Combining Domain Decomposition and Parallel-in-Time Methods for Heat Equation

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor's thesis
Study field: Computational Engineering | Computer Science | Electrical Engineering | Mathematics
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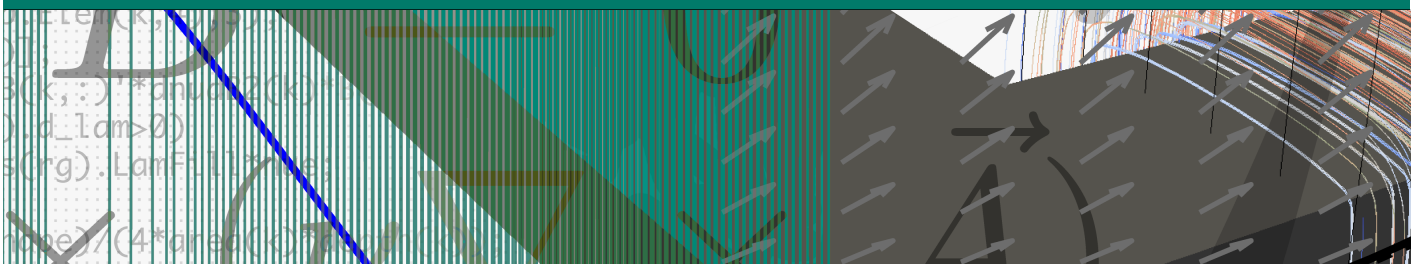

Description

Parabolic partial differential equations (PDEs) as the eddy current problem or the heat equation depend both on the space and on time. For simulating these problems one often chooses a method of lines approach, i.e., the space is discretized first and the arising system of ordinary differential equations (ODEs) is solved with a time integration scheme. In this context, one can apply domain decomposition approaches and Parallel-in-Time (PinT) methods to increase efficiency through parallelization.

This thesis deals with applying the PinT method ParaReal to the heat equation. For domain decomposition and space discretization a code framework based on mortaring and IsoGeometric Analysis (IGA) is provided (see exemplary simulation result in Fig. 1). We want to apply the examined methods for the simulation of electrical machines (eddy current problem), so another focus lies on the validation of results and measuring the increase in efficiency in comparison to other approaches.

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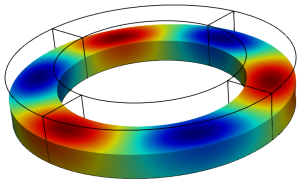

Fig. 1: Parallel simulation using mortaring in IGA.

Work plan

- Familiarizing yourself with IGA and mortaring in provided code framework and analytically
- Implementing ParaReal for parallel transient simulation
- Simulation of heat equation and numerical experiments to measure increase in efficiency

Prerequisites

Basic knowledge in `Matlab/Octave` is required to understand the underlying code frameworks. Additionally, experience with numerical methods for differential equations is helpful but can be acquired in the context of this work.

CEM