

Automated domain decomposition for electric machines with convergence studies



TECHNISCHE
UNIVERSITÄT
DARMSTADT

Proposal for a Bachelor's thesis | Project work | HiWi job
Study field: Electrical Engineering | Computational Engineering
March 11, 2025



1 Description

The fast and accurate simulation of electric machines is crucial for prototypical design, with finite element methods being widely used. However, complex simulations can be computationally expensive. Domain decomposition (DD) methods, which split the problem into smaller sub-problems, offer a well-studied solution to accelerate these computations [2]. The approach has particular potential for designing electric machines, where the small spatial dimension of the air gap is important due to its high energy density lending itself naturally to overlapping DD methods, potentially significantly improving convergence speeds.

The project goals are to study the convergence behaviour of the overlapping domain decomposition according to different boundary conditions applied for the subdomain solves. We will implement these algorithms in the MQS FE solver Pyrit [1].

Contact:

Max Schaufelberger
max.schaufelberger@
tu-darmstadt.de

Office: S2|17 120

2 Work Plan

- Get used to pyrit as a FE solver
- Implement boundary conditions
- Design and implement convergence studies
- Summarise everything in written report and oral presentation

3 Prerequisites

- Python programming knowledge
- Basic knowledge of finite element methods

References

- [1] Jonas Bundschuh et al. "Pyrit: A Finite Element Based Field Simulation Software Written in Python" doi: 10.1108/COMPEL-01-2023-0013.
- [2] Victorita Dolean et al. "An Introduction to Domain Decomposition Methods: Algorithms, Theory and Parallel Implementation".

