

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)**

SUBJECT: Deep Learning Digital Twin of a Radiologist for evaluation of breast MRI

SUPERVISOR: Jan Mielniczuk, professor, Institute of Computer Science, PAS

DESCRIPTION:

Evaluating breast MRI images, both for image quality and for the identification of lesions, is a complex and time-consuming task typically performed by experienced radiologists. This complexity makes it challenging to use reinforcement learning approaches that require interactive feedback from radiologists for training generative AI models.

This project, aims to overcome these challenges by developing a deep learning digital twin of a radiologist. This digital twin will be capable of assessing image quality and identifying lesions in breast MRI scans. The digital twin will be used in deep reinforcement learning experiments to generate virtual dynamic contrast-enhanced (DCE) acquisitions.

The successful candidate will be a member of a newly established research team at the Institute of Computer Science, PAS, which is dedicated to advancing the state of the art in biomedical imaging and AI. The project is co-funded by National Agency for Academic Exchange (NAWA) as part of the Polish Returns project: "Improving Virtual Dynamic Contrast-Enhanced MRI through the Use of Deep Reinforced Learning" under the supervision of Dr. Andrzej Liebert.

Key tasks of the project include:

1. Collaborating with an experienced radiologist at the University Hospital in Erlangen, Germany, to learn how to evaluate the quality of MRI images.
2. Annotating publicly available datasets with detailed image quality assessments and lesion identifications.
3. Implementing and training multi-class, multi-level classifiers using PyTorch.
4. Conducting deep reinforcement learning experiments to refine the digital twin's capabilities.

Candidate Requirements:

1. A Master's degree (M.Sc.) in Biomedical Engineering, Computer Science, or a related field.
2. Proficiency in Python programming.
3. Preferentially experience in at least one of the following areas:
 - Implementation and training of neural networks.
 - Biomedical image processing.
4. A strong scientific curiosity and interest in biomedical image processing.

Candidate should contact Dr. Andrzej Liebert (andrzej.liebert@uk-erlangen.de) and Prof. Jan Mielniczuk (jan.mielniczuk@ipipan.waw.pl) before formal submission of documents.

BIBLIOGRAPHY:

[1] Mann RM, Cho N, Moy L. Breast MRI: State of the Art. *Radiology* 2019;292(3):520-536. doi: 10.1148/radiol.2019182947

[2] Kapsner LA, Balbach EL, Folle L, Laun FB, Nagel AM, Liebert A, Emons J, Ohlmeyer S, Uder M, Wenkel E, Bickelhaupt S. Image quality assessment using deep learning in high b-value diffusion-weighted breast MRI. *Sci Rep.* 2023 Jun 29;13(1):10549. doi: 10.1038/s41598-023-37342-3.

[3] Wielema, M., Sijens, P.E., Pijnappel, R.M. et al. Image quality of DWI at breast MRI depends on the amount of fibroglandular tissue: implications for unenhanced screening. *Eur Radiol* (2023). <https://doi.org/10.1007/s00330-023-10321-y>