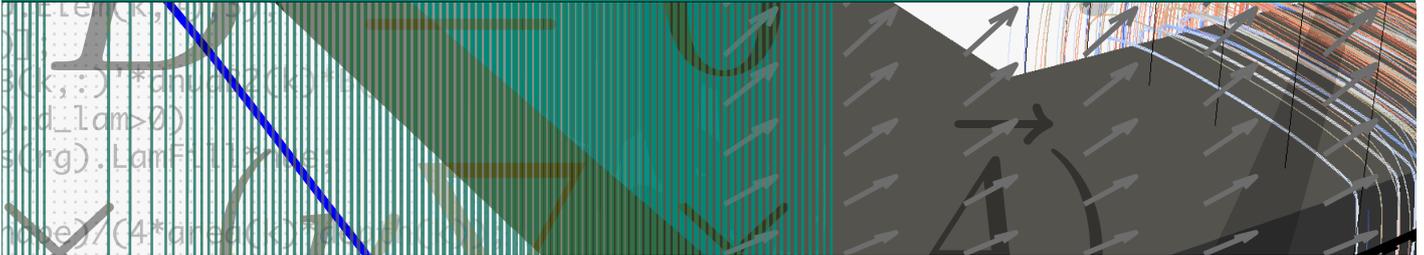# Electric machine simulations using NURBS-enhanced Finite Elements

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor's or Master's thesis
Study field: Computational Engineering
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Description

Conducting numerical simulations to evaluate performance characteristics is an integral part of the electric machine design workflow. Traditionally, these simulations are conducted using the Finite Element Method (FEM), which operates on the mesh — a discrete representation of the underlying design geometry that consists of piecewise-polynomial elements.

Curved geometries, e.g. the circular airgap between stator and rotor in an electric machine, are usually represented by Non-uniform rational B-Splines (NURBS) and can not be represented exactly, but only approximated by these finite elements. The NURBS-enhanced Finite Element Method (NEFEM) is a recently proposed extension, in which select elements are modified to allow exact representation of NURBS-curved geometries [1].

The goal of this thesis project is to investigate the applicability of NEFEM to electric machine simulations using an experimental implementation based on the Finite Element solver GetDP [2]. Tasks will include geometric modelling and simulation setup for electric machines and interpretation of results.

Prerequisites

- Interest in modeling and numerical simulations
- Theoretical knowledge of FEM preferred
- Programming experience in Python and C++ preferred, but not required

References

[1] N. Hosters, J. Helmig, A. Stavrev, M. Behr, and S. Elgeti, "Fluid-structure interaction with NURBS-based coupling," *Comput. Meth. Appl. Mech. Eng.*, vol. 332, pp. 520–539, 04 2018, arxiv:1812.01562.

[2] P. Dular and C. Geuzaine, "GetDP: A general environment for the treatment of discrete problems," University Liege, 2017. Available: `http://getdp.info`

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Weighted Core Areas: