PHD STUDENT

RADIOPHYSICS AND MRI PHYSICS LABORATORY – UNIVERSITÉ LIBRE DE BRUXELLES

Optimisation of breast cancer treatment through the use of multi-institutional big data and the application of advanced Artificial Intelligence methods

Job description

We are seeking a highly motivated candidate with a Master degree in Civil (ideally Biomedical) Engineering, Computer Science, Medical Physics, or equivalent, to conduct research in an ambitious Data Science project titled: "Optimisation of breast cancer treatment through the use of multi-institutional big data and the application of advanced Artificial Intelligence methods". The proposal will focus on all aspects of data science; from supporting the creation of structured databases to the development and validation of image analysis pipelines using machine- and deep learning. Novel methods will have to be explored such as federated learning, in collaboration with multiple international institutions managed from the Bordet site. The project will be carried out on ULB's ERASME campus (Anderlecht, Brussels) in the medical physics laboratory of the Institut Jules Bordet (the Belgian reference centre for cancer treatment). More information on the laboratory can be found on the website: https://cvchercheurs.ulb.ac.be/Site/unite/ULB836UK.php

Project description

In 2020, 2.3 million women were diagnosed with breast cancer and the disease was responsible for 685 000 deaths globally. It is the most prevalent non-dermatological cancer in women, and the second leading cause of cancer death. Despite significant improvements over the last few decades, breast cancer remains a major public health problem.

Together with surgery and systemic therapy, radiotherapy represents one of the three main treatment modalities for early stage breast cancer. A frequent challenge in radiotherapy is the accurate definition of the clinical target volume (CTV). Inherent to any radiotherapy treatment, this definition is a delicate balance between including sufficient tissue to avoid a geometrical miss and sparing as much healthy tissue as possible to avoid treatment-related morbidities. In 2009, an RTOG (Radiation Therapy Oncology Group) multi-institutional and multi-observer variability study of target and normal tissue delineation revealed clinically and dosimetrically significant differences between institutions and observers, concluding that a systematic consensus would be highly desirable. One of several consensus guidelines on target volume delineation for elective radiotherapy in early stage breast cancer was subsequently published in 2015 by an ESTRO (European Society for Therapeutic Radiation and Oncology) working group. Eight years later, the ESTRO consensus guidelines are accepted as the golden standard and routinely used in the clinic. The first research question we aim to answer in this study is whether the existence of the consensus guidelines for target volume delineation has decreased the

inter-observer and inter-institution delineation variability. Secondly, to decrease the inter-observer variability and improve the efficiency in the radiotherapy clinic, can we develop a tool for automatic delineation of the CTV? For the latter, a multi-institutional (big) data approach with federated learning of deep convolutional neural networks will be explored.

The project will subsequently focus on the optimisation of systemic therapy in early stage breast cancer. In an ambitious research program, the primary objective will be to develop a large multi-omics artificial intelligence-based algorithmic framework to accurately predict pCR and risk of recurrence in early-stage breast cancer patients. The project will consist of three pillars, each representing one of the three main BC subtypes (e.g., luminal, HER2+, TNBC), and will put a particular focus on routinely available imaging modalities such as digital pathology and metabolic imaging.

Further information on the project can be obtained by contacting: Dr. Ir. Jennifer Dhont (ULB / Institut Jules Bordet) - jennifer.dhont@hubruxelles.be, Senior Data Scientist, Institut Jules Bordet

Profile

We are looking for a highly motivated, pro-active and creative PhD student who can work in a transdisciplinary environment composed of physicists, data scientists and physicians. The candidate must be able to work independently, as well as demonstrate a strong commitment to the team and have good organizational skills to manage the (international and inter-disciplinary) collaborations in this project. The ideal candidate should:

- Hold a Master of Science or Engineering degree in one of following disciplines: Physics, Biomedical Engineering, Medical Physics, Computer Science or equivalent;
- Have demonstrated coding skills (Python, MATLAB or other);
- Show proof of proficiency in French or English (or both), both in oral and written communication;
- Be a team player who can work autonomously and who is able to meet deadlines;
- Be willing to spend part of her/his time abroad for research activities and participation in workshops and conferences;
- Be willing to step out of their comfort zone by learning concepts outside of their initial scientific background (medical physics, medical oncology, data science);
- Experience with a deep learning framework (Tensorflow, PyTorch) is a plus;
- A good knowledge of data science, medical image analysis or medical physics will be considered as an asset.

Application procedure

The position is for an initial duration of two years, renewable once (max: 48 months in total). The project will start November 1st 2023. Soon to be graduating master students are welcome to apply provided that they will have graduated before the start of the position. The candidates already in possession of a PhD are not eligible. The applicant should provide a motivation letter, curriculum vitae, a summary of previous research work / master thesis and the name and e-mail addresses of two reference persons by e-mail to Dr. Ir. Jennifer Dhont (Jennifer.dhont@hubruxelles.be) by **September 1st 2023** at the latest. Selected candidates will then be interviewed in the following weeks.