Institute of Fundamentals and
Theory in Electrical Engineering

Masterthesis

Consideration of Nonlinear/Hysteretic Effects in the Finite Element Method

Motivation

In general, magnetic materials have a nonlinear material law and suffer under hysteretic effects. This results in a nonlinear form of the equations that describe the magnetic field, which can not be solved directly anymore, but in an iterative way. A popular and efficient method to do this is the Newton-Raphson method. However, to guarantee convergence to the real solution for a broad range of problems is still a challenging task. As a basis for the finite element method, our in-house open source code openCFS already provides the needed framework/infrastructure to incorporate nonlinear material laws into magnetic equations.

Research Questions

Overall Question: Is there a way to simulate nonlinear/hysteretic magnetostatic field equations efficiently?

Learning Goals: Get in touch with various popular software and methods:

- Git, C++, Coreform Cubit, Paraview and openCFS to implement efficient code
- Solve partial differential equations (e.g. Maxwells equations) and nonlinear equations: Finite Element Method, Newton-Raphson, ...

Tasks

- Literature research (Nonlinear/Hysteretic magnetic material laws, Finite element method, Methods to solve nonlinear systems of equations)
- Implementation of a hysteresis model into openCFS
- Implementation of a solution scheme to solve the nonlinear equations in openCFS

Organisation

- Language: English
- Start: Immediately possible

Contact/Supervisor

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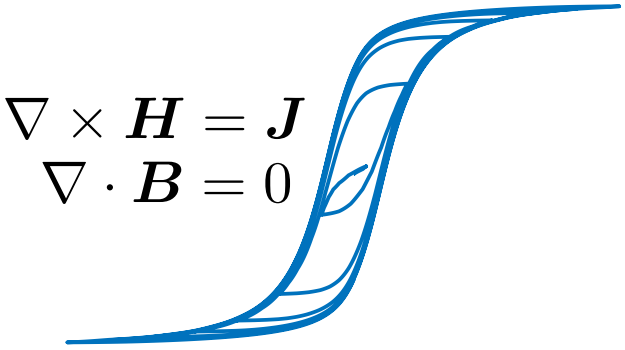

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