Deep Learning for Multisite MRI Harmonization

Training period: 4-5 months in 2023 (March-July).

Laboratory: LaBRI, UMR 5800, Université Bordeaux - Talence – France

Supervisor:

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Partners:

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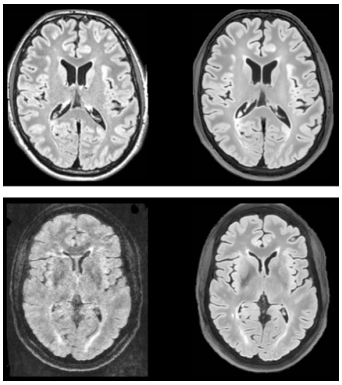
While medical imaging is now an integral part of clinical practice, the quantitative analysis of images produced is a major problem. The mass of data generated increases every day while the manual analysis of medical images is long and tedious. At the time of BigData and Cloud Computing, it is important to offer robust and accurate methods to automatically extract useful information from medical images. However, the lack of standardization in acquisition often results in contrast variations in MRI from site to site. Such variations prevent consistent measurement during automated segmentation.

In this project, the candidates will focus on developing MRI image harmonization based on deep learning. In recent years, various MRI harmonization techniques based on image synthesis have been proposed to overcome the lack of standardization of MRI imaging. These methods are usually a special type of image-to-image translation. Herein, the candidate will propose improvements for multimodal MRI harmonization in multisite massive dataset.



Example of synthesis-based harmonization (Zuo et al 2023).
Left: original MRI. Right Harmonized MRI.

Objectives of the project:

- To propose a review of current DL methods applied to MRI harmonization,
- To implement some of them,
- To propose improvements of the studied DL methods,
- To validate the proposed method on provided clinical datasets.

Profile of the candidate:

The candidate (diploma of engineering school or Master 2) should be a specialist in deep learning and machine learning. She/He will have skills in image processing and programming. Interest in medical imaging is a plus. A good experience of Python, Keras, Pytorch and tensorflow is recommended. A good English reading/writing is also a key element.

To apply, send a file containing CV, list of publications (if possible), motivation letter, transcripts, defense report (if possible) as well as any documents likely to strengthen the application.

Finally, this training period will yield to a Ph.D. position in October 2023. Consequently, the candidature should be interested to pursue toward a Ph.D. after this training period.

References:

Zuo, Lianrui, et al. "Unsupervised MR harmonization by learning disentangled representations using information bottleneck theory." *NeuroImage* 243 (2021): 118569.

Shao, Muhan, et al. "Evaluating the impact of MR image harmonization on thalamus deep network segmentation." *Medical Imaging 2022: Image Processing*. Vol. 12032. SPIE, 2022.

Cackowski, Stenzel, et al. "ImUnity: a generalizable VAE-GAN solution for multicenter MR image harmonization." *arXiv preprint arXiv:2109.06756* (2021).

Bashyam, Vishnu M., et al. "Medical image harmonization using deep learning based canonical mapping: Toward robust and generalizable learning in imaging." *arXiv preprint arXiv:2010.05355* (2020).

Liu, Mengting, et al. "Style transfer using generative adversarial networks for multi-site MRI harmonization." *International Conference on Medical Image Computing and Computer-Assisted Intervention*. Springer, Cham, 2021.