

# On a Multiscale and Multiphase Model of Function, Perfusion and Growth in Human Liver

Tim Ricken, Daniel Werner and Navina Waschinsky\*

\* TU Dortmund University, August-Schmidt-Str. 6, 44227 Dortmund, Germany  
e-mail: tim.ricken@tu-dortmund.de,

web page: <http://www.bauwesen.tu-dortmund.de/ms/en/Institute/>

## ABSTRACT

The human liver regulates metabolism in a complex time depending and non-linear coupled function-perfusion-mechanism. The viability of the organ could be affected by a failure in the liver structure. A common damage is the accumulation of fat in the tissue, known as a fatty liver.

In previous publications a computational model with a multicomponent/multiphase/multiscale approach to simulate important functionalities which are directly coupled with the blood perfusion is presented, see [2, 3]. Now, the growth in the liver tissue and its influence on the metabolism is examined. Furthermore, the development of the fatty liver disease which occurs of lipid inclusions and growing cells is presented.

The main functions of the liver take place at the smallest cells of the liver, the hepatocytes, which are embedded in the liver lobules. Nutrient, oxygen and other substances are transported with an anisotropic blood flow via a delicate system of capillaries, so called sinusoids. The inner structure of the lobule is highly complex due to the inhomogeneous distribution of the sinusoidal network and the complex arrangement of the hepatocytes. For a homogenization of the complex geometry we use a multiphase mixture theory based on the Theory of Porous Media (TPM), see [1].

The model considers a three-phasic component body: a porous solid structure, fat tissue which is capable of growth and a fluid. Each phase consists of a carrier phase  $j_a$ , namely a solvent, and miscible microscopic components, called solutes. The solutes are the relevant nutrients included in the carrier phase which regulate the metabolism. The metabolism is calculated with an embedded set of ordinary differential equations (ODE) which describes the production, utilization and storage of the metabolites.

**Keywords:** Multiphase, Multiscale, mixture theory, homogenization, finite element method (FEM)

## REFERENCES

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