

DEEP LEARNING FOR DETECTION OF MULTIPLE SCLEROSIS LESIONS IN LESS GD INJECTION MRI CONTEXT

R&D INTERNSHIP – MASTER

Contacts

Thomas Grenier, Creatis – team Image & Model : thomas.grenier@creatis.insa-lyon.fr
Michael Sdika, Creatis – team Image & Model : michael.sdika@creatis.insa-lyon.fr
Hélène Ratiney, Creatis – team NMR & Optics : helene.ratiney@creatis.insa-lyon.fr
François Cotton, Creatis – team NMR & Optics : francois.cotton@chu-lyon.fr

Application deadline : **January 2019**
Beginning of internship : **February to end of March 2019**
Internship duration : **4 to 6 month**
Financial support : **540€ / month**
Internship location : **CREATIS, Campus de la Doua, Lyon, France**

Keywords: Deep learning detection and segmentation, MRI, medical image processing, 3D analysis.

Project – Develop and test a 3D robust lesion detection approach of active lesions

The internship focuses on the design of an approach able to efficiently detect/segment multiple sclerosis active lesions from MR images acquired before gadolinium injection. Actual clinical MRI protocols studying multiple sclerosis follow up are based on a controversial usage of Gadolinium (Gd). Such usage allows distinguishing precisely the active lesions from the others which then permits pharmaceutical treatment modifications. The first step is to detect and segment all MS lesions and then identify active ones. The final objective is to perform active lesions detection but without using MR images acquired after injection of Gd. To do so, we can exploit deeply the available MRI modalities acquired before the injection. The ones acquired post injection can be used to create the ground truth used for training. Thus one main challenge is to propose a novel DNN architecture that exploits optimally the different MR modalities and the 223 available patient's MRIs.

Context within CREATIS laboratory

CREATIS is a biomedical imaging research laboratory, with about 200 persons, whose main areas of excellence and international influence are linked to the identification of i) major health issues that can be addressed by imaging and ii) of theoretical barriers in biomedical imaging related to signal and image processing, modelling and numerical simulation.

CREATIS meets these challenges through a multidisciplinary approach, based on a matrix organisation which stimulates interaction between six research teams working in information and communication science and technology, engineering sciences and life sciences.

The CREATIS team « Image and Models » explores new medical images analysis approaches in order to improve knowledge and understanding of diseases or computer aided diagnosis tools. This team performs upstream research, yielding the design of advanced image processing and modelling methods such as Deep Learning approaches.

The “NMR and Optics” team goal is to develop new ways of measuring MR-based indirect parameters and in the process, to seek for new biomarkers. This team has experience and knowledge in many applied magnetic resonance aspects going from theory of MR physics to medical validation and applications. Bolstered by its experience and taking into account that Magnetic Resonance is a modality that often plays a central role for many biomedical imaging investigations, the team members are involved in most of transversal, inter-team projects.

The proposed project involves researchers of “image & model” and “NMR & Optics” teams and is also a first milestone of a national project submitted to ANR which aim at studying the usefulness and MR alternatives of Gd injection in multiple sclerosis follow up. If accepted, this national project will involve two others French laboratories and will propose PhD opportunities.

Initial skills

- Programming: C++/python/bash, – library : ITK, TensorFlow, PyTorch.
- Image processing: filtering and noise removal, segmentation, machine learning
- Medical imaging : MRI

Expected applicant profile

- University Master or Engineering School student (last year of study) with computer science, image analysis and/or applied mathematics profile
- Interest, curiosity, learning capability and creativity are appreciate qualities,
- Positive spirit, communication skills and ability to work in a team is necessary,
- Autonomy, dynamism and motivation to advance his/her own part of the project,
- Excellent methodological and hands-on computer programming skills
- Facility of understanding and manipulating mathematical models.
- Student considering to continue as PhD student (we are searching funds for a PhD on this project)