

NURBS Enhanced Finite Elements for Electric Motor Simulation

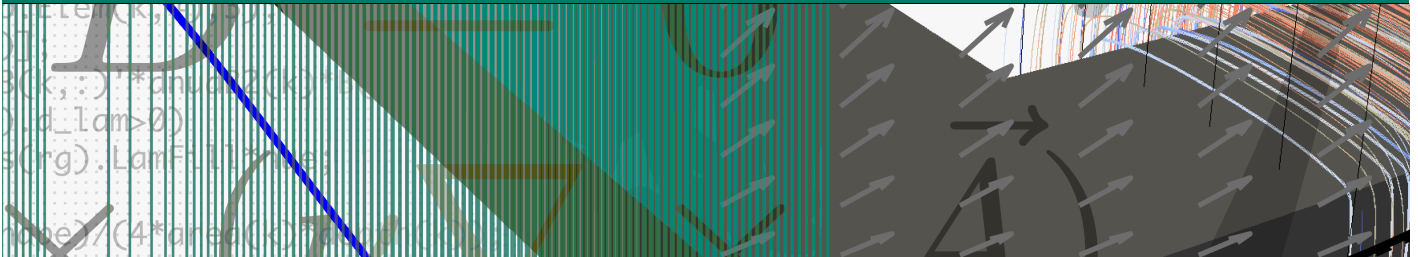


TECHNISCHE
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DARMSTADT

Proposal for a Masters's thesis

Study field: Computational Engineering | Mechatronics | Electrical Engineering | Mechanical Engineering

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Description

When simulating electric machines, the use of lowest order Finite Elements (FE) is the classical discretization approach due to the simplicity of meshing and local refinement, see Figure 1. However, triangular elements fail to represent circular sections exactly and derivative based optimization becomes almost impossible due to the necessity of remeshing.

These issues can be overcome in an Isogeometric Analysis (IGA) setting, where the geometry mapping is predefined by Non-Uniform Rational B-Splines (NURBS), see Figure 2, allowing for exact geometry representation and analytic derivatives. Here, on the other hand, local refinement can be challenging.

The task for this thesis is to combine the advantages of both methods and create an enhanced discretization scheme, where NURBS are used for the geometry mapping, but lowest order FE basis functions are used for the computation. This way, the mapping is exact and the FE space locally refined. As a consequence, the model does not need to be remeshed for geometry changes, making parameter studies or optimization very efficient.

Work plan

- Literature research for Finite Elements and eccentricity of electric motors
- Familiarization with the given Matlab code
- Implementation lowest order FEM with NURBS mapping
- (Derivation of derivatives for optimization)

Prerequisites

- Programming experience, ideally in Matlab
- Knowledge in Finite Elements or strong interest to learn

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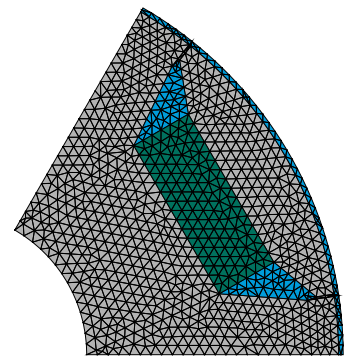


Figure 1: 2D FEM mesh of a PMSM motor.

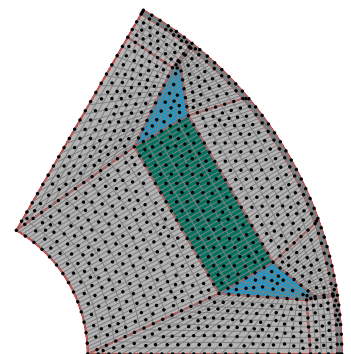


Figure 2: 2D IGA mesh with mapped FEM nodes.