University of Stuttgart
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Institute of Mechanics, Structural Analysis
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Announcement – Master's Thesis

Derivation and implementation of a multiphase model for the description of diseases in the liver

Motivation: Liver function and perfusion can be harmed by various liver disease. To describe the complex multiphasic liver tissue and the development, progress and a possible therapy of hepatic disease, numerical simulations based on the Theory of Porous Media (TPM) are developed. Histopathological changes such as necrosis or development of a tumor cause different material behavior and the tissue can undergo growth and remodeling processes. To successfully describe these, an existing multiphase model will be extended to include additional solid phases to describe fat tissue, necrosis and tumor.

Tasks: How to describe different histopathological changes in biological tissue by using the Theory of Porous Media? What are the respective governing equations and their tangents? How can such a formulation be implemented into a simulation program?

Procedure: To describe biological tissues with multiple tissue morphologies, at first a multiphasic TPM model has to be enhanced by four additional solid phases. The weak forms and the analytical tangents for the derivation of the stiffness matrix will be derived. The theoretical part is extended by a practical part, where the derived equations have to be implemented into the Finite Element Software FEBio. Finally, the developed model will be simulated and evaluated using various boundary value problems.

Requirements: Ideally you have first experience with numerical simulations and FEM (Introduction to FEM, Numerics), homogenization techniques (mixture theory, Theory of Porous Media) as well as first programming experience (ideally C++).

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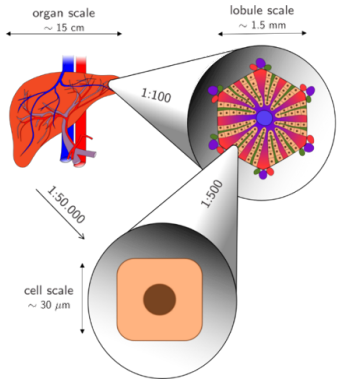

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