Doctoral Candidate 1 - Intra-scan modulation with model-guided AI for accelerated diffusion MRI

Host Institution	University of Antwerp, Belgium
PhD enrolment	University of Antwerp, Belgium
Primary Supervisor	Prof. dr. Jan Sijbers, imec-Vision Lab
Subject area	MR sequence design, simulations and modelling, parameter estimation, physics-informed Deep Learning

About this doctoral project and your tasks

You will develop a **physics-informed AI-supported framework** for the direct estimation of diffusion parameter maps from multi-shot diffusion weighted MRI data, of which each shot (k-space trajectory) is encoded with a different diffusion weighting (q). The framework will merge the advantages of both **data-driven and physical model-based** methods, thereby exploring recently emerging physics-aware deep learning strategies such as the hybrid (quantitative) Recurrent Inference Machine. Finally, the acquisition settings of the framework will be optimized to allow parameter estimation with minimal quantified uncertainty.

Your tasks will include:

- Following the state-of-the-art on **quantitative diffusion MRI** and staying up-to-date with scientific literature on quantitative diffusion MRI throughout the PhD trajectory.
- Developing a **forward model** that describes the dependency of the measured k-q space on the diffusion parameters and acquisition settings and accounts for inter-shot motion.
- Developing, training and testing a **physics-informed neural network (PINN)** for direct, motion-compensated diffusion mapping from intra-scan modulated multi-shot k-q space data.
- Quantifying the **uncertainty** of the estimated diffusion parameter maps.
- Developing a strategy for **optimal experiment design**.
- Testing the network on **(pre)clinical MRI scanners**.

Foreseen secondments

For this project, we foresee secondments to:

- Prof. dr. Julia Schnabel (2 months) at **Helmholtz Munich** (Germany)
- Prof. dr. Dirk Poot (3 months) at **Erasmus MC** (The Netherlands)
- Dr. Thomas Janssens (2 months) at **Siemens Healthineers** (Belgium)