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ECG Imaging of Ventricular Extrasystoles

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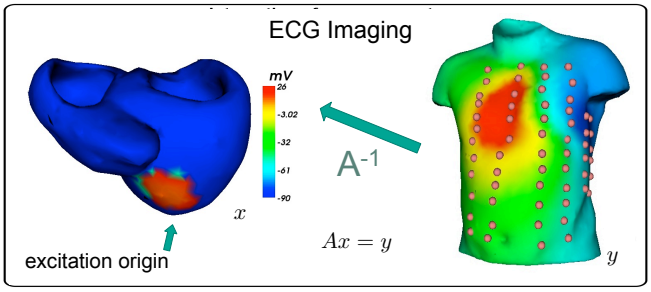
Ventricular arrhythmias (ventricular extrasystoles, ventricular tachycardias) can burden a patient's health and increase the risk of syncopes or sudden cardiac death. Extrasystoles and ventricular tachycardias are treated by cardiologists in catheter-guided ablation therapies.



During catheter ablation therapies of extrasystoles, cardiologist use catheters to stimulate the heart at the assumed excitation origin of a premature beat. The resulting ECG is then compared with the previously recorded ECG of the extrasystole. The catheter is relocated until a good match is found. This process guides the clinician to a proper ablation point and is referred to as pace mapping. Studies by Sippens Groenewegen have shown the capability of pace mapping to localize ectopic centers to an accuracy of 20mm, but also the strong effect of myocardial infarction on patterns in the 64-channel body surface potential maps (BSPM) that were used in the study.

IBT develops ECG imaging (ECGI) methods for the direct localization of ectopic foci from BSPMs of the extrasystole that are taken before the intervention. ECGI is completely non-invasive and will provide cardiologists with a much more accurate first stimulation point in pace mapping. Ultimately, IBT aims at reconstructing the location of ectopic foci at an accuracy that exceeds that of pace mapping.

To achieve this, MRI-based maps of infarction scars will be introduced into the solution of the mathematically inverse problem that underlies ECGI, as well as results from single subthreshold stimulations of the myocardial tissue.

The project is performed in close cooperation with cardiologist at Uniklinik Mannheim.

Publications

- Y. Jiang et al. An impedance based catheter positioning system for cardiac mapping and navigation. *IEEE Transactions on Biomedical Engineering* (56/8), 1963-1970, 2009
- D. Farina et al. Acceleration of FEM-based transfer matrix computation for forward and inverse problems of electrocardiography. *Medical & Biological Engineering & Computing* (47/12),1229-1236, 2009
- W. Schulze et al. A Kalman filter with integrated Tikhonov-regularization to solve the inverse problem of electrocardiography. *IFMBE Proceedings World Congress on Medical Physics and Biomedical Engineering* (25/2), 821-824, 2009