University of Stuttgart
Germany

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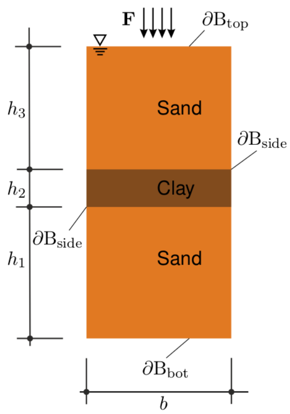
Proposal – Master Thesis

FEM-Based Simulation for a Non-Local Reduced Biphasic Model in Fluid-Saturated Thin Deformable Porous Materials

Motivation:



Fluid-saturated porous materials undergoing elastic deformation, such as soil or biological tissues, are modeled using a biphasic model with strongly coupled differential equations of fluid pressure and solid displacement. Solving these equations is of high computational complexity, mainly for nondeterministic models or data-driven evaluations. Therefore, applying model reduction methods is crucial, in particular for any kind of limit regimes.

For porous materials in thin domains with almost unidirectional flows, the complexity of the biphasic model can be reduced by means of asymptotic analysis, based on the domain's width-length ratio. The resulting reduced model is nonlocal, but is computationally more efficient as it has a highly reduced number of primary variables.

Goal: This thesis aims to numerically validate the reduced model for both accuracy and computational efficiency.

Tasks:

1) Understand the asymptotic analysis for the reduced model.
2) Set up a numerical scheme based on the FEM for the reduced model.
3) Implement the discretized 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

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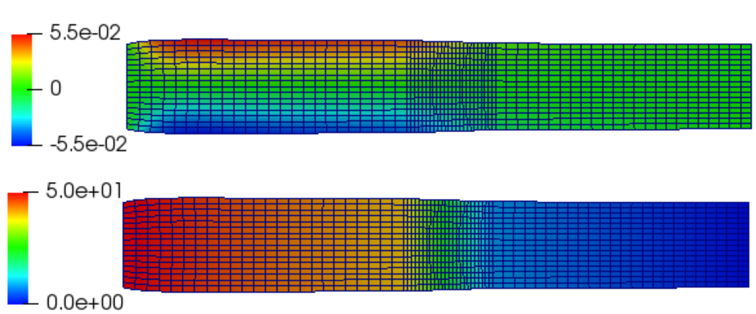
Dr. Alaa Armiti



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