Doctoral Candidate 13 - Brain age estimation from multiparametric k-space data

Host Institution	Amsterdam UMC, The Netherlands
PhD enrolment	University of Amsterdam, The Netherlands
Primary Supervisor	Prof. Dr. Matthan Caan, Dept. of Biomedical Engineering & Physics
Subject area	Parameter estimation, DL for image reconstruction, quantitative imaging, brain age analysis

About this doctoral project and your tasks

Estimating brain age is a promising new method for characterising disease onset and progression in an early stage. You will be in the unique position to develop **methods for estimating brain age** directly from the source of MRI: k-space. You will do so using quantitative multi-parametric R1/R2*/QSM reconstruction using a **unified forward model in a neural network**, e.g., the Recurrent Inference Machine (*Zhang et al., Neuroimage 2022*), while **accounting for motion and B0-inhomogeneities** using reference navigators and self-consistency. You will use the publicly available AHEAD (Amsterdam ultra-high field adult lifespan database) dataset for experimentation. (Bayesian) uncertainty estimation will be included, by validation against established outcome measures: quantitative sharpness and interquartile range in relaxometry parameters, in and out of age distribution. You will use this information for brain age regression using age/sex as additional input, and generative models will be developed for training.

Your tasks will include:

- Develop a unified model for MRI reconstruction, quantification, and estimation of brain age
- Create a representative training set for supervised learning using generative modeling
- Explore self-supervised methods for training
- Train a motion correction network using available navigator data
- Apply the network to the AHEAD-database and identify cases with accelerated ageing
- Explore other applications of end-to-end learning in MRI

Foreseen secondments

For this project, we foresee secondments to:

- Dr. Ana-Maria Oros-Peusquens (2 months) at **Forschungszentrum Jülich** (Germany)
- Prof. Daniel Rueckert (2 months) at **Technische Universität München** (Germany)
- Dr. Bradley Macintosh (2 months) at **Oslo University Hospital** (Norway)
- Dr. Ole Gunnar Johansen (2 months) at **Nordic Imaging Lab** (Norway)

About the host institution and research group

Amsterdam UMC is the largest university medical center in the Netherlands, connected to the University of Amsterdam. The **department of Biomedical Engineering & Physics** bridges the gap between engineering and physics at one side and life sciences and clinical medicine at the other. We provide further understanding of pathological processes and develop and improve quantitative methods for prevention, diagnosis, and treatment of diseases. The **lab on AI for quantifying MRI** targets learned approaches for understanding pathological processes in MRI. The lab is embedded in a larger ecosystem of MRI research at the departments of Radiology and Nuclear Medicine, and the Spinozacentre for Neuroimaging.

About the offer

- The selected candidate will be employed by Amsterdam UMC for **36 months** on the MSCA-DN project, with extension up to 12 months to complete the doctoral degree.
- Doctoral candidates are offered a **competitive remuneration** based on the MSCA allowances and the regulations of the host institution. You will receive a gross monthly salary according to the standard wages for researchers in training (OiO) at Amsterdam UMC (currently min. € 3017).
- **Expected start date**: between April and September 2025. We encourage last-year master students who will graduate by this time to already apply.

More information is available in the **general information document** for IQ-BRAIN positions.

Specific profile and requirements

- Your profile aligns with the **general requirements and eligibility criteria** of the IQ-BRAIN project.
- You have a master's degree in **physics, computer science, mathematics, biomedical engineering, or related field** (or will have by the time of your appointment).
- Background in **scientific computing and/or magnetic resonance imaging** is appreciated.
- **Python** programming experience and relevant experience in **pytorch** is preferential.

How to apply

All applications must be submitted via the **IQ-BRAIN job platform**:
 https://www.uantwerpen.be/en/projects/iq-brain/jobopenings/apply/.

Deadline for applications: 1 December, 23:59. More information about the application procedure is available in the general information document for IQ-BRAIN positions.

More information

For additional information about the research project, please contact:

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