Karlsruher Institut für Technologie

Institut für Biomedizinische Technik

Bachelor Thesis

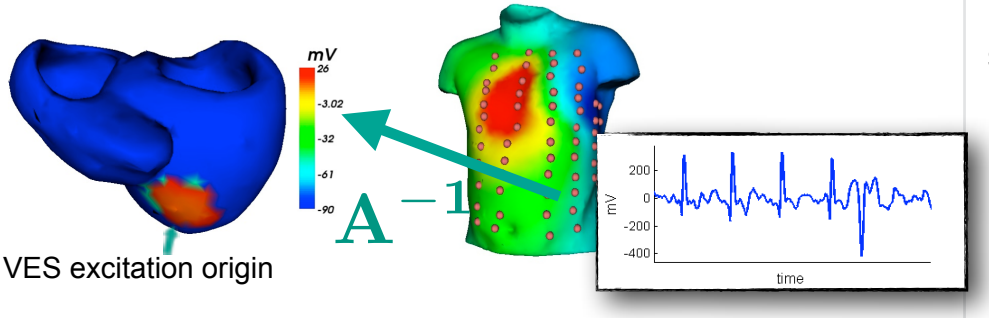
ECG Signal Processing for Inverse Electrocardiographic Imaging of Ventricular Extrasystoles

Motivation

ECG imaging (ECGI) is a **new technique for the non-invasive visualization of electrical activity in the heart**. In a clinical cooperation with the University Hospital Mannheim, we are validating the imaging method with patients that suffer from ventricular extrasystoles (VES). Patients undergo magnetic resonance imaging scans to generate computermodels of the thorax and heart. Later, in the electrophysiology laboratory (EP lab), a map of body surface extracellular potentials (BSPM) is recorded while catheter signals are collected in the human heart during an interventional procedure. The catheter signals serve as a validation reference for the method.

From the BSPM signal, along with the volumetric model of the patient, cardiac potentials such as transmembrane voltages can be reconstructed. To obtain the reconstruction, a linear inverse problem has to be solved that is severely ill-posed: the body is a low-pass filter and any high-frequent noise in the BSPM is therefore considered by the solver to have a strong impact on the signals in the heart.

It is therefore **of utmost importance** for the solution of the ECG imaging problem **to start with a BSPM that has as little noise as possible**. Unfortunately, in a clinical environment, artifacts such as baseline wander, power line interferences or high frequency noise are always present.



VES excitation origin

Tasks

In the project, signal processing tools will be used to identify ventricular extrasystoles and beats of normal sinus rhythm in the BSPM recordings. From the BSPM of these beats transmembrane voltages in the myocardium will be reconstructed using inverse problem solvers. Different filtering techniques (wavelet-, Fourier- or PCA-based) and multi-beat averaging will be used to obtain a BSPM with as little noise as possible, but with sufficient signal to reconstruct the cardiac signals.

Requirements

- programming skills in MATLAB
- basic understanding of signal processing
- ideally some fundamentals of cardiac physiology

Field of Research

Inverse problem of ECG

Identification of morphological properties of the ECG

Projects

DFG / University Hospital Mannheim

Areas

Signal processing

Software programming

Algorithmics

Field of Studies

Electrical engineering

Computer science

Starting Date

from October 2012

Contact

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