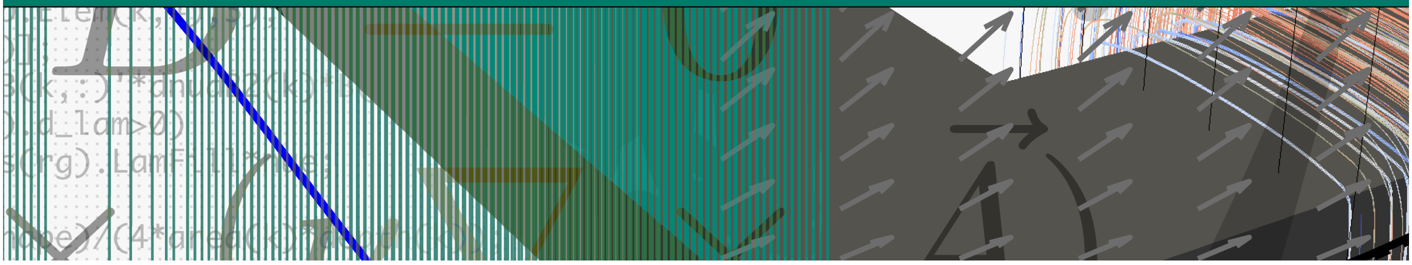
Mortaring Methods for Thin Shell Approximations of Insulation Layers of CERN's Superconducting Magnets

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor's/Master's thesis
Study field: Computational Engineering | Electrical Engineering | Mathematics | Applied Superconductivity



Description

Superconducting magnets as e.g. used in particle colliders such as the LHC at CERN exhibit complex transient magneto-thermal phenomena whose analysis requires appropriate numerical methods such as the finite element (FE) method. When using the latter, thin insulation layers can lead to numerical problems in thermal simulations due to their high aspect ratios.

To circumvent this problem, thin shell approximations collapsing the volumetric insulation layer into a surface can be used. However, without further considerations, these methods require the meshes on both sides of the shell to be conforming. In order to conveniently treat layer-to-layer insulation of superconducting magnets, a way to deal with non-conforming meshes is desirable.

Mortaring methods are a well-known possibility to cope with non-conforming meshes [1]. Thus, this announcement proposes to implement mortaring for thin shell approximations in the open-source finite element framework GetDP.

Work plan

- Study of thermal thin shell approximations and mortaring methods
- Implement mortaring as an extension to existing thin shell models
- Comparison of numerical results with measurements and simulation results from other software available at CERN

Prerequisites

Basic knowledge of the finite element method and applied superconductivity

References

[1] A. Quarteroni and A. Valli. *Domain Decomposition Methods for Partial Differential Equations*. Numerical Mathematics and Scientific Computation. Oxford: Oxford University Press, 1999

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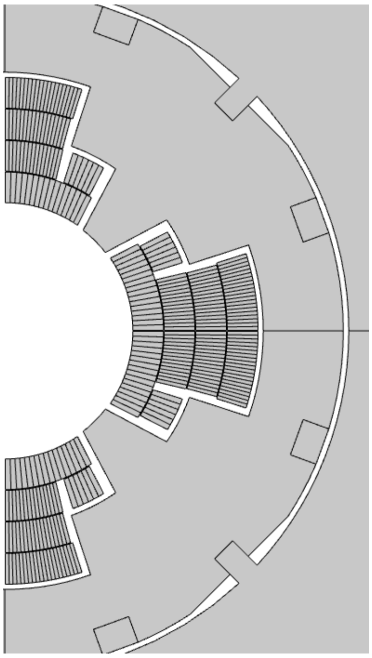

Figure 1: Typical magnet cross-section.

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