Adaptive strategies based on artificial intelligence for radiotherapy Head and Neck cancer treatment

https://www.creatis.insa-lyon.fr/site7/en/node/46859

Intensity-modulated radiation therapy techniques such as volumetric modulated arc therapy (VMAT) have become the standard treatment for head-an-neck tumors. Thanks to these techniques, highly conformal dose distributions with steep dose gradients are obtained, which is beneficial for both ensuring sufficient planning target volume (PTV) coverage and sparing the multiple surrounding organs at risk (OAR).

However, to be safely delivered, highly conformal dose distributions necessitate accurate CTVs and OARs delineations, patient immobilization with reliable and accurate systems, and in-room imaging techniques. In addition, adequate margins around clinical target volumes and critical organs have to be used to ensure both optimized PTV coverage and minimum side effects. The main consequence of the implementation of such sophisticated technique is a complexification of the workflow and an increase of the time dedicated to the different treatment steps.

The first tedious step is the delineation of the OARs and CTVs which is time-consuming particularly in the head and neck region. Delineation is also known to be prone to large inter-operator variability for both OARs and CTVs.

The first objective of this project will be to provide a state-of-the-art reference database of images and expert-validated delineations of both OAR and CTVs for completing a database, and to evaluate the performances of an artificial intelligence-based segmentation method, developed by Elekta, of lymph nodes and organs at risk for patients with head-and-neck cancer.

We will build two reference databases: one with CT images injected with iodine contrast agent and the other one with Cone beam CT images previously processed with a new reconstruction algorithm able to improve the contrast. Correlation between CT and CBCT images will be done using AI and will enable CBCT grey levels to be converted in HU.

Thanks to these new tools we will be able to reconsider our treatment strategies. We will estimate the uncertainties related to our treatment workflow (imaging modality and frequency). We will perform dose recalculation on CBCTs to assess daily dose changes. Finally, we will evaluate the robustness of the treatment margins used versus interfraction change.

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

Applicant profile: Medical physics, computer sciences.

Location: Léon Bérard center, radiation therapy department, CREATIS lab, 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 October 2019. Interviews will be conducted in Lyon in September/October/November 2019 depending on availability.