

Development of an end-to-end solution for breast cancer stratification from the combination of multiparametric MRI radiomic and deep-learning

A full-time 18months postdoctoral position is available at cancer center Léon Bérard in partnership with CREATIS lab to work on a project about the development of and end-to-end solution for breast stratification within a collaborative project with Hitachi (DlxAI : Diagnostic Imaging with AI)

GOAL OF THE PROJECT

The goal is to developed and end-to-end solution for breast cancer detection and characterization by associating mutliparametric MRI radiomic and deep learning.

SCIENTIFIC CONTEXT

Breast cancer is the most commonly diagnosed cancer in women [1]. Breast cancer represents 25% of all cancer types in women and is the fifth most common cause of death [2]. Such as most clinically relevant solid tumors and their microenvironment, breast cancer is highly heterogeneous at the phenotypic, physiologic, metabolic, and genomic levels [3-7]. This heterogeneity is the major cause of treatment failure and emergence of therapy resistance [8]. In the past decade, the field of medical image analysis has grown exponentially and has facilitated the emergence of radiomic, a discipline resulting in the conversion of images into mineable data for decision support. The central aim of radiomic is to uncover tumor characteristics at different microscopic scales (genetic, molecular, cellular, histologic), at the macroscopic scale [9-12]. Therefore, Radiomic may provide great potential to capture valuable information for precision medicine. We have previously shown that multiparametric MRI-based radiomic increase the diagnosis performances of radiomic for the prediction of neoadjuvant chemotherapy response thanks to data variety increase.

However, tumor manual segmentation, a mandatory step to extract radiomics features, is laborious, time consuming and limits a use in clinical routine and may introduce inherent variability in radiomics features. As a result, it hampers the use of radiomic prospectively, limits the size of available data, and may alter models performances in term of reproducibility. Automated segmentation methods and end-to-end solution are thus needed to speed-up the processing pipeline and minimize reproducibility problem.

OBJECTIVES AND DEVELOPMENT PROGRAM

In the Cancer Center Leon Bérard, a prospective and longitudinal study is currently running on patients with breast tumor. The MR protocol include multiple parametric pulse sequences with: (1) Dynamic contrast enhanced (DCE) to capture quantitative information about microperfusion and permeability after pharmacokinetic modeling of MR-DCE data; (2) Diffusion-weighted MRI combining intravoxel incoherent motion imaging (IVIM) and Kurtosis (DKI) to probe the tissue microstructure by quantifying simultaneously the water self-diffusion, the diffusion linked to the microperfusion and the blood fraction with a reduced scan time; (3) Chemical shift encoded (CSE) imaging to simultaneously quantify lipid content, fatty acid composition, magnetic susceptibility and transverse relaxation time [13-14] with a single acquisition compatible with all MR clinical systems. From this acquisition protocol, an annotated database (including manual segmentation done by an expert, clinical data and histology, n=400) have been constituted and is still growing. We have also developed automated methods for radiomics features extraction and mining.

The objective of this post-doc is to develop from this data and end-to-end solution for breast tumor detection and stratification (prediction of clinical molecular subtype, histology, etc ,.....)

To reach the objective, deep learning methods using U-net architecture could be used for the detection step and radiomic analysis for the classification. In a second time, full deep-learning (or hybrids) approaches could be envisioned for both detection and classification. The post-doc will take place in the department of Radiology of the comprehensive cancer center Leon Berard, involve Radiologists and researchers, and is conducted within a partnership with CREATIS lab and HITACHI. It is include in a larger research program aiming to facilitate, at the local scale, the development of "true big data" according to the "4V law" to develop a numerical identity of tumors for characterization, phenotyping, and monitoring.

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 daily working language), have good communication and organizational skills, and a PhD in a relevant area (Biomedical engineering, computer sciences ...). Candidates are expected to be highly motivated and to be able to work autonomously still in a teamwork.

COMPETENCE / SKILLS

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

SALARY

Depending on candidate experiences.

CONTACTS

This project involves radiologists of the department of medical imaging of cancer Center Leon Bérard and researchers from CREATIS lab. To apply, please send extended *curriculum vitae* with research experiences and a detailed list of publications (English); a cover letter stating your interests and future goals; and possible referents to:

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