Deep Learning for segmentation of multiple sclerosis lesions

Training period: 4-6 months in 2019 (March-July).

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

Supervisors:

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Partners:

- Spain, University of Valence (J. V. Manjon)
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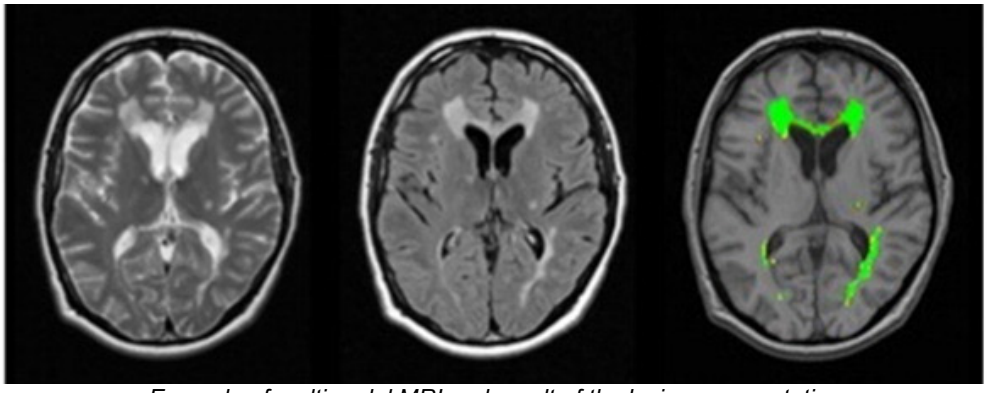
While medical imaging is now an integral part of clinical practice, the quantitative analysis of images produced is a major problem. The mass of data generated increases every day while the manual analysis of medical images is long and tedious. At the time of BigData and Cloud Computing, it is important to offer robust and accurate methods to automatically extract useful information from medical images.

In this project, the candidates will focus on multiple sclerosis (MS). MS lesion segmentation is crucial for evaluating disease burden, determining disease progression and measuring the impact of new clinical treatments. MS lesions can vary in size, location and intensity, making automatic segmentation challenging. In the past, we proposed methods to address this problem (Guizard et al. 2015). Recently, several deep learning (DL) methods have been successfully applied to this problem (Brosch et al. 2016, Kamnitsas et al. 2017, Valverde et al. 2017). Last challenge on MS lesions extraction demonstrated the efficiency of DL for such task (http://wmh.isi.uu.nl).



Example of multimodal MRI and result of the lesion segmentation obtained with our method (Guizard et al. 2015).

Objectives of the project:

- To propose a review of current DL methods applied to MS lesions segmentation
- To implement some of them, especially top-ranked methods in the MS challenge (http://wmh.isi.uu.nl).
- To propose improvements of the studied DL methods
- To validate the proposed method on provided clinical datasets.

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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 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.

References:

Brosch, T., L. Y. Tang, Y. Yoo, D. K. Li, A. Traboulsee and R. Tam (2016). "Deep 3D convolutional encoder networks with shortcuts for multiscale feature integration applied to multiple sclerosis lesion segmentation." IEEE transactions on medical imaging **35**(5): 1229-1239.

Guizard, N., P. Coupé, V. S. Fonov, J. V. Manjón, D. L. Arnold and D. L. Collins (2015). "Rotation-invariant multi-contrast non-local means for MS lesion segmentation." NeuroImage: Clinical **8**: 376-389.

Kamnitsas, K., C. Ledig, V. F. Newcombe, J. P. Simpson, A. D. Kane, D. K. Menon, D. Rueckert and B. Glocker (2017). "Efficient multi-scale 3D CNN with fully connected CRF for accurate brain lesion segmentation." Medical image analysis **36**: 61-78.

Valverde, S., M. Cabezas, E. Roura, S. González-Villà, D. Pareto, J. C. Vilanova, L. Ramió-Torrentà, À. Rovira, A. Oliver and X. Lladó (2017). "Improving automated multiple sclerosis lesion segmentation with a cascaded 3D convolutional neural network approach." NeuroImage **155**: 159-168.