Design and Analysis of Slotless Linear Permanent-Magnet Brushless DC Motor

粘鐿耀、陳盛基

E-mail: 9607745@mail.dyu.edu.tw

ABSTRACT

Brushless DC motors have excellent performance and design diversified characteristics. Consequently, motor topology is provided with various possibilities. In the numerous types, linear brushless DC motor which provides many advantages as rotary brushless DC motor is mainly designed for the applications of linear motion. Furthermore, due to the direct drive property, it is really suitable for linear motion. The analysis and design of an ironless linear permanent magnet brushless DC motor (PMBDCM) are studied in this thesis. First, based on magnetic field theory, various critical equations of motor design are developed, such as air-gap flux density, thrust, inductance, force constant and back-emf constant. And then, simulation software, Maxwell 2D is performed to verify the match between calculation equations and the simulation results. It is confirmed that developed equations can be applied to ironless PMBDCM analysis and design.

Keywords : ironless ; permanent magnet brushless DC motor(PMBDCM) ; magnetic circuit ; finite element method(FEM)

Table of Contents

REFERENCES

[1] Gyu-Hong Kang, Jung-Pyo Hong and Gyu-Tak Kim, “ A Novel Design of an Air-Core Type Permanent Magnet Linear Brushless Motor by Space Harmonics Field Analysis, ” IEEE Transactions on Magnetics, vol. 37, no. 5, pp. 3732-3736, 2001.

[2] Ozgur Ustun and R. Nejat Tuncay, “ Design, Analysis, and Control of a Novel Linear Actuator, ” IEEE Transactions on Industry Applications, vol. 42, no. 4, pp. 1007-1013, 2006.

[3] J. K. Kim, S. W. Joo, S. C. Hahn, J. P. Hong, D. H. Kang and D. H. Koo, “ Static Characteristics of Linear BLDC Motor Using Equivalent Magnetic Circuit and Finite Element Method, ” IEEE Transactions on Magnetics, vol. 40, no. 2, pp. 742-745, 2004.

[4] Catalog:Platinum DDL, Kollmorgen, Radford, VA, USA, 2001.

[5] David K. Cheng, Field and Wave Electromagnetics, Addison- Wesley Publishing Company Inc., 1989.

[6] D.C. Hanselman, Brushless Permanent Magnet Motor Design, The Writers' Collective, 2003.

[7] 許溢适, “ 實用電動機設計手冊 ”, 強峰印刷企業有限公司印, 2007年。

[8] 王怡鈞, “ 電磁學 ”, 超級科技圖書股份有限公司, 1987年。

[9] 孫清華, “ 最新無刷直流馬達 ”, 全華科技圖書股份有限公司, 2001年。

[10] 茆尚勳, “ 直驅式跑步機用直流無刷馬達之設計 ”, 成功大學機械工程學系碩士論文, 2002年。

[11] 黃昌圳，“有限元素法在電機工程的應用”，全華科技圖書股份有限公司，2005年。
[12] 劉國強、趙淩志、蔣繼婭，“Ansoft工程電磁場有限元分析”，電子工業出版社，2005年。