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Energy-based Modeling of Dynamic Hysteresis using the Parametric Magnetodynamic Model and its Parameter Identification

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Modeling of magnetization dynamics, transients and iron losses in laminated structures of non-oriented soft magnetic steel sheets is a complex problem. The applied hysteresis model to represent the constitutive relation of the sheet plays a central role for the resulting eddy current and flux distributions. There exists so far no macroscopic material model considering simultaneously dynamic hysteresis, the laminated structure and the issue of parameter identification.

The main goal of this paper is to establish a material model as an intermediate representation between measured data and macroscopic material characteristics. An energy-based hysteresis model which bases upon the decomposition of total field strength into reversible and irreversible terms is used. The values of model parameters are determined using experimental data and are expected to be more intrinsic and objective than those of empirical models, and hence better correlated with microstructure parameters.

The full paper will illustrate two different model parameter identification schemes: (i) semi-physical scheme using the anhysteretic magnetization curve to identify the reversible field component and coercivity to identify the irreversible components and (ii) mathematical scheme based on the robust trust-region-reflective algorithm. In addition, the model integration into the lamination model will be detailed as well as the models accuracy analyzed in terms of iron loss and hysteresis loop shape prediction.