AP06

Cogging Force Reduction of a Stationary Discontinuous Armature PM-LSM by Magnet Segmentation

Yong-Jae Kim[1]*, Youn-Ok Choi[1], and Geum-Bae Cho[1]

[1]Department of Electrical Engineering, Chosun University,
375, Seosuk-dong, Dong-gu, Gwangju 501-759, Korea

*Corresponding author: e-mail: kimyj21@chosun.ac.kr

Recently, permanent magnet type linear synchronous motors (PM-LSMs) have been used as a driving source of transportation systems, to satisfy requirements such as high-speed, low noise, simplification of driving apparatus of transportation systems and also to simplify maintenance. In order to resolve the problem of higher costs, the authors' laboratory has proposed a stationary discontinuous armature PM-LSM in which the armature is engaged only when accelerated and decelerated operation is necessary, when PM-LSM is used with long-distance transportation systems in factories [1]. Fig. 1 shows speed profiles of PM-LSM horizontal transportation systems. However, the stationary discontinuous armature PM-LSM contains the outlet edges which always exist as a result of the discontinuous arrangement of the armature. For this reason, cogging force generated between the entrance end (entry interval) and the exit end (ejection interval) has become a problem. The problem is that the cogging force that operates at each outlet edge affects the mover's drive, and there is a possibility that hunting occurs during acceleration and deceleration when freewheeling changes over to re-acceleration and deceleration [2]. Particularly, hunting acts as the major factor of vibration and noise and, in the worst case, causes step out due to load disturbance. Therefore, the reduction of cogging force at each outlet edge is highly desirable in order to prevent the possibility of hunting occurring at the re-accelerator and decelerator and this allows stable drive of the stationary discontinuous armature PM-LSM. Therefore, we considered displacing the two magnet segments of each pole in order to reduce the cogging force of the outlet edge. This paper presents the results of three-dimensional (3-D) numerical analysis by the finite element method (FEM) of the cogging force exerted by the outlet edge.

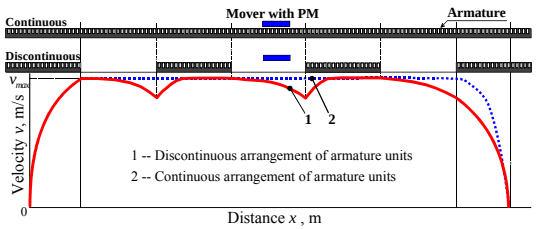

Fig. 1. Speed profiles of PM-LSM horizontal transportation systems.

REFERENCES

[1] M. Kajioka, K. Oka, M. Watada, S. Torii and D. Ebihara, Proc. Conf. on Power electronics electrical drives automation & motion, A2-25 (2000).

[2] Y.-J. Kim, H. Dohmeki and D. Ebihara, IEE Proceedings Electric Power Applications. 153, 585 (2006).

AP07

Influence of flux Barrier arc and slot to pole combination for wide speed range on the Interior Permanent Magnet Synchronous Motor

Jae-Hak Choi[1]*, Yon-Do Chun[1], Pil-Wan Han[1], Dae-Hyun Koo[1], and Jang-Sung Chun[2]

[1]Industry Applications Research Division, Korea Electrotechnology Research Institute, Changwon, Korea
[2]TSA Co., Ltd, Bucheon-si, Gyeonggi-do, Korea

*Corresponding author: e-mail: choijaehak@keri.re.kr

The interior permanent magnet (IPM) synchronous motor has many advantages, such as high efficiency etc., and this motor is becoming widely used not only in home applications like air conditioners but also electric vehicles [1]. Especially, the motor applied to home appliances should run quietly, and traction motor for the hybrid electric vehicle is need to have low torque ripple and cogging torque as well as high power density [2]. Such motors have to be satisfied basic speed-torque operation range characteristics. Variable speed range is more important than cogging torque and torque ripple cause noise and vibration, because the system has to meet the required operation specification. There are several significant parameters that make an effect on the motor speed-torque range. The main parameters are the number of turns and flux barrier arc according to slot-pole combinations. In this research, the IPM motor is investigated with respect to the variable speed range according to flux barrier arc. The number of turns is only considered to meet same current level. Fig.1 shows the definition of flux barrier arc, and Fig. 1(b) shows the slot-pole combination.

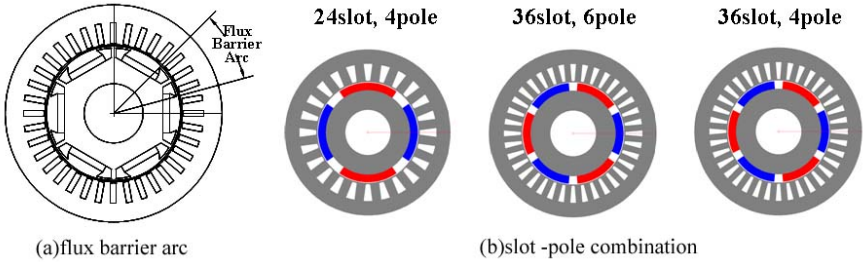

Fig. 1. flux barrier arc and slot-pole combination of IPMSM.

REFERENCES

[1] T. Ohnishi and N. Takahashi, "Optimal Design of Efficient IPM Motor Using Finite Element Method," IEEE transaction on magnetics, vol. 36, no. 5, pp. 3537-3539 (Sep. 2000).

[2] ki-Chan Kim, *et al*, "A study on the characteristics due to pole-arc to pole-pitch ratio and saliency to improve torque performance of IPMSM," IEEE transaction on magnetics, vol. 43, no. 6, pp. 2516-2518 (June 2000).