

## Modeling and Imaging Electrophysiology and Contraction of the Heart

A computer model of the human heart is presented, that starts with the electrophysiology of single myocardium cells including all relevant ion channels, spans the de- and repolarisation of the heart including the generation of the Electrocardiogram ECG and ends with the contraction of the heart that can be visualized using 4D Magnetic Resonance Imaging MRI. The model can be used to better understand physiology and pathophysiology of the heart, to improve diagnostics of infarction and arrhythmia and to enable quantitative therapy planning.

Several applications of the computer model will be presented: The generation and perpetuation of Atrial Fibrillation can be understood and various RF-ablation strategies can be evaluated. The well-known ST-segment elevation and depression during ischemia will be discussed using the computer model. Also the sign and shape of the T-wave will be analyzed with the concept of dispersion of Action Potential Duration. A new method of optimization of electrode placement and time delay for Cardiac Resynchronization Therapy is presented.

The computer model can also be used as a regularization tool to gain better solutions of the ill-posed inverse problem of ECG. Movies of the evolution of electrophysiology of the heart can be reconstructed from Body Surface Potential Maps (BSPM) and MRI, leading to a new non-invasive medical imaging technique.