Deep learning for the segmentation of vascular volumes from 3D MRA

Team

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Context

Segmentation of vascular volumes from 3D Magnetic Resonance Angiographies is a difficult problem, mainly due to image noise and to the thin aspect of the vessels. This problem has been addressed in several work in the MIV team since fifteen years. Recently, a denoising and segmentation method has been developed in the framework of the ANR project VIVABRAIN. Although satisfactory, the method suffers from several drawbacks, especially in terms of false positives and a lack of robustness regarding thin vessels. The main purpose of this internship is to explore techniques from deep learning [1] to segment vascular networks from 3D MRA and compare these results with existing methods.
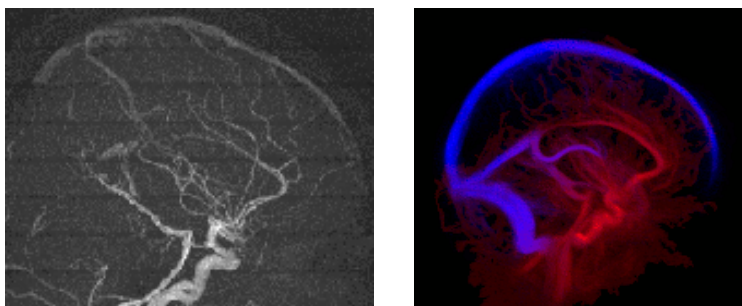
Expected work

The research of this internship will focus on :

1. state of the art in the field of vascular 3D MRA segmentation based on deep learning (*i.e.* deep convolutional neural networks) ;

2. development of a segmentation methodology dedicated to 3D MRA ;

3. implementation of the approach in the open-source library TensorFlow [2].

The training of the neural networks may be based on :
— the public base of phantom images VascuSynth http://vascusynth.cs.sfu.ca ;
— the public image base of Bullitt https://public.kitware.com/Wiki/TubeTK/Data.

Skills required

— Programmation : Python, C++ ;
— Image processing ;
— Machine learning.

Références

[1] Yann LeCun, Yoshua Bengio, Geoffrey Hinton. Deep Learning *Nature* 521, 436–444, 2015

[2] TensorFlow tutorials https://www.tensorflow.org/tutorials/