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

SUBJECT: Generative AI for Secure Breast MRI Data Exchange: Development, Validation, and Privacy Assurance

SUPERVISOR: dr. hab. inż Paweł Morawiecki, prof. IPI PAN

DESCRIPTION:
The secure and ethical sharing of breast magnetic resonance imaging (MRI)[1] data remains a major obstacle in the advancement of artificial intelligence (AI) models for breast cancer diagnosis. Existing datasets are limited in size and diversity, and regulations such as the GDPR restrict inter-institutional data exchange due to privacy concerns.

This project aims to address these challenges by developing generative AI models—specifically, latent diffusion models (LDMs) and generative adversarial networks (GANs)[2]—to synthesize high-quality, anonymized breast MRI data. These models will allow for the creation of realistic, privacy-preserving synthetic data that reflects the complexity and heterogeneity of real clinical scans, enabling secure dataset augmentation and inter-institutional exchange[3].

The project has an additional funding from the OPUS grant (NCN) „Data ownership and privacy meet generative neural networks" No: 2023/49/B/ST6/02580. A scholarship from the grant is 5000 PLN monthly for 3 years.

Key tasks of the project include:

1. Developing and training deep generative models (GANs and LDMs) using Python and PyTorch.
2. Implementing methods for conditioning synthetic image generation using clinical data and lesion masks.
3. Conducting privacy risk analyses using membership inference and data extraction attacks.
4. Testing the effectiveness of synthetic data in training classification, segmentation, and further generative AI models.

Candidate Requirements:

1. A Master's degree (M.Sc.) in Computer Science, Biomedical Engineering, or a related discipline.
2. Proficiency in Python programming with focus on frameworks for deep learning and image processing such as PyTorch, MONAI, Simple ITK, Pandas.
3. Preferentially, experience in one or more of the following areas: (a) Implementation and training of deep neural networks, (b) Medical image processing or working with MRI data

Candidate should contact prof. Paweł Morawiecki (pawel.morawiecki@ipipan.waw.pl) and dr. Andrzej Liebert (Andrzej.liebert@ipipan.waw.pl) before formal submission of documents.

BIBLIOGRAPHY:

1 Mann RM, Cho N, Moy L (2019) Breast MRI: State of the Art. Radiology 292:520-536
2 Osuala R, Kushibar K, Garrucho L et al (2023) Data synthesis and adversarial networks: A review and meta-analysis in cancer imaging. Medical image analysis 84:102704
3 Szafranowska Z, Osuala R, Breier B, Kushibar K, Lekadir K, Diaz O (2022) Sharing generative models instead of private data: a simulation study on mammography patch classification16th International Workshop on Breast Imaging (IWBI2022). SPIE, pp 169-177