Dose delivery uncertainty estimation for probabilistic treatment planning

Radiotherapy treatment planning and delivery faces many uncertainties, the most important being target volume definition and uncertainty in the dose distribution delivered to the patient. Among the most important causes are setup errors, inter and intra-fraction motion of the target volume and dose calculation errors. Since decades, these uncertainties are commonly managed via margins. Therefore, the clinical target volume (CTV) delineated by the physician is traditionally expanded to a larger planning target volume (PTV). However this PTV concept has several limitations. In particular dose regions were the target is rarely may receive the same dose as regions when it is most likely to be. Recently, robust and probabilistic optimization methods have been investigated in order to incorporate motion and uncertainty into treatment plan optimization [1]. The aim of the project is to evaluate the dose delivery uncertainty for several localizations, and to compare margin strategy vs probabilistic/robust planning. Comparisons will be done by taking into account of the imaging devices available for treatment. We want to propose a formalism exploiting both a pre-treatment imaging device and a monitoring modality able to track intrafraction motion. We wish to propose treatment plans that are robust again uncertainties, in particular when a tracking system is not available. It will be based on a probabilistic treatment planning technique that incorporates uncertainties in the delivered dose, including inter and intrafraction shifts. Robust treatment plans will be performed using our own algorithms based on voxel shifting methods [1].

We will first focus on prostate cancer treatment. To generate the prostate displacement probability maps, follow-up data recorded at our institution since 2015 with Clarity® TP-US modality from around 100 patients will be analyzed (approximately 2000 treatment sessions) [2]. Finally, at the end of the study, we plan to develop robust planning for other localizations.

The PhD will be conducted in the CREATIS team “tomoradio” located in the radiation therapy department of the Léon Bérard cancer center, Lyon, France.

References:

1. Unkelbach J et al. Phys Med Biol 2018
2. Biston MC et al. Radiother Oncol 2019

Applicant profile: Medical physics, computer sciences.

Location: Léon Bérard center, radiation therapy department, Laboratoire CREATIS, Lyon, France

Salary: around 1800 € per month

Length: 3 years starting in January

Contact: Please send your CV and application letter by email to:

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Applications will be gathered until early September 2019. Interviews will be conducted in Lyon in September/October 2019 depending on availability.