Doctoral Candidate 9 - Unsupervised uncertainty prediction for trustworthy and unbiased qMRI

Host Institution	Helmholtz Munich, Germany
PhD enrolment	Technische Universität Munich, Germany
Primary Supervisor	Prof. dr. Julia Schnabel, Institute of Machine Learning in Biomedical Imaging
Subject area	Advanced machine learning, image reconstruction, uncertainty quantification, trustworthy AI

About this doctoral project and your tasks

You will address the issue of **diagnostic uncertainty** related to the variability of quantitative magnetic resonance (qMR) image acquisition, reconstruction, and/or expert labeling, and mitigate inherent biases related to the data and learning process within deep learning (DL) frameworks, in order to **increase their trustworthiness**.

Using **qMRI physics-based simulations,** combined with population-derived data biases e.g. due to scanner types, age or gender, DL models for disease classification or quantification (e.g. segmentation) tasks will be trained for predicting measurement over/under-confidence, and further modulated (de-biased) at inference time, to increase their diagnostic accuracy and trustworthiness. As some uncertainty can be traced back to the raw k-space MR data, a feedback loop to the qMR reconstruction process will be developed, ultimately **improving the diagnostic qMR image quality and DL model generalization properties**, while keeping the human expert in the loop for inspection of residual diagnostic uncertainty.

Your tasks will include:

- Carrying out independent PhD research on the topic proposed
- Publishing your high-quality research in international journals and conference proceedings
- Collaborating with IQ-BRAIN project partners as well as local experts for your project
- Engaging with and further supporting the research and (limited) teaching activities in the lab

Foreseen secondments

For this project, we foresee secondments to:

- Dr. Dirk Poot (2 months) at **Erasmus MC** (the Netherlands)
- Prof. dr. Jorge Cardoso (3 months) at **King's College London** (United Kingdom)
- Prof. dr. Rita Nunes (2 months) at **Instituto Superior Técnico** (Portugal)

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