

The Chair of Applied Dynamics offers the following project or master thesis topic:

Computational modelling of the cardiac electromechanics of a rat heart using finite elements

Computer models describing the electromechanical process in living hearts help to improve efficient treatments and medical devices for heart diseases with reduced time and lower costs. Rat hearts are often preferably employed as surrogates due to their similar structure and less ethical problems. The cardiac electromechanics of a living rat heart comprises the electrical signal, so called electrical potential, which is transmitted through the heart and to trigger contractions of the muscles. Consequently, blood is pumped from the right and the left ventricles into the lung and the whole body, respectively. To fully observe this physiological phenomenon, we need to develop and solve a computational model in which the electrical conduction system controlling the rhythm is strongly coupled with the mechanics (passive and active) of the heart. In this work, we mainly focus on investigation of cardiac electromechanics with exploration of the coupled excitation-contraction problem in the heart. Basically, this work can be done by using the finite element method to solve the coupled model in Abaqus. To validate the proposed model, simulation results such as electrical potential, displacements, and pressure-volume curves of the ventricle can be compared with experiments performed by our cooperation partners at the Universitätsklinikum Erlangen. Concretely, based on our existing electrophysiological model and mechanical model of the cardiac muscles implemented in Abaqus, the implementation of the coupling of these models 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, Python desirable)
- Basic knowledge on matrices (or tensors desirable)

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