Doctoral Candidate 16 - Quantitative phenotyping via the generative modelling of quantitative MRI data

Host Institution	King's College London, United Kingdom
PhD enrolment	King's College London, United Kingdom
Primary Supervisor	Prof. Dr. Jorge Cardoso, Artificial Medical Intelligence Group
Subject area	Advanced ML for medical applications; Scientific Computing, Image Processing and Image Acquisition

About this doctoral project and your tasks

MRI imaging can be highly heterogeneous in how it is acquired. Even though MRI physics parameters and associated acquisition sequences are key determinants of the appearance and contrast of the acquired qualitative images, downstream AI models (generative, segmentation, clustering, etc) do not take these into consideration, resulting in poor generalisability and in non-quantitative biomarkers. This project aims to build **generative models of brain MRI imaging data** that are physics aware, able to deal with multiple modalities and resolutions, and invariant to the physics of acquisition. Rather than relying on quantitative data, which is often limited in terms of volume and variability, these models will be made self-supervised, with non-quantitative MRI data used to augment the model with large phenotype and appearance variability. Training models with non-quantitative acquisitions will also allow for the disentangling image content (i.e., the underlying phenotype) and style (i.e., the physics of acquisition).

Ultimately, this generative model will **map data from a non-quantitative acquisition to a set of harmonised quantitative maps (qMRI**). This will not only allow for non-quantitative images to be generated from qMRI data using Bloch equation models (or their static approximations), but also allow for the creation of downstream physics-invariant biomarker extraction networks (segmentation, classification, etc).

Your tasks will include:

- Develop **physics-inspired AI models**
- Contribute towards **MONAI Generative Models open-source toolkit**
- **Train advanced AI models** on very large datasets
- Work with hospital staff to collect large datasets providing the necessary **generalisability**
- **Validate** the work against qMRI ground truths

Foreseen secondments

For this project, we foresee secondments to:

- Prof. dr. Matthan Caan (3 months) at **Amsterdam UMC (**The Netherlands)
- Prof. dr. Marleen Verhoye (2 months) at **University of Antwerp** (Belgium)
- Dr. Thanh Vân Phan (3 months) at **Icometrix** (Belgium)

Funded by the European Union

IQ-BRAIN is an MSCA-Doctoral Network funded by the European Union, starting in December 2024 (GA No. 101169519).

About the host institution and research group

King's College London is an internationally renowned university delivering exceptional education and world-leading research. KCL is dedicated to driving positive and sustainable change in society and realising our vision of making the world a better place.

The **School of Biomedical Engineering & Imaging Sciences**, part of King's College London, is driven by a commitment to improve the way healthcare is delivered through the use of advanced engineering. BMEIS is diverse and talented group working across the whole MedTech sector, advancing research, innovation and teaching progress through a shared mission of engineering better health for patients worldwide. The school's state-of-the-art labs and clinical-research facilities are embedded in St Thomas' Hospital to ensure our research projects are fully aligned with current clinical practice. Long-term collaborations with global MedTech companies and new partnerships with innovative start-ups ensure multiple pathways to translation.

Artificial general intelligence is the hypothetical intelligence of a machine capable of learning and understanding any human-learnable intellectual task. Our research team's aims are a bit narrower - we focus on medical intelligence and clinical impact. The **Artificial Medical Intelligence Group (AMIGO)** @ KCL, part of the School of Biomedical Engineering and Imaging Sciences, is a highly-multidisciplinary group researchers comprised of engineers, computer scientists, mathematicians, physicists and clinicians, using foundational artificial intelligence, statistical and physics modelling techniques to explore large real-world hospital-derived datasets, in order to tackle key medical issues.

About the offer

- The selected candidate will be employed by KCL for **36 months** on the MSCA-DN project.
- Doctoral candidates are offered a **competitive remuneration** based on the MSCA allowances and the regulations of the host institution. KCL has received the following UKRI grant to recruit a Doctoral Candidate (DC): monthly Living Allowance € 4.654; monthly Mobility Allowance € 600; and monthly Family Allowance € 660 (only if applicable). Please note that the final monthly, gross salary will result from deducting (from the mentioned amounts) all compulsory national labour taxes (social security, etc.) to be borne by the employer. Moreover, funding is available for technical and personal skills training and participation in international research events.
- **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, engineering, or related field** (or will have by the time of your appointment).
- Background in **scientific computing, machine learning and AI, and/or magnetic resonance imaging (MRI)** is appreciated.
- Candidates would also benefit from significant proficiency in programming, primarily with the use of python and pytorch.

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More information

For additional information about the research project, contact:

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