CREATIS

Multitask learning and uncertainty in the annotations for pathology characterisation in spine images

—

Research Internship 2020 - Master II
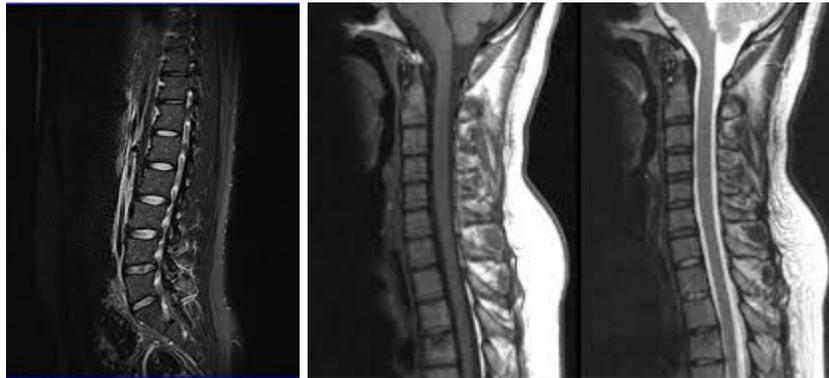
Keywords   Image registration, Image segmentation, Deep Learning

Context   Machine learning is a powerful strategy for medical image analysis, providing accurate results on problems that are too challenging to model analytically. **Deep neural networks** are currently revolutionizing this area. For example they have produced state-of-the-art methods for medical image segmentation [1,2], image registration [3,4], and image synthesis.

For medical data, image classification is still a challenging task. Indeed, as opposed to the large training dataset used in computer vision (ImageNet is about 1 million sample), medical training dataset are much smaller (few dozen, sometimes few hundred).

The problem we will focus on is the characterization of spondyloarthritis on magnetic resonance images (MRI).

Objectives   We have acces to a training dataset of 700 MRI of the spine. A class index is associated to each vertebrae of each image.

The objectives is build and train a deep neural network that is able

- to localize and identify each vertebrae

- to classify each vertebrae

- to ensure that the classification for each vertebrae is effectively done by voxel from this vertebrae

To cope with the small size of the training dataset, we consider using multitask learning to regularize the training. We will investigate different voxel level auxiliary tasks such as localization or segmentation of several structures of interest known by the physician to have a role in the disease. Unsupervised auxiliary tasks (autoencoder) will also be considered.

To ease the medical expert annotation task, we will consider the use of uncertainly annotated supervised learning: the voxel level task will be only loosely annotated.

This internship can open opportunities as a phd candidate or a deep learning expert in industry.

Internship environnement   The internship will be supervised by

- M. Sdika (Machine/Deep learning, image analysis)
- F.Cervenansky (Deep learning, python)
- J.B. Pialat (Medical expertize)
- G. Vervust (Medical expertize)

Location, Duration:

- CREATIS lab, Lyon, France
- 6 months
- about 550 €/ months

Application   The candidate is expected to have a M1 in either machine learning, image processing or applied mathematics. We are seeking a serious candidate who can work semi-autonomously with:

- strong programming skills, including experience with python
- good knowledge of machine learning, deep learning
- knowledge of image processing (image segmentation, registration and warping)
- methods, writing ability

Interested candidates will send any relevant documents (cover letter, CV, letters of reference, transcripts, previous internship reports, code sample,...) to:

- michael[dot]sdika[at]creatis[dot]insa-lyon[dot]fr
- frederic[dot]cervenansky[at]creatis[dot]insa-lyon[dot]fr
- jean-baptiste[dot]pialat@chu-lyon[dot]fr

References

1. Ronneberger *et al*, "U-net: Convolutional networks for biomedical image segmentation", MICCAI 2015
2. Ganaye, Sdika, Benoit-Cattin, "Semi-supervised learning for segmentation under semantic constraints", MICCAI 2018
3. Gros, ..., Sdika "Automatic spinal cord localization, robust to MRI contrasts using global curve optimization". Medical Image Analysis, 2018
4. Liu, Mingxia, et al. "Deep multi-task multi-channel learning for joint classification and regression of brain status." MICCAI. 2017.