LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Université de Lille 1 SCIENCES ET TECHNOLOGIES

L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille   Valeo

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Master project, 2017-2018

Characterization and analysis of magnetic material behaviour used in electrical machines dedicated to electrical mobility

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Context

Soft magnetic materials are widely employed, usually as a laminated material, for the magnetic core manufacturing of electrical machines (transformers, rotating machines …). Indeed, the electromagnetic energy conversion relies on the use of such materials as they are the vector of the energy conversion with the amplification and channeling of the magnetic flux.

In the context of electrical mobility, the energy efficiency of electrical motors is, among other aspects, intimately related to the magnetic materials properties. These properties, and in particular the magnetic behavior that exhibits a hysteresis phenomenon, are an important parameter to be accounted for in tools dedicated to electrical machine design. Usually, the magnetic behavior law is identified from standard measurements, under sinusoidal excitation, with Epstein frames. The losses are also identified from these standard measurements.

Nevertheless, in practice, the magnetic core in electrical machines is subjected to complex excitation waveforms due to, for instance, the PWM power supply. Therefore, it is of interest to characterize the material magnetic behavior under the excitation waveforms met in real operation in the magnetic core of the electrical machine. The aim of such study is to get data to improve the material models (magnetic law and iron losses) used in the design tools.

Objective and works steps

The main objective of this internship is to characterize and analyze the magnetic material behavior with excitation waveforms close to those met in practice. As the direct measurement of these waveforms is difficult in practice, a numerical model of the electrical machine, with some modeling hypotheses, will be used to extract the waveforms.

Three main steps will be considered in order to fulfill this objective:
- Bibliographic work regarding the magnetic material properties.
- Simulation of an electrical machine used for electrical mobility and extraction of typical magnetic field excitation waveforms.
- Choice of materials and characterization with the selected waveforms and analysis of the material performances (magnetic law and iron losses).

Key word

Magnetic materials, characterization, iron losses, energy conversion, electrical motors, modelling

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