University of Stuttgart
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Institute of Mechanics, Structural Analysis and Dynamics of Aerospace Structures
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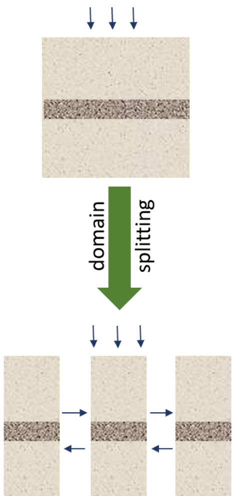
Proposal – Master Thesis

A Knowledge-Driven Reduced Order Biphasic Model for Fluid-Saturated Deformable Porous Materials

Motivation:



Fluid-saturated poro-elastic materials, such as soil or biological tissues, are modeled using a biphasic model with strongly coupled differential equations. Solving these equations is of high computational complexity, mainly for nondeterministic models or data-driven evaluations. Therefore, applying model order reduction methods is crucial to reduce the complexity.

For thin porous materials, a reduced order model has been derived by means of asymptotic analysis in [Armiti-Juber and Ricken, 2021] It provides reliable solutions in thin domains, while accuracy is limited in non-thin domains with effective dynamics in transverse direction. It is expected that the accuracy of the reduced model can be improved in non-thin domains by splitting them into several interacting thin sub-domains. Then, the reduced model can be applied for each sub-domains by taking into account the interaction between them.

Goal: This thesis aims to extend the applicability of the reduced model in [Armiti-Juber and Ricken, 2021] to non-thin domains.

Tasks:

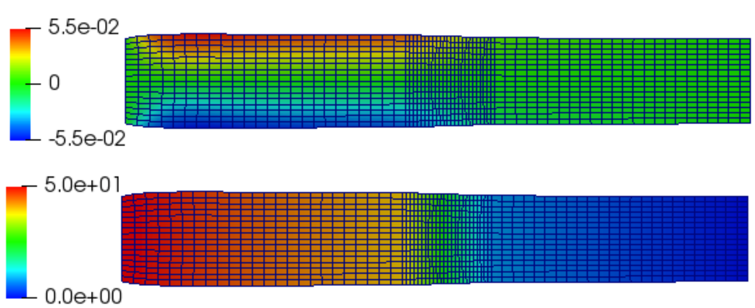
1) Understand the asymptotic analysis for the reduced model.
2) Set up a numerical scheme based on the FEM for the extended reduced model in a several interacting thin domains.
3) Implement the discretized extended reduced model and perform several numerical comparisons.

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



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

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