

Modeling of permanent magnet behavior in rotating electrical machinery

Dmitry Egorov

Lappeenranta University of Technology, group of Electrical Drives

The penetration of permanent magnet (PM) technology in the market of electrical motors has led to increasing interest to the modelling of PMs. The magnetic properties of PM can be reduced dramatically with increasing of the temperature or application extremely high field strengths acting on the PM [1]. The precise determination losses in PM are also the actual topic nowadays that is dictated by general demands of machine effectiveness. Recently, the hysteresis loss was observed in PM materials [2]. The possibility for hysteresis loss was analytically observed for tooth coil winding permanent magnet synchronous motor (PMSM) [3], rotor surface magnet PMSM [4], traction motor [2] and high speed motor [3]. Finally, some extra high accuracy measurement was performed in KBFI for different types of PMs [5]. Currently, the new measurements are in process in KBFI in order to create accurate models for PM simulation.

The following topics will be discussed in the seminar: hysteresis loss in PM material, measuring of PMs, FEA based models for partial PM demagnetization.

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[2] J. Pyrhönen, S. Ruoho, J. Nerg, M. Paju, S. Tuominen, H. Kankaanpää, R. Stern, A. Boglietti and N. Uzhegov, "Hysteresis Losses in Sintered NdFeB Permanent Magnets in Rotating Electrical Machines," IEEE Trans. Ind. Electron., vol. 62, no. 2, pp. 857 - 865, January 2015.

[3] D. Egorov, N. Uzhegov, I. Petrov and J. Pyrhönen, "Factors affecting hysteresis loss risk in rotor-surface-magnet PMSMs," in 2016 XXII International Conference on Electrical Machines (ICEM),

Lausanne, Switzerland, 2016.

[4] A. Fukuma, S. Kanazawa, D. Miyagi and N. Takahashi, "Investigation of AC Loss of Permanent Magnet of SPM Motor Considering Hysteresis and Eddy-Current Losses," IEEE Trans. Magn., vol. 41, no. 5, pp. 1964-1967, May 2005.

[5] I. Petrov, D. Egorov, J. Link, R. Stern, S. Ruoho and J. Pyrhonen, "Hysteresis losses in different types of permanent magnets used in PMSMs," IEEE Trans. Ind. Electron., vol. PP, pp. 1-1, March 2016.