Master's thesis project:

Algorithm development for robust electrophysiological measurements with dry electrodes during MRI scan.

General description:

The application scenario of this project is the extraction of heart information from electrocardiographic signals acquired from adults.

Often ECG measurements are used during cardiac diagnostic imaging to create synchronization triggers between the main acquisition, e.g., MRI or Ultrasound, and the heart activity of the patient being scanned. The electrophysiological measurements traditionally employ adhesive wet electrodes, such as Ag/AgCl electrodes, which are uncomfortable and can cause skin irritation, allergic reactions, and inflammation due to toxicological problems of the gel. In addition, the quality of the acquired signal decreases with gel dehydration especially if the MR or Ultrasound scan acquisition is long and require that electrodes be worn for a long time. The more comfortable and easier to use dry electrodes might be able to overcome these limits. However, the lack of adhesive contact between electrode and skin and the acquisition condition, i.e., signals are acquired during MR or Ultrasound scan, make the amount of noise and artifacts induced by motion dominant and the extraction of medical information becomes very challenging.

To overcome these challenges we aim to extend the existing signal processing techniques. Software algorithms will be developed and tested on an existing innovative hardware. It should enable the acquisition of electrophysiological signals with multiple dry electrodes. In particular, this project will focus on the software by means of the development of a processing algorithm based on a blind source separation (BSS) technique with minimal length segmentation of multi-channel recordings. Due to the combination of the two approaches, it is much more likely that even in the case of a persistently high level of motion artifacts and noise on all the measurements, good quality medical information can be extracted.

Student task description:

- Literature review of motion artifact removal on ECG signals;
- Development of the denoising algorithm with MRI and Ultrasound constraints in mind;
- Acquisition of ECG signal from fantoms.
- Validation of the proposed method and comparison with the state of the art

Requirements:

- Excellent Master's student in Computer/Electrical/Biomedical Engineering or related disciplines.
- Good oral and written communication skills in English
- Programming skills (preferably Matlab or Python)
- Experience in biomedical signal processing is a plus

Assignment:

- Work to be executed mostly at Philips HCT in Eindhoven
- Up to 9 months Philips Eindhoven scholarship and housing support
- To start not later than October 2021