

Modelica Models for Magnetic Hysteresis, Materials and Transformers

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This paper presents new extensions of the Modelica.Magnetic.FluxTubes library [1] which will be integrated into the Modelica Standard Library soon. The extensions mainly are hysteresis elements for modeling of ferromagnetic and dynamic hysteresis of magnetic materials during transient simulation of electromagnetic components with lumped network models. Two different static hysteresis models, the Tellinen [2] and the Preisach model [3] have been implemented. Dynamic hysteresis is accounted for with a dB/dt term. Consideration of both the static and dynamic hysteresis during transient simulation allows, among others, for determination of hysteresis losses. This becomes more and more important during design of electromagnetic actuators and systems due to increasing requirements on power density and miniaturization. A new material package, mainly based on in-house measurements, provides hysteresis data of several magnetic materials for a one-click configuration of the hysteresis elements. Additionally, based on the hysteresis elements, models for permanent magnets as well as single- and three-phase transformer models have been implemented. An exemplary model of a single-phase transformer including simulation results is shown in Figure 1.

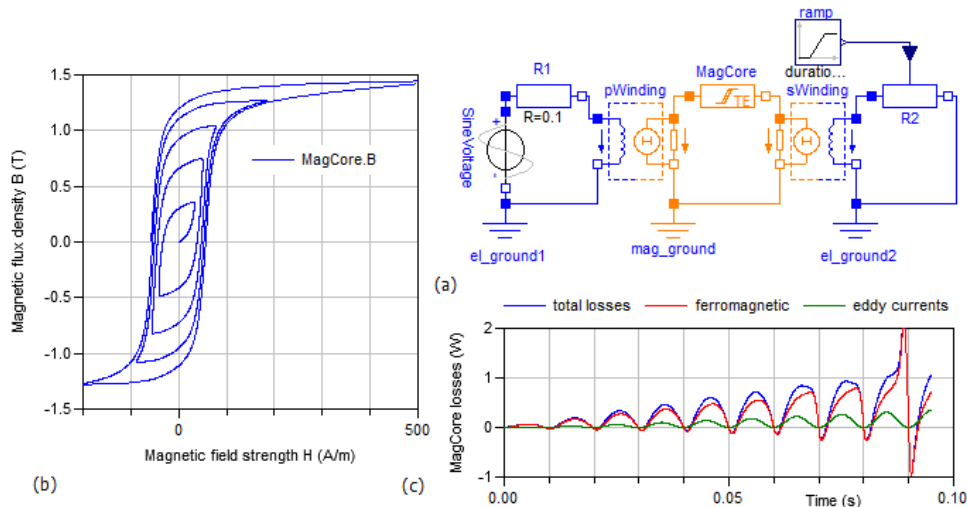


Figure 1: Model of a single-phase transformer with the new hysteresis element MagCore and a ramped load (a), resulting $B(H)$ hysteresis loops of the magnetic core (b) and the corresponding hysteresis losses divided into their ferromagnetic and eddy current components (c)

References

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