Direction
des **ressources humaines**
Université de Strasbourg

Position description

1. Position identification

Title of post: Postdoc position in deep learning applied to mass spectrometry data and histopathological images

Type of contract: Postdoctoral position

Category (A,B or C):

Contract/project period: 32 months **Expected date of employment: 15/11/2023**

Proportion of work: 100%

Workplace: ICube Laboratory, 300 boulevard Brant, Illkirch, France

Desired level of education: PhD in computer science

Experience required: /

Contact(s) for information on the position (identity, position, e-mail address, telephone): Pr. Cédric Wemmert, wemmert@unistra.fr

Date of publication: 25/09/2023

Closing date for the receipt of applications: 15/11/2023

2. Research project or operation

Primary liver cancers define a wide spectrum of tumors including hepatocellular carcinomas (HCC), cholangiocarcinomas (CCA) and combined hepatocellular-cholangiocarcinomas (cHCC-CCA) sharing both components. Due to high intratumor heterogeneity, accurate diagnosis of cHCC-CCA is still challenging. In addition, studies aiming to evaluate its prognosis provided discordant outcomes, with tumor behavior closer either to HCC or CCA. Considering the different management and prognosis of the types of primary liver cancers, improving their morphological characterization and recognition is needed and helpful to accurately identify cHCC-CCA.

In order to provide a comprehensive morphological signature of cHCC-CCA, we aim to develop a multiscale morphological approach (from molecular to microscopic) integrating molecular pathology using MALDI imaging (a global in situ proteomic approach), histology and immunohistochemistry (IHC). Firstly, phenotypical features of cHCC-CCA will be derived from direct comparison with HCC and CCA. Secondly, we will search for specific phenotypical features of cHCC-CCA in order to develop a diagnostic application and a prognostic correlation on the clinical outcomes. For this purpose, specific artificial intelligence algorithms based on deep learning will be developed to extract useful information and features from each image modality. The project will benefit from the collaboration and the expertise of computer scientists specialized in data and image analysis, pathologists, analytical chemists specialized in molecular imaging by mass spectrometry and clinicians. We aim to build a comprehensive exhaustive

classification of cHCC-CCA based on their multilevel morphological features and identify prognostic subgroups allowing to propose a tailored management of patients

3. Activities

➢ **Description of the research activities:**

The candidate recruited will be in charge of developing and testing new models of deep neural architecture for multi-modal analysis of mass spectrometry and histopathology data. We propose a sparing and original approach, relying on the use of a common backbone unsupervisely trained in an autoencoder. For that, we will rely on a pre-trained model that has proved its capacity to accurately identify and classify liver tumors between HCC and CCA. This model will be fine-tuned on our own dataset of pure HCC, pure CCA, and mixed tumors. To have enough data and a more robust model, patches from TMA and WSI will be used for that task. Once the autoencoder is trained, the first layers to the latent space will be kept and used to train simultaneously 3 fully connected classifiers: one to distinguish between HCC and CCA, one to evaluate the mVI and one to quantify the fibrosis of the tumor (the 3 features associated to clinical outcomes). This architecture will be trained on the annotated TMA: each TMA image will be divided into small tiles associated with the pathologist annotation. Finally, the trained models will be applied in a patch-based manner and evaluated on WSI. The evaluation will rely on the annotations provided by the pathologists. For each patch on the WSI our networks will provide a probability on the three aspects of the disease (tumor composition, mVI and fibrosis). Thus, for each WSI, we will obtain spatial information on the different features: which part of the tumor is considered as CCA or HCC, parts of the tissue that indicate that there is or not a vascular invasion and localization of the fibrosis.

➢ **Related activities:**

4. Skills

➢ **Qualifications/knowledge**:

PhD in Computer Science, specialized in machine learning.
Solid knowledge of Data Science and more particularly of supervised and unsupervised deep learning methods.
Experience in (medical) image analysis would also be valuable.

➢ **Operational skills/expertise:**

Good experience in Python programming and deep learning libraries (Keras, PyTorch…).
Good verbal (English or French) and written (English) communication skills.

➢ **Personal qualities:**
Interpersonal skills and the ability to work individually or as part of a project team.

5. Environment and context of work

➢ **Presentation of the laboratory/unity:**

The ICube team is composed of data scientists and image processing researchers from ICube laboratory. They have been working in close collaboration since many years, in the field of data mining and machine learning, mainly for automatic image information extraction. Their main domains of application are medical imaging, including automatic extraction and analysis of objects of interest from histopathological slides. The core team will be completed by two researchers specialized in signal processing to bring their expertise on the MALDI images analysis. More generally, the members of SDC have long term, international experience in biological and medical image analysis, devoted to fast segmentation for cartography of WSI [40], spatial-based automatic analysis on tumoral microenvironment based on clustering and expert knowledge modelization. These previous works led to a robust theoretical background, algorithmic processes and software tools, that will provide a solid basis for further works in this project.

The work will be done in close collaboration with the INDiD team in Paris, which explores two main research axes dedicated to liver and pancreatic tumours : (1) from inflammation to cancer related to metabolic syndrome, (2) tumour environment and aggressiveness with a specific interest in the development of translational approaches based on innovative tools including MALDI imaging.

➢ **Hierarchical relationship:**

The work will be done under the supervision of Pr. Cédric Wemmert (ICube) and Pr. Valérie Paradis (INDiD) and in collaboration with a PhD researcher at ICube (Ilias Rmouque).

➢ **Special conditions of practice (notice attached):**

To apply, please send your CV, cover letter and diploma to :
Pr. Cédric Wemmert (wemmert@unistra.fr)