COMPUTATIONAL LIFE SCIENCES AND BIOMEDICAL ENGINEERING

Biomedical Engineering Building
A-8010 Graz, Stremayrgasse 16

The progressive ageing of our society together with an ongoing shortage of resources challenges public health care enormously. This requires developing more efficient and affordable methods and technologies for biomedical applications. Modeling and simulation at different levels of the organism, the charact-erization of structural and functional biomedical information serves as a basis for new applications and devices in clinical diagnosis and intervention, and is thus an essential condition for stratified and personalized medicine. Internationally outstanding research activities in biomechancis, medical, neural and health care engineering are expressly distinguished by light house projects and research grants.

BIOMECHANICAL ENGINEERING

Prof. Gerhard A. Holzapfel

We focus on the investigation of the cardiovascular system in particular on arterial walls in health and disease and the heart. Pursued approaches are experimental, theoretical, or computational and they address phenomena at the nano, micro, or macrolevels – from the protein to the organ. We are using microstructural data from artery walls to model and simulate the related biomechanical behavior using continuum mechanics and computational methods such as the finite element method. Computational methods enable cardiovascular device manufactures to predict performance of their devices in virtual patients prior to deployment in human trials which allows safer designs and reduced development costs. Our research has been supported by the National Institutes of Health (NIH), The Royal Society and the European Commission amongst others.

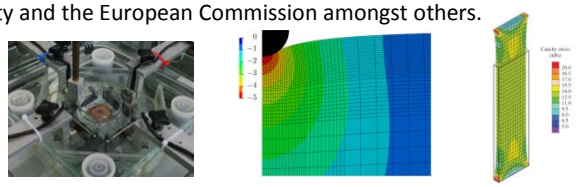

Fig. 1: (a) Device to identify biaxial tissue properties; (b) finite-element (FE) results of the indentation of an atomic force microscope into a cell; (c) FE results of a specimen from an artery subjected to a stretch of 1.3.

HEALTH CARE ENGINEERING

Prof. Christian Baumgartner, Prof. Jörg Schröttner

In our research we deal with the development and implementation of new point-of-care and sensor technologies, the development and validation of computational methods and models on biophysical and biomedical data aiding in diagnosis and therapeutic management. Methodological, technical, operational, organizational, economic and quality assuring aspects of intra- and extramural health care with particular emphasis on patient safety complement our research profile. Lab infrastructure is available for experimental work in cellular electrophysiology and sensors, clinical engineering and biomedical device design & safety. The Institute houses an European Notified Body (PMG) which is not only authorized to test medical devices, but also to issue certificates, allowing products being placed on the entire European market.

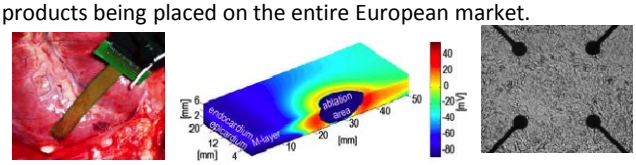

Fig. 2: (a) Measurement of transmural EGC and (b) modeling and simulation of electrical activation in hypothermia; (c) cultivated cell layer of cardiomyocytes for *in vitro* measurement and interpretation of electric field potentials.

MEDICAL ENGINEERING

Prof. Rudolf Stollberger, Prof. Hermann Scharfetter

The goal of our research activities is to make essential contribution to the field of in-vivo biomedical imaging with a new generation of integrated quantitative techniques to deliver functional and structural information for stratified and personalized medicine. Biomedical imaging is an elementary module of the health care system and an indispensable method for life science research. It delivers the essential information for many key decisions within the diagnostic – therapeutic continuum. Our research is mainly performed in competitive peer reviewed programs like Special Research Centers (SFB) of the Austrian science foundation or within the FET-Open program, the excellent science module of Horizon 2020.

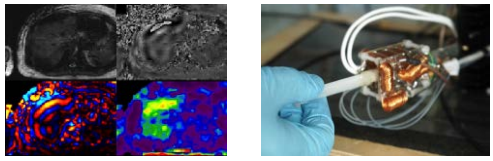

Fig. 3: (a) Assessment of liver stiffness by MRI; (b) measurement device for quadrupole resonance.

NEURAL ENGINEERING

Prof. Gernot Müller-Putz

The Institute for Knowledge Discovery with the BCI Lab has been one of the world's top labs since the beginning of BCI research. The so-called "Graz BCI" was one of the first online electroencephalogram (EEG)-based BCIs and successfully used for various applications like communication, computer games and neuroprosthetic control. All developed applications have been tested in healthy users and several end user populations. The BCI Lab is an interdisciplinary research institution with a research focus on brain-computer communication, dynamics of brain oscillations and functional brain mapping and imaging, signal processing and machine learning, movement decoding, cognitive neuroscience and develops neurorehabilitative therapies. We organize the Int. BCI Conference every 3 years. Our research has been supported by local and European Projects.

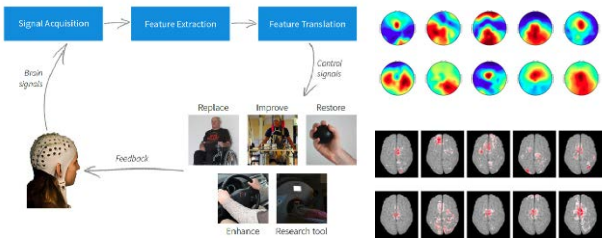

Fig. 4: Schematics of human brain computer interfacing and activation maps during imagined arm movements.

THE BIOMEDICAL ENGINEERING GROUP (Professors)

From left to right: GA Holzapfel, C. Baumgartner, J. Schröttner, H. Scharfetter, R. Stollberger, G. Müller-Putz