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ABSTRACTS

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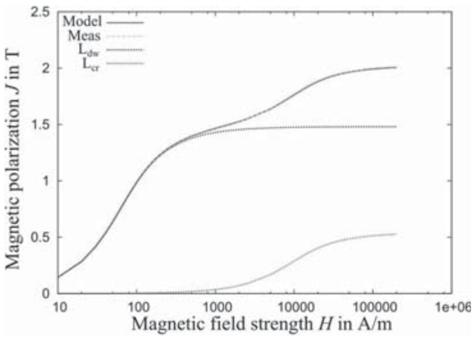
BP-12. Double Langevin Function for Description of Anhysteretic Magnetization Curves. S. Steentjes[1], M. Petrun[2], *G. Glehn*[1], D. Dolinar[2] and K. Hameyer[1] *1. Institute of Electrical Machines, RWTH Aachen University, Aachen, Germany; 2. FERI, University of Maribor, Maribor, Slovenia*

Many of the most used and well-known hysteresis models exploit the Langevin function for description of the anhysteretic magnetization curve. Among these models is for example the Jiles-Atherton [1] or the GRUCAD [2] hysteresis model. Although the Langevin function exhibits some interesting advantages over other functions, it was e.g. selected quite arbitrarily in the process of deriving the Jiles-Atherton hysteresis model [3]. Based on these advantages, the Langevin function emerged as the most popular choice to describe the anhystereic part of many contemporary hysteresis models. Using the Langevin function when predicting hysteresis loops can however

also lead to problems that are linked to the limited number of parameters and accuracy of the description of the anhysteretic curve [3], [4]. The inability to describe a measured anhysteretic curve accurately prevents adequate parameter identification and consequently accurate prediction of static hysteresis loops. The biggest deviations arise especially in the knee region of the anhysteretic curve. This results in larger deviations when using discussed hysteresis models to predict dynamic magnetization and power losses in soft magnetic materials. In this paper these problems are addressed by applying a double Langevin function instead of single one, as it is common practice. Figure 1 shows a comparison of the double Langevin function with the measured and extrapolated anhysteretic curve. The first Langevin function L_{dw} relates to the ordering of magnetic moments related to the movement of domain walls. The second L_{cr} accounts for the rotation of the magnetic moments relative to the preferred axis (coherent rotation). The double Langevin function enables to improve the accuracy of the description of various anhysteretic magnetization curves and is furthermore implemented into the Jiles-Atherton hysteresis model.

[1] D. C. Jiles and D. L. Atherton, *J. Magn. Magn. Mater.*, vol. 61, no. 1, pp. 48-60, 1986. [2] P. Koltermann, L. Righi, J. Bastos, R. Carlson, N. Sadowski, and N. Batistela, *Physica B: Condensed Matter*, vol. 275, no. 1-3, pp. 233-237, 2000. [3] E. Kokornaczyk, M. Gutowski, *IEEE Trans. Magn.*, vol. 51, no. 2, pp. 1-5, 2015. [4] S. Steentjes, M. Petrun, D. Dolinar and K. Hameyer, *IEEE Trans. Magn.*, vol. 52, no. 5, pp. 1-4, May 2016.



Comparison of measured and extrapolated anhysteretic magnetization curve (measured) and the identified double Langevin function (model) for a non-oriented electrical steel grade.