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ABSTRACTS

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DV-11. Performance Analysis of the Parametric Magneto-Dynamic Model of Soft Magnetic Steel Sheets. *M. Petrun*[1], S. Steentjes[2], K. Hameyer[2] and D. Dolinar[1] *1. FERI, University of Maribor, Maribor, Slovenia; 2. IEM, RWTH Aachen, Aachen, Germany*

Widespread usage of non-oriented (NO) soft magnetic steel sheets (SMSSs) in different electromagnetic devices requires adequate descriptions of the intertwined electromagnetic phenomena. Such phenomena can be solved using various models [1]-[3], where e.g. FE coupled models [1], magnetic equivalent circuits (MECs) [1], [3] and most recent the parametric magneto-dynamic model (MDM) [2] can be used. Using the MDM the diffusion phenomena can be effectively solved based on a simple matrix differential equation [2], where the MDM is based on the division of a lamination into several equally thick slices. This allows treating the otherwise non-uniform distribution of the magnetic field across the lamination thickness as uniform inside the individual slices. A similar approach is also used when modeling the diffusion phenomena using MECs [1], [3]. The adequate number of slices N_s in such models (MEC and MDM) is strongly dependent on the excitation dynamics and material properties, where the used number N_s significantly influences the performance and response of the model. For example, decreasing the number of slices increases the computational performance rapidly, while the calculated electromagnetic variables tend to show characteristic oscillations (Fig. 1), which cause a decrease in the accuracy of the model. The recommended number of slices is in the literature often associated with the penetration depth of the magnetic field, however using this criterion the obtained performance is often not accurate enough or not optimally computational inexpensive. On that account, this paper presents a detailed analysis of the MDM performance with respect to the number of slices for various excitation dynamics, where reasons for oscillations are explained and criteria for optimum slice thickness regarding used excitation dynamics are presented. Further, the influence on the power loss calculation is evaluated and additional measures to increase the performance of the discussed MDM are presented in detail.

[1] O. Bottauscio, A. Manzin, A. Canova, M. Chiampi, G. Gruosso, and M. Repetto, "Field and circuit approaches for diffusion phenomena in magnetic cores," *IEEE Trans. Magn.*, vol.40, no.2, pp.1322-1325, 2004 [2] M. Petrun, V. Podlogar, S. Steentjes, K. Hameyer, and D. Dolinar, "A Parametric Magneto-Dynamic Model of Soft Magnetic Steel Sheets," *IEEE Trans. Magn.*, vol.50, no.4, April 2014 [3] Hui, S.Y.R.; Zhu, J.G.; Ramsden, V.S., "A generalized dynamic circuit model of magnetic cores for low- and high-frequency applications. II. Circuit model formulation and implementation," *Power Electronics, IEEE Trans. on*, vol.11, no.2, pp.251,259, Mar 1996

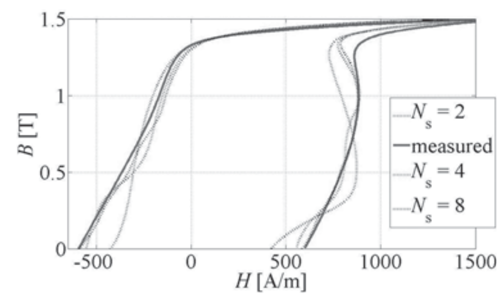

Fig. 1: Measured dynamic hysteresis loop for a 0.5 mm thick NO SMSS at f = 1000 Hz and B_{max} = 1.5 T compared to calculated hysteresis loops using N_s = 2, 4 and 8.