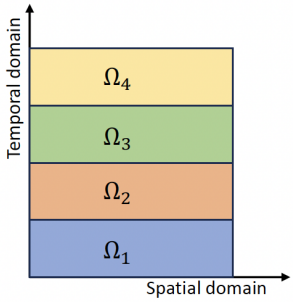
University of Stuttgart
Germany

Institute of Mechanics, Structural Analysis and
Dynamics of Aerospace Structures
Prof. Dr.-Ing. Tim Ricken

Proposal – Master Thesis

A Hybrid Reduced-Order Parallelization-in-Time Approach for Thin Porous Materials

Motivation:



Numerical simulations are the key tool for predicting multiphsical systems. However, the complexity of such systems typically leads to high computational times, which opposes the need to speedup simulations in many applications. One approach to remedy this issue is applying model-order reductions tools, ranging from knowledge-driven to data-driven methods. Another approach is parallelization methods, that distribute the time-spatial domain over multiple processors.

Reduced-order models (ROM) have been developed to predict the effective dynamics in thin porous materials. For such materials, we propose a hybrid reduced-order parallel-in-time method that solves full models on multiple parallel processors, each of them initialized with a snapshot of reduced order.

Goal:

This thesis aims to develop a hybrid multiple-shooting algorithm for thin porous materials based on model-order reduction and parallel-in-time methods. The implementation will be done using DOLFINx, the Python frontend of the FEniCSx finite-element software.

Tasks:

1) Literature review on model-order reduction and paralellization-in-time methods.
2) Set up and implementation a single-shooting algorithm based on a reduced model and a full model.
3) Extend the implementation to a multiple-shooting algorithm.
4) Validate the hybrid algorithm by performing several numerical tests and comparisons with other parallel-in-time methods.

Requirements:

1) Knowledge of fluid dynamics and/or solid mechanics
2) Knowledge of numerical simulation and FEM
3) Programming experience

Editor:
Prof. Tim Ricken

Supervisor:
Dr. Alaa Armiti

Supervisor:
Maximilian Brodbeck

For further information: Please don't hesitate to contact us

Contact: Pfaffenwaldring 27, 70569 Stuttgart
E-mail: alaa.armiti-juber@isd.uni-stuttgart.de
E-mail: maximilian.brodbeck@isd.uni-stuttgart.de