Enabling Quasi-3D Simulations in Pyrit – a finite-element solver in Python

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a HiWi job
Study field: Computational Engineering | Electrical Engineering
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Description

Quasi-3D (Q3D) methods are numerical methods, which exploit the symmetry of a geometry to perform 3D field simulations on a 2D mesh (see Fig. 1), thus improving the computational efficiency and accuracy compared to conventional 3D finite-element simulations. At TEMF, an axisymmetric Q3D method for simulating high-voltage arresters as well as a translational Q3D method for quench simulations of superconducting accelerator magnets have been developed in an object-oriented MATLAB framework.

Now, the Q3D MATLAB code shall be transferred to Pyrit, an in-house finite-element solver in Python in order to make it accessible for an interested audience. Your task will be to integrate the Q3D code into a given Pyrit software structure as well as to cleanse it from code parts that have become obsolete in the course of the method's development.

Work plan

- Get acquainted with Q3D methods, the Pyrit software and code development structures within a motivated team
- Transfer and integrate the Q3D code from MATLAB to Pyrit (Python)
- Verify the correctness of the Q3D Python implementation by test cases

Prerequisites

Solid knowledge of MATLAB and Python programming languages, joy in software engineering, strong team spirit, interest in diving into the technical depths of numerical methods and field simulation.

References

- Laura A. M. D'Angelo, Yvonne Späck-Leigsnering, Herbert De Gersem: "Quasi-3D Magneto-Thermal Quench Simulation Scheme for Superconducting Accelerator Magnets". In: *IEEE Transactions on Applied Superconductivity*, vol. 32, no. 6, 2022. arXiv: `https://arxiv.org/abs/2112.00682`
- Pyrit-Wiki: `https://git.rwth-aachen.de/jonas.bundschuh/pyrit-wiki`

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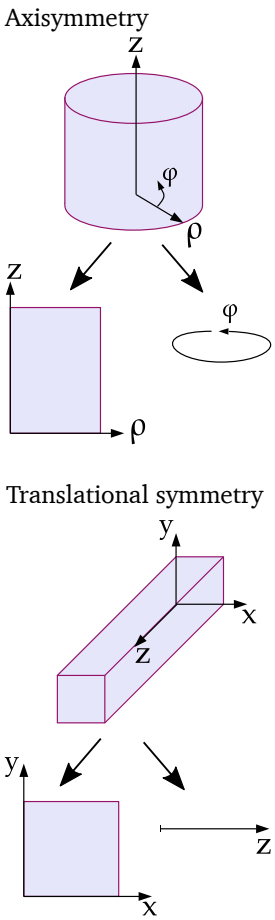

Figure 1: Symmetrical 3D geometries are decomposed into a 2D plane and a 1D dimension.