

Doctoral Candidate 15 - Quantifying neurofluid pathways through AI-accelerated long T1/T2-range MRI

Host Institution	Oslo University Hospital, Norway
PhD enrolment	University of Oslo, Norway
Primary Supervisor	Prof. Dr. Kyrre Emblem, Department of Physics and Computational Radiology
Subject area	MRI sequences for measuring neurofluids

About this doctoral project and your tasks

You will develop AI-accelerated MRI sequences to characterize **neurofluids** that are thought to play a key role in brain waste clearance. The MRI sequences aim to **accurately capture ultralong T1/T2 relaxation times in fluids**, far exceeding the otherwise seen moderate ranges in brain tissue. To enable high-resolution sharp imaging with an optimized point-spread function, you will develop a quantitative Recurrent Inference Machine (RIM), a neural network with a forward model incorporating T2-decay during long read-out trains. You will develop 3D Look-Locker and mixed spin-echo inversion-recovery sequences for brain parenchyma mapping and strong T2 CSF-specific weighting. You will be in the unique position to measure the T1- and T2-distribution throughout CSF in the brain, aiming to **characterize the brain waste clearance pathways**.

Your tasks will include:

- Forward modelling of the MRI data acquisition with magnetic relaxation.
- Training a physics informed neural network on simulated data based on the forward model.
- Deploy a dedicated relaxation map estimation pipeline for real data analysis.
- Apply the model on patient data to investigate brain waste clearance.
- Compare results with the current technique using compressed SENSE.
- Identification and implementation of potential improvements in estimation efficiency by utilizing assumption of parsimonious decay models.

Foreseen secondments

For this project, we foresee secondments to:

- Prof. dr. Matthán Caan (3 months) at **Amsterdam UMC** (The Netherlands)
- Prof. dr. Julia Schnabel (3 months) at **Helmholtz München** (Germany)
- Dr. Ole Gunnar Johansen (2 months) at **Nordic Imaging Lab** (Norway)