The Chair of Applied Dynamics offers the following

project/master thesis topic:

Finite element modelling of cardiac mechanics in a rat heart with fibre and sheet dispersion

Rat hearts play a central role in research of heart pathology. To fully understand electromechanics of the heart, cardiac electrophysiology, mechanics and their interaction must be thoroughly analyzed. Therefore, computational models describing electromechanics allow to investigate the heart function in healthy and diseased cases. The electromechanics strongly depends on the fibre and sheet directions of the cardiac muscles. In fact, cardiac cells are organized into fibres lying on sheet planes, which distribute helically around the heart. Furthermore, there is apparently dispersion along the fibre and sheet orientations which significantly influences the heart's electromechanics. In our ongoing rat heart project, the electromechanics of a rat heart was successfully implemented. However, the mechanics still lacks the fibre and sheet dispersion. This is a crucial point to enhance the electromechanical model in order to capture more realistic dynamic behaviour of the heart. The proposed method to solve this problem is the standard finite element approach in which the improved mechanical model can be implemented using Abaqus UMAT and VUMAT subroutines to solve the overall coupled electromechanical problem. To validate the enhanced model, simulation results for the fiber dispersion of the heart can be compared with experiments performed by our cooperation partners at the Universitätsklinikum Erlangen. Consequently, modeling the dispersion of fibre structure, its implementation into Abaqus as well as its verification and validation are the main tasks of this research. This topic is conducted at the Chair of Applied Dynamics under the supervision of Dr. Minh Tuan Duong.

Qualification

- Students studying: computational engineering, engineering, mathematics, physics, informatics
- Basic programming skills (in Fortran desirable)
- Basic knowledge on matrices (or tensors desirable)

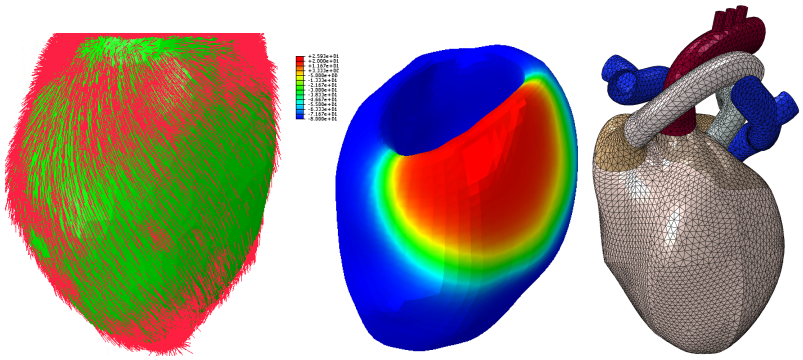

Fig. 1: Fibre orientations and electrophysiology of left ventricle (left and middle) and mesh model of a rat heart (right) (source: LTD rat heart project).

If you are interested, please email at ***minh.tuan.duong@fau.de***.