LABORATORY OF BIOPHYSICS

Deep learning-based analysis of qMRI data

Quantitative Magnetic Resonance Imaging (qMRI) is a branch of MRI that focuses on extracting maps of biomolecular parameters, such as relaxation and diffusion, that can provide unambiguous characterization of the state of biological tissues *in vivo* or *in situ*. Yet, to keep the duration of qMRI scans reasonably short, compromise has to be made in terms of imaging resolution, signal sampling and signal-to-noise ratio. This affects the robustness of the fitting analysis that is routinely used to extract MR parameters. To circumvent this problem, recently our group has introduced robust phasor analysis for model-free qMRI data processing [1, 2]. As a further step forward, in this project we exploit deep learning (DL) for fully automated analysis of qMRI data at large scale. Deep neural networks (DNN) are utilized to learn higher dimensional features to facilitate the discrimination between various tissues. We also apply DL to expedite the qMRI scan times by reconstructing the under-sampled MRI signals [3].

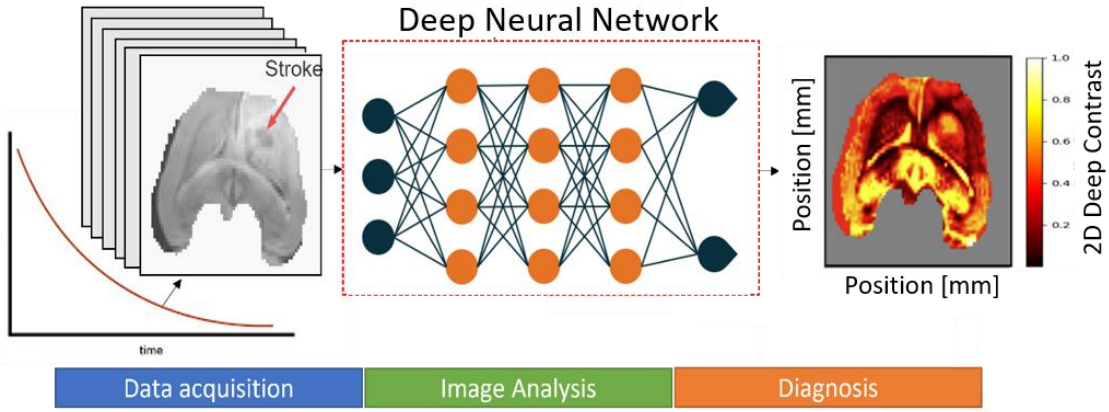

Figure 1. Overview of deep learning approach for tissue classification of spatio-temporal qMRI data

We are looking for **BSc** and **MSc thesis** students to work on:

1. applying our DL methods to expedite qMRI scan times by reconstructing high-resolution images from under-sampled data;
2. optimizing the DNNs on large scale qMRI data and improve the accuracy of biological tissue classification.

All models are implemented using in-house developed scripts (Python) and using PyTorch deep learning framework. This project gives the opportunity to get familiar with artificial intelligence (AI) and offers exposure to our academic partners in the Dutch 4TU consortium 'Precision Medicine' and opportunities for internships at involved national medical hospitals.

References:

1. Vergeldt, F.J. *et al.* (2017). Multi-component quantitative magnetic resonance imaging by phasor representation. *Sci Rep* 7, 861.
2. Franssen, W. *et al.* (2020). Full-harmonics phasor analysis: unravelling multiexponential trends in magnetic resonance imaging data. *J Phys Chem Lett*, 11(21), 9153-9158.
3. Asadiabadi, S. *et al*. (2022) Deep representation learning of multi-modal diffusion-relaxation qMRI data. In prep for *IEEE Trans. Med. Imaging*.

Further information:

dr. Sasan Asadiabadi

sasan.asadiabadi@wur.nl

dr. Camilla Terenzi

camilla.terenzi@wur.nl