PhD proposal for competitive EDISS fellowship 2024

36 months from October 2024

Head and neck radiotherapy planning using multi-parametric MRI

Locations:

In Lyon at Centre Léon Bérard in both diagnostic imaging and radiotherapy departments as well as on campus LyonTech-La Doua at CREATIS.

Scientific context:

Cancer is the leading cause of mortality and morbidity globally. Radiation therapy is used in more than 50% of patients treated for cancer. Head and neck tumors have the sixth most frequent cancer prevalence and are often associated with poor outcomes and lifelong sequels. Radiation therapy is particularly challenging due to anatomical complexity and physiological functions associated with the organs at risk (Largent A, 2020). Current treatment implementation relies mostly on CT imaging in Hounsfield units (HU) that can be directly linked to electron density. Nevertheless, CT is limited by a low-to-moderate soft-tissue contrast, which can lead to uncertainties in the delineation of target volumes (TV) and organs at risk (OARs). Magnetic Resonance Imaging (MRI) for delineation of both the target volume and the OARs, offering more precision and less inter-observer variation (Maria A, 2015; Owrangi AM, 2018). These advantages could improve the radiotherapy treatment plan. However, the intensities of MR images rely on the magnetic resonance properties of tissues and there is no straightforward link between MR signal intensity of tissue and electron densities maps used for RT planning. Several types of methods have been proposed to generate synthetic CT images based on MR images. These methods are statistics-based or physical-guided techniques and some of them are a combination. Statistical methods can be flawed when faced with anatomical variations and different locations of lesions. This is the reason why we mainly focus on physical methods based on multi-parametric MRI. Patients with nasopharyngeal, oropharyngeal, laryngeal, and oral cavity squamous cell carcinoma treated by radiotherapy at the Comprehensive Cancer Center Léon Bérard (CLB) in Lyon are currently included in the study at a rate of about two exams per week. The MRI acquisition protocol included clinical routine sequences and qDixon 3D VIBE and UTE spiral VIBE for the treatment planning. Our project aims to use multiple parametric MRI for direct RT planning mainly using physical-guided techniques and to compare target volume (TV) and dose calculation with usual CT-based RT planning.

Profile and skills of the candidate:

- Physicist or specialist of image processing (segmentation, image registration) with good skills in imaging and physics.
- Good practice and knowledge of programming or prototyping softwares (Matlab and Python)
- Willingness to get involved in the medical field and to work in an interdisciplinary environment
- Autonomy, dynamism
- Good oral and written level in English

Key words: Medical imaging, quantitative multi-parametric MRI, Physical-based radiotherapy planning

References

Maria A Schmidt and Geoffrey S Payne. Radiotherapy Planning using MRI. Phys Med Biol. 2015 November 21; 60(22): R323–R361. doi:10.1088/0031-9155/60/22/R323

Owrangi AM, Greer PB, Glide-Hurst CK. MRI-only treatment planning: benefits and challenges. Phys Med Biol. 2018 Feb 26;63(5):05TR01. doi: 10.1088/1361-6560/aaaca4.

Largent A, Nunes JC, Lafond C, Périchon N, Castelli J, Rolland Y, Acosta O, de Crevoisier R. MRI-based radiotherapy planning. Cancer Radiother. 2017 Dec;21(8):788-798.

Applications:

Applications, with a detailed CV, transcripts and rankings of the lectures and a personal letter highlighting the adequacy of the candidate's background and skills in relation to the proposed subject, should be sent to : frank.pilleul@lyon.unicancer.fr, olivier.beuf@creatis.insa-lyon.fr and benjamin.leporq@creatis.insa-lyon.fr.