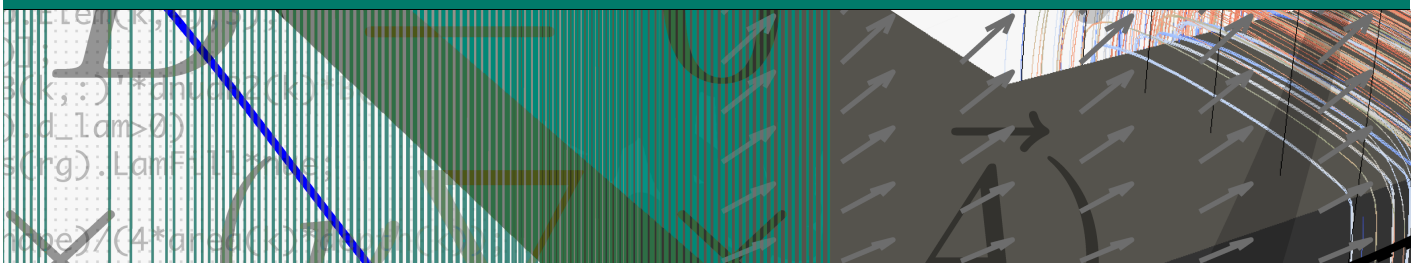
Modern Domain Decomposition Methods in Both Space and Time

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a HiWi-Job, Bachelor's thesis, Master's thesis or Projectseminar
Study field: Computational Engineering | Computer Science | Electrical Engineering | Mathematics
April 2, 2024



Description

Parallel algorithms play an increasingly vital role in both research and industry for accelerating simulations. Domain Decomposition methods (DDMs), such as *nonoverlapping Schwarz* or *Dirichlet-Neumann/Neumann-Neumann* methods (refer to [1]), are effective approaches for introducing spatial concurrency, thereby facilitating parallel computations. When the problems under examination are not only spatially dependent but also time-dependent, *waveform relaxation* enhances information exchange between different time steps [2, 3]. This, in turn, enhances additional concurrency in time when combined with *Parareal* methods.

The objective of this project is to implement selected algorithms from the provided references and evaluate their performance using discretized benchmark problems.

Prerequisites

Motivation and interest in numerical methods, as well as experience in programming numerical algorithms (e.g., time integration), are essential. Proficiency in Matlab, C++, or Python is also required.

References

[1] A. Toselli and O. B. Widlund, "Domain Decomposition Methods – Algorithms and Theory", *Volume 34 of Springer Series in Computational Mathematics*, 2005.

[2] M.J. Gander, YL. Jiang & RJ. Li, "Parareal Schwarz Waveform Relaxation Methods" *In: Domain Decomposition Methods in Science and Engineering XX*, 2013.

[3] B. Song, YL. Jiang & X. Wang, "Analysis of two new Parareal Algorithms based on the Dirichlet-Neumann/Neumann-Neumann Waveform Relaxation Method for the Heat equation", *Numer Algor*, 2021.

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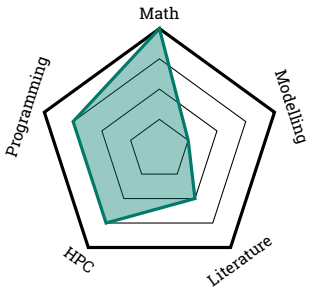
Weighted Core Areas:



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