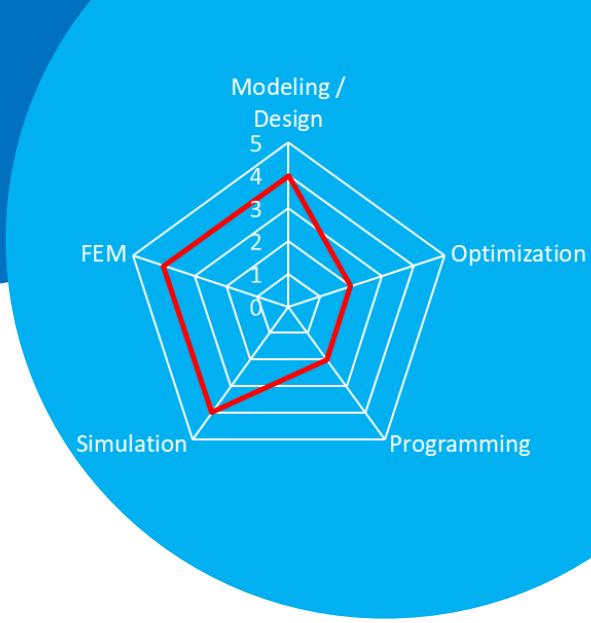
Universität Stuttgart
Institut für Elektrische
Energiewandlung

BA / FA

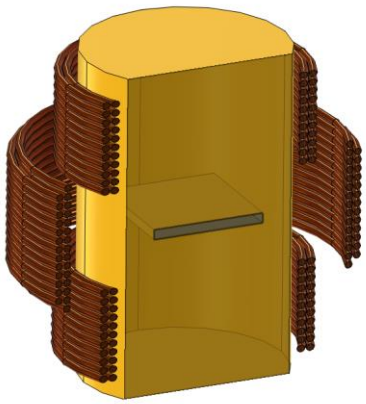


Concept Study for a Large Scale Maxwell Coil

Ferrite materials are widely used in wireless power transfer (WPT) systems for flux guidance. However, ferrite losses are usually measured on small toroidal core samples, whose cross-section is much smaller than that of WPT ferrite tiles. The loss data therefore cannot be transferred directly, because effects such as inhomogeneous flux distribution, temperature gradients and geometry-dependent eddy currents are not captured.

A Maxwell coil combined with calorimetric loss measurement allows ferrite samples to be characterized under homogeneous field conditions. The existing test setup has only been demonstrated for samples up to 5 × 45 mm, and previous work reached its limits at 45 × 45 mm. Characterizing WPT-typical tiles of 100 × 100 mm therefore requires a new system design.

The objective of this research project is the conceptual development of a comprehensive test bench, including coil system, compensation network, power electronics and cooling system, considering both electromagnetic and thermal aspects. The concept development follows VDI 2206.



Student Profile:

→ Master's student in electrical engineering, mechatronics, or related fields
→ Familiar with development process VDI 2206 and VDI 2221
→ Knowledge of electromagnetic fields and inductive power transfer
→ Basic understanding of magnetic materials and loss mechanisms in ferrites
→ Experience with FEM simulation (COMSOL)
→ Basic understanding of heat transfer and thermal modeling
→ Interest in systematic product development and test bench design
→ Experience with MATLAB

Tasks:

→ Literature review on ferrite loss measurement, Maxwell coils and calorimetry
→ Analysis of the existing setup and its limiting factors
→ Definition of requirements (field strength, frequency, sample size…)
→ Concept development according to VDI 2206 and 2221
→ Simplified 2D simulations to investigate basic scaling effects
→ Electromagnetic and thermal FEM simulation of coil and sample
→ Design of compensation network and cooling concept
→ Evaluation of concepts and recommendations for implementation. Selection and documentation of final design

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