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Patient-Specific Biomechanical Modeling of the Heart

Application in Dilated Cardiomyopathy

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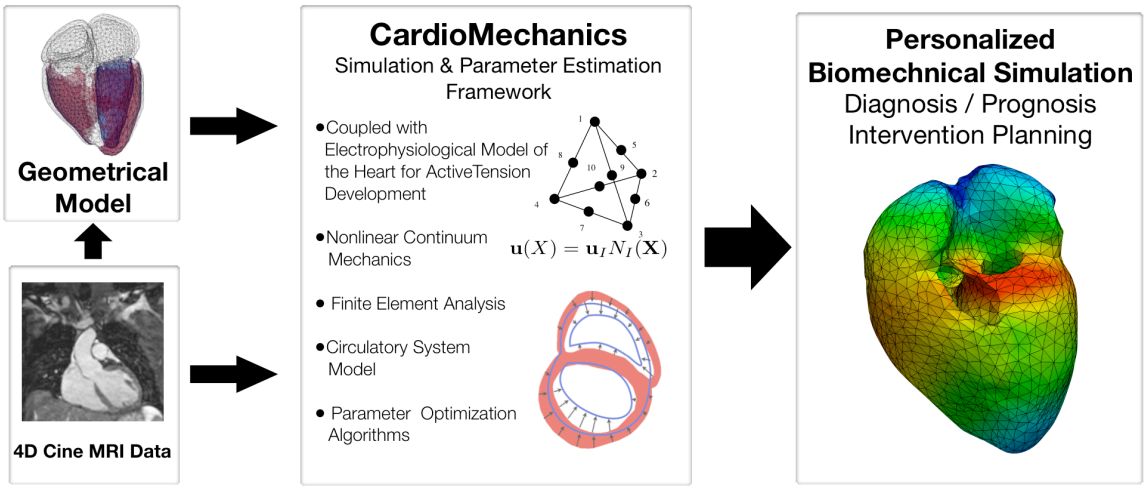
Cardiomyopathies are one of the principal causes of heart failure. They affect the mechanical properties of the myocardium, usually resulting in a reduced pumping action. In the United States, more than 10,000 people die ever year due to this cardiac dysfunction [Nature 415, 227-233].

In this research project, an biomechanical computer model is used to simulate the contraction of the heart. It is coupled with an electrophysiological model which is used to simulate the excitation conduction and the tension development of the heart.

For a patient-specific simulation, the i*nverse problem of cardiac biomechanics* has to be solved. Hereby, parameter estimation technique is used to adapt the mechanical parameters (e.g. contractility, elasticity) of the simulation in such a way that the simulation output matches the 4D Cine MRI data of the patient with cardiomyopathy.

The individualized computer model will serve as a tool to further analyze the heart function and to determine mechanical properties of myopathic tissue. This information can support the diagnosis and therapy planning. Furthermore, the computer model can be used to improve surgical interventions.



Publications

- T Fritz et al. Analyzing the Transmural Electromechanical Heterogeneity of the Left Ventricle in a Computer Model. *Biomedizinische Technik / Biomedical Engineering (Proceedings BMT2010)*
- T Fritz et al. In Silico Analysis of the Impact of Transmural Myocardial Infarction on Cardiac Mechanical Dynamics for the 17 AHA Segment. *Functional Imaging and Modeling of the Heart 2011*