Institut für Baumechanik
und Numerische Mechanik

Gottfried Wilhelm Leibniz Universität Hannover
IBNM, Appelstr. 9a, 30167 Hannover

Leibniz Universität Hannover

Prof. Dr.-Ing. D. Schillinger

www.ibnm.uni-hannover.de

edited by:
M.Sc. Adnan Ebrahem

Tel.: +49 (0)511.762-**5085**
Room: 3408 - **113**
E-Mail: **adnan.ebrahem**
@ibnm.uni-hannover.de

Bachelor thesis

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First examiner: Prof. Dr.-Ing. D. Schillinger	Supervisor: M.Sc. Adnan Ebrahem
Second examiner: Prof. Dr.-Ing. U. Nackenhorst	

Computational analysis of the deformation of the liver due to the surrounding tissues
Numerische Analyse der Deformationen der Leber aufgrund des umliegenden Gewebes

The liver has a high regenerative capability ensuring recovery of liver volume and physiology [1]. This property is of interest especially in liver surgery as the postoperative success of the liver after surgical resection depends mainly on the regeneration process. The computational modeling of this regrowth is a main topic in biomechanics still under investigation in a series of research works.

In this thesis we want to focus on the representation of the geometric boundaries of the liver due to its surrounding tissue [2]. Specifically, we want to investigate the influence of the resulting deformations on the regrowth process. The modeling of the regrowth process itself is not part of this work. One main part of the thesis will be to do a literature review on numerical methods used for liver modeling. In particular, special attention has to be paid to the governing equations for the representation of the liver as a continuum. In addition, material properties and a boundary value problem has to be defined that takes into account the surrounding tissues. Finally, the aim is to implement a simple computational model of the liver that is able to compute the stresses and displacements due to the surrounding tissues. The thesis can be done in German or English.

Requirements:

- Knowledge about Material Mechanics
- Course on Finite Elements

Objectives:

- Obtain fundamental understanding about the multiscale regrowth process of the liver (mechanical, biochemical and physiological factors)
- Develop a simple computational biomechanical model
- Analyze the influence of the surrounding tissues on the regrowth process of the liver

Literature:

[1] HOHMANN, NADINE, ET AL (2014): "How does a single cell know when the liver has reached its correct size?." PloS one 9.

[2] AL-MAYAH, ADIL, ET AL (2009): "Deformable modeling of human liver with contact surface." 2009 IEEE Toronto International Conference Science and Technology for Humanity (TIC-STH). IEEE.