hangzhou, Zhejiang, China*

GP-08. Look-up Table-based Dynamic Simulation and Experimental Verification of Flux Reversal Linear Synchronous Motor. *S. Chung* [1], J. Kim[1], B. Woo[1], Y. Chun[1], D. Hong[1] and J. Lee[1] *1. Electric Motor Research Center, KERI, Changwon, Korea, Republic of*

GP-09. A Novel Design of Modular Three-Phase Permanent Magnet Vernier Machine with Consequent Pole Rotor. *S. Chung* [1], J. Kim[1], B. Woo[1], Y. Chun[1], D. Hong[1] and J. Lee[1] *1. Electric Motor Research Center, KERI, Changwon, Korea, Republic of*

GP-10. Design and Analysis of Linear Stator Permanent Magnet Vernier Machines. *Y. Du* [1,2], K. Chau[1,3], M. Cheng[1], Y. Fan[1] and Y. Wang[1] *1. School of Electrical Engineering, Southeast University, NanJing, Jiangsu, China; 2. School of Electrical and Information Engineering, Jiangsu University, Zhenjiang, Jiangsu, China; 3. Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, Hong Kong, China*

GP-11. Design and Analysis of a Flux-Mnemonic Dual-Magnet Brushless Machine. *W. Li* [1], K. Chau[1], J. Jiang[1] and F. Li[1] *1. Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China*

GP-12. Experiment and analysis of large capacity line-start PM motor. *Q. Lu* [1], Y. Ye[1] and Y. Fang[1] *1. College of electrical engineering, Zhejiang university, Hangzhou, Zhejiang, China*

GP-13. Optimal design of double-sided iron-core type permanent magnet linear synchronous machine for vertical transportation system. *Y. Zhu* [1], S. Lee[1], D. Koo[2] and Y. Cho[1] *1. Dept. of Electrical Engineering, Dong-A University, Busan, Korea, Republic of; 2. Electric Motor Research Group, Korea Electro-technology Research Institute, Changwon, Korea, Republic of*

GP-14. Optimal shape design of rotor bar in induction motor for torque maximization. G. Lee[1], *S. Min* [1] and J. Hong[1] *1. Mechanical Engineering, Hanyang University, Seoul, Korea, Republic of*

Optimal shape design of rotor bar in induction motor for torque maximization.

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Permanent magnet(PM) motor is widely used for the hybrid electric vehicle due to its high power density and compact size. However, recently due to the problem of supply and demand for rare earth metals the manufacturing cost tends to increase so that non-permanent magnet motors like reluctance motor and induction motor are paid attention to be an alternative. Particularly, the induction motor has advantages like ease to manufacture and robust to maintain[1], but lower power density is pointed out as a weak point compared to PM motor. Hence, many studies have been carried out to increase the performance including shape optimization of stator, rotor[2] and rotor bar[3,4] in the induction motor. Previous works are elusive to achieve desired improvements in power performance since few parameters are controlled. One important focus is the shape of the rotor bar since is one of the most important factors to improve the performance in the induction motor[5,6]. In this paper, level-set function is adopted to express material boundaries between rotor bar and a ferromagnetic and material property of relative permeability is determined by the level-set distribution. The optimization problem is formulated to maximize the torque at rated speed under the specified volume fraction(VF) within the design domain. Implicit material boundaries are moved by speed function which governs the level-set equation and normal velocity calculated using sensitivities of the objective function and the constraint by the adjoint variable method.

The proposed method is applied to optimal shape design of rotor bar in the induction motor for hybrid electric vehicle of 50kW capacity. The reference design of the induction motor and the design domain of the rotor bar are shown in Fig. 1 Since the rated speed of the reference model is 2904rpm, torque is calculated based on the corresponding condition by input voltage 100 Vrms. Fig. 2 shows the optimal designs of the rotor bar with respect to different volume fractions and optimal volume fraction to maximize mean torque is determined by the spline curve interpolation. Reference design and the optimal design are shown in Fig. 3. It is noted that the optimal design relaxes the saturation effect in the inner side of rotor and has a chamfer to avoid the saturation in the bridge and the air gap. Optimal volume fraction maximizing the torque performance is found at VF=0.72. To validate the proposed method, efficiency and power factor are calculated and it is summarized in Table 1 that the optimal design provides 5.89%, 16.67% and 16.22% increase in torque, efficiency and power factor, respectively.

[1] O.A. Turcanu, T. Tudorach, V. Fireteanu, Influence of squirrel-cage bar cross-section geometry on induction motor performances, International Symposium on Power Electrical Drives, Electrical Drives, Automation and Motion, pp. 438-1443, 2006

[2] S.-M. Wang, J.-N. Kang, J.-C. Noh, Topology optimization of a single-phase induction motor for rotary compressor, IEEE Trans. Magn., Vol. 40, No. 3, pp. 1591-1596, 2004

[3] D.-H. Cho, H.-K. Jung, C.-G. Lee, Induction motor design for electric vehicle using a niching genetic algorithm, IEEE Trans. Magn., Vol. 37, No. 4, pp. 994-999, 2001

[4] M. Cunkas and R. Akkaya, Design optimization of induction motor by genetic algorithm and comparison with existing motor, Mathematical and Computational Applications, Vol. 11, No. 3, pp. 193-203, 2006

[5] S. Williamson and C.I. McClay, Optimization of the geometry of closed rotor slots for cage induction motors, IEEE Trans. Industry applications, Vol. 32, No.2, pp. 560-568, 1996

[6] K.-J. Park, K.-S. Kim, S.-H. Lee, D.-H. Koo, K.-C. Ko, J. Lee, Optimal design of rotor slot of three phase induction motor with die-cast copper rotor cage, International Conference on Electrical Machines and Systems, pp. 61-63, 2008.

	Mean Toruqe [Nm]	Efficiency [%]	Power Factor
Reference Design	152.57	63.0	0.74
Optimal Design (VF = 0.72)	161.55 (5.89%↑)	73.5 (16.67%↑)	0.86 (16.22%↑)

Performance Comparison between reference and optimal design

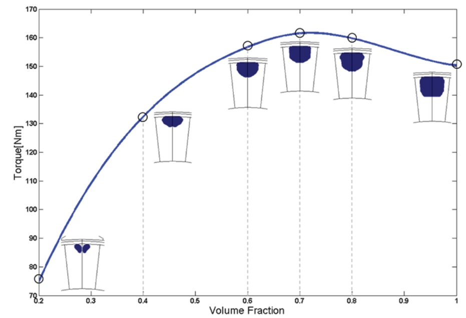

Fig. 2 Torque and optimal configuration according to different VFs

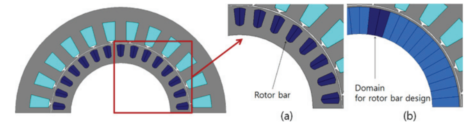

Fig. 1 Configuration of induction motor: (a) reference design (b) design domain

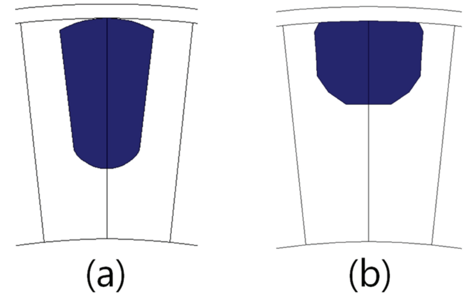

Fig. 3 Comparison of rotor bar configuration : (a) reference design (b) optimal design(VF=0.72)