Postdoctoral fellowship

Artificial Intelligence for Digital Pathology

General information

- Keywords : digital pathology, computer vision, deep learning, immunotherapy, Whole Slide Images
- Duration : between 18 and 24 months. To start early 2022.
- Institutes : Université de Paris, Laboratoire d'Informatique Paris Descartes (LIPADE), SIP (Systèmes Intelligents de Perception) team & Centre Georges Francois Leclerc (Dijon hospital) & Hôpital Ambroise-Paré (Boulogne hospital)
- Location : 45 rue des Saints-Pères, 75006 Paris (LIPADE), France
- Supervision : Ass. Prof. Nicolas Loménie and Camille Kurtz (first.lastname@u-paris.fr)
- Application : Please send a cover letter, a CV and contact of 2 referees to Nicolas Loménie with Camille Kurtz in cc. The position is opened until filled.

Project

Motivation and Context

Digital Pathology is the new medical imaging challenge [2] (Figure 1, left). It expands to Computational Pathology as more and more genotic data are available for cross analysis phenotype vs. genetics and tumoral micro-environment analysis.

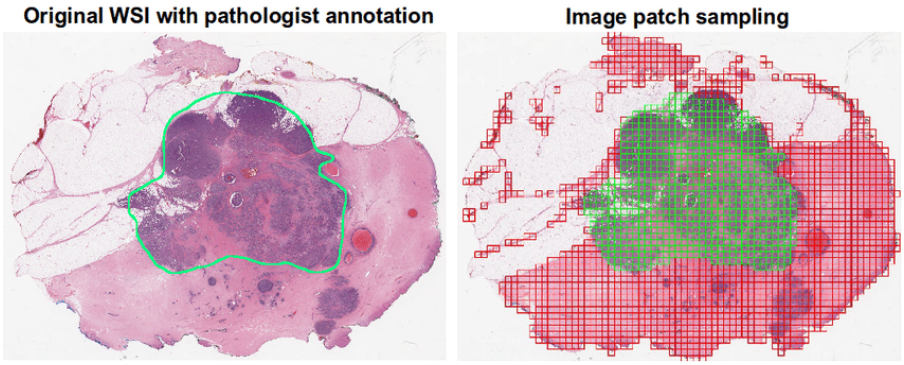

Figure 1 – (left) A digital pathology whole slide image (20,000 × 14,000) ; (right) patch-based classification of suspicious tissue.

This is exactly what we are currently doing in the Lab with many ongoing collaborations. Our scientific motivation is to take advantage of cutting-edge AI algorithms developed in the field of computer vision within our team (Figure 1, right) to the field of anatomo-pathology to make tissue analysis faster, more objective, easily reproducible and able to apply it on a very large scale. In this context, we have strong collaborations with the Centre Georges Francois Leclerc (Dijon hospital) & Hôpital Ambroise-Paré (Boulogne hospital) in addition to a large network of physicians with whom we set up various challenges [1] and projects. Two PhD. students are working on this specific topic

in the team. This position is aimed at supporting the scientific effort of the AI-COLOPREDICT project ("Artificial intelligence to estimate the prognostic of colorectal cancer in adjuvant setting using hematoxylin eosin safran histological slides"), recently funded by the French National Institute for Cancer (INCA - Institut National Du Cancer) for the period 2021–2023. Within this consortium, large cohorts of images and clinical data are available and first experiments have been conducted to design an *in silico* bio-marker for immunotherapy [3].

Proposed work and implementation

The enrolled researcher will work at LIPADE laboratory and closely collaborate with the different labs of the consortium expanding preliminary results [3]. The purpose of this project is to optimize and improve the existing workflow for clinical applicability. In particular, we will investigate the impact of slide staining on image analysis results. In oncology, staining by immunohistochemistry (IHC) is widely used for the diagnosis and / or monitoring of cancers by detecting abnormal cells such as those found in cancerous tumors. However, this staining remains complex. A challenge thus relies in the development of image analysis methods that can consider basic staining methods in clinical routines, such as safran eosin hematoxylin (HES). We plan to study how algorithms and models designed for the analysis of IHC-stained slides could be adapted to analyze HES-stained slides. In particular, we will focus on the design of automatic segmentation methods of the tumoral front. A perspective here will be related to the use of transfer learning methods [2] with different histopathology data sets (or even natural images - ImageNet), and for various tasks.

Impact of the results The impact is two-fold. From a data scientist's point of view, this project will enable us to improve our image analysis system to obtain better quality results, while ensuring better generalization properties. From a pathologist point of view, the developed tool will allow him to analyze larger amounts of tissues, more easily, and to potentially discover the presence of computational bio-markers. This will also enable the pathologist to better identify the challenges related to the analysis of such masses of image data.

Data The images used so far are WSI from patients suffering from liver cancers (Hepato Cellular Carcinoma, HCC) or colorectal ones with annotations. More data to come (HPV cancer etc.). We should also develop a user friendly workflow by integrating it into a digital pathology open source software (for example : QuPath or Cytomine) or a web-based visualization interface.

Desired background

Highly motivated candidates (PhD) with experience in computer vision, machine learning and Python programming and an interest in handling large amount of data. We are looking for candidates having a track record of publications in recognized conferences and journals. She/He will also be involved in the redaction of publications, project reports and the development of software provided to the INCA and the other project partners. Hence, both theoretical background and hands-on experience are expected to get as much as impact as possible from the collaboration with physicians.

References

1 https://www.drivendata.org/competitions/67/competition-cervical-biopsy/

2 Khened, Mahendra, Avinash Kori, Haran Rajkumar, Balaji Srinivasan and Ganapathy Krishnamurthi. "A generalized deep learning framework for whole-slide image segmentation and analysis." Scientific Reports 11 (2021).

3 Reichling, R. *et al*, "Artificial intelligence-guided tissue analysis combined with immune infiltrate assessment predicts stage III colon cancer outcomes in PETACC08 Study." Gut 2020 Apr ;69(4) :681-690 https://github.com/Klopfe/PETACC8