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

SUBJECT: Development and investigation of generator networks for virtual dynamic contrast-enhanced Breast MRI

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

DESCRIPTION:

Breast cancer is the most prevalent cancer among women, necessitating high-quality diagnostic tools for early detection. Breast MRI, has among all modalities the highest sensitivity but requires an intravenous administration of a gadolinium-based contrast agent (GBCA). Virtual dynamic contrast-enhanced (vDCE) MRI methods can mitigate these risks associated with the administration, by generating images similar to images after administration of GBCA, thus making breast MRI more accessible and sustainable.

The initial implementation of vDCE was successful, demonstrating the feasibility of generating artificial contrast-enhanced acquisitions of the breast. The next steps in this project focus on enhancing the network's performance, particularly in cases with dense breast tissue, which presents unique challenges vDCE.

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. Pre-processing the ACRIN-6697 dataset and other openly available datasets in order to investigate generalizability of the vDCE method.
2. Developing 3D-Based Neural Network Architectures for generation of vDCE
3. Improving Loss Functions by leveraging existing lesion segmentation data
4. Investigating new Loss Functions to enhance the dynamic aspects of vDCE, with network performance assessed through mixed-linear-model analysis.

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] Liebert A, Schreiter H, Kapsner LA, Eberle J, Ehring C, Hadler D, Brock L, Erber R, Emons J, Laun FB, Uder M, Wenkel E, Ohlmeyer S, Bickelhaupt S. Impact of Non-Contrast Enhanced Imaging Input Sequences on the Generation of Virtual Contrast-Enhanced Breast MRI Scans using Neural Networks. medRxiv 2024:2024.2005.2003.24306067. doi: 10.1101/2024.05.03.24306067

[3] Chung M, Calabrese E, Mongan J, Ray KM, Hayward JH, Kelil T, Sieberg R, Hylton N, Joe BN, Lee AY. Deep Learning to Simulate Contrast-enhanced Breast MRI of Invasive Breast Cancer. Radiology. 2023 Mar;306(3):e213199. doi: 10.1148/radiol.213199.