18 months Post doc position
Lung Tumor Segmentation with deep neural networks

A full-time 18-month postdoctoral position is available at CREATIS Laboratory in partnership with the cancer center Léon Bérard (Lyon) to work on a new project about automated lung nodule detection for radiomic analysis, funded by the IRP3 of the SIRIC LYriCAN.

GOAL OF THE PROJECT

The goal of this project is to develop a framework for lung nodule detection and segmentation with deep learning.

SCIENTIFIC CONTEXT

During the last years, lung cancer therapy has been improved thanks to the emergence of targeted therapies and immunotherapy. In this context, the non-invasive identification of tumor histological subtypes and phenotype is crucial to stratify the patients and monitor the therapy.

In parallel with the rise of artificial intelligence and image analysis methods, the size of available medical imaging data has grown exponentially and has facilitated the emergence of radiomic: the conversion of images into mineable data (the radiomics) for decision support. The central aim of radiomic is to uncover tumor characteristics at microscopic scales (histologic, cellular, molecular, genetics) or/and macroscopic scale (from the image) (1-3).

Radiomic features extraction is based on the segmentation of the lesion and is often done manually by a radiologist. This clearly limits prospective analysis based on large scale datasets. To address this issue, there is a need in automated lesion segmentation/detection method.

WORK ENVIRONMENT

In the Cancer Center Leon Berard, a development program aiming to boost the constitution of large annotated dataset for data mining investigation is in progress. The proposed work will consist in the development of fast and prospective images annotation tools and involves transversal partnership with radiologists of Centre Leon Bérard and researchers from the CREATIS[1] laboratory for the expertise in radiomic and deep learning (4-5).

DEEP LEARNING CHALLENGES AND POTENTIAL INVESTIGATION

Several types of tumors need to be detected. Primary tumors has clearly visible but when its extension to mediastinal ganglia but in this case, the contrast between ganglia and healthy tissue is poor: ganglia often barely visible, can be missed by the expert or can be the subject of discussion between trained radiologists. If Unet networks (6) are expected to work well to detect the primary tumor, ganglia segmentation remain a challenge due to the poor contrast and the unreliable annotation. Several directions are considered:

- ✘ the use of the very large healthy subject dataset from Léon Bérard Center to enhance detection/segmentation system with approaches such as semi supervised learning for anomaly detection.
- ✘ Investigating the problem of annotation uncertainties with weakly supervised learning (healthy subject→ no lesion, patients → some lesions are annotated but some lesions might not be annotated)
- ✘ Uncertainty estimation would be an interesting plus for the radiologist. It would for example allow pointing out locations where the system is not confident and requires expert confirmation.

  A database of manually annotated images is already available for training and will grow along the project.

PROFILE

The successful applicant will have a strong expertise in image analysis with deep learning, should be fluent in English (and preferably in French which will be the working language), have good communication and organizational skills, and a PhD in a relevant area (Biomedical engineering, applied mathematics, computer sciences …). Candidates are expected to be highly motivated and to work autonomously.

COMPETENCE / SKILLS

Very good programming skills and is required. Knowledge of Python and the practical use of any deep learning framework (pytorch, keras, tensorflow, ...) are key prerequisites.

SALARY

Depending to candidate experiences.

1 www.creatis.insa-lyon.fr

CONTACTS

To apply, please send extended *curriculum vitae* with research and programming experiences and a detailed list of publications (English); a cover letter stating your interests and future goals; and possible referents to:

- **michael.sdika@creatis.insa-lyon.fr**
- **benjamin.leporq@creatis.insa-lyon.fr**
- **olivier.beuf@creatis.insa-lyon.fr**

The post doc will be located in the creatis lab (Lyon) and is expected to start in fall 2019.

References

1. Lambin P et al. Nat Rev Clin Oncol 2017; 14:749
2. Gillies RJ et al.. Radiology 2015; 278:563-577.
3. Lambin P et al. Eur. J. Cancer 2012; 48:441-446
4. Martin et al. Automatic Segmentation of the Cerebral Ventricle in Neonates Using Deep Learning with 3D Reconstructed Freehand Ultrasound Imaging. *2018 IEEE International Ultrasonics Symposium (IUS)*, 2018
5. Ganaye et al. Semi-supervised learning for segmentation under semantic constraint. MICCAI 2018.
6. Ronneberger, et al. U-Net: Convolutional Networks for Biomedical Image Segmentation, MICCAI 2015