INSTITUTE OF SENSOR AND
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10th European Conference on Magnetic Sensors and Actuators

EMSA 2014

Vienna, Austria

July 6-9, 2014

EMSA 2014

Book of Abstracts

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Vienna University of Technology
Faculty of Electrical Engineering and Information Technology
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WP26

Magnetization Dynamics and Power Loss Calculation in NO Soft Magnetic Steel Sheets under Arbitrary Excitation

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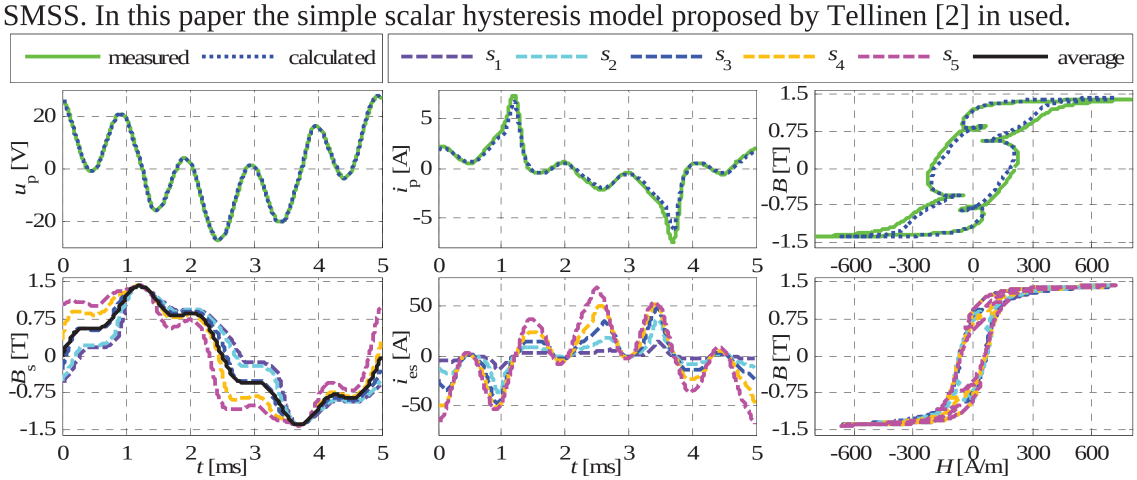
The aim of this paper is to analyze and evaluate the magnetization dynamics and power loss in non-oriented (NO) soft magnetic steel sheets (SMSSs) under complex excitation waveforms. For the analysis the parametric magneto-dynamic model presented in [1] is used, where the SMSS is divided into an adequate number of virtual slices N_s. The equation describing the equilibriums of magnetomotive forces in all the slices of the SMSS is in matrix form expressed as (1), where i_p is current in the excitation winding, l_m is the mean length of the magnetic path, $\bar{\mathbf{H}}(\bar{\mathbf{\Phi}})$ is a vector of field strengths as non-linear functions of the average magnetic fluxes in the slices and $\mathbf{L}_m$ represents a linear tensor matrix of magnetic inductance.

$$\mathbf{N}i_p = \bar{\mathbf{H}}(\bar{\mathbf{\Phi}})l_m + \mathbf{L}_m \frac{d\bar{\mathbf{\Phi}}}{dt}, \quad \mathbf{N} = N_p[1]_{N_s \times 1} \qquad (1) \qquad\qquad u_p = i_p R_p + \frac{d i_p}{dt} L_{\sigma p} + \mathbf{N}^T \frac{d\bar{\mathbf{\Phi}}}{dt} \qquad (2)$$

Coupling with electrical excitation circuit completes (2), where u_p is the applied excitation voltage, and R_p and $L_{\sigma p}$ are the resistance and leakage inductance of the excitation winding. The magneto-dynamic model is fully described by (1) and (2) in combination with a static hysteresis model, which describes the non-linear relationship in individual slices of the SMSS. In this paper the simple scalar hysteresis model proposed by Tellinen [2] in used.



The figure shows the measured and calculated results for the depicted excitation voltage u_p of frequency $f = 200$ Hz with an added fifth harmonic for a 0.5 mm thick NO steel sheet, which is divided into $N_s = 5$ virtual slices s. In the full paper the magneto-dynamic model is evaluated over a wide frequency and magnetic flux density range, with various excitation waveforms, where accuracy and limitations of the discussed model are studied. The experimental results for the discussed evaluation are carried out on an Epstein frame.

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