
Feasibility of prostate treatment plan based on MRI images

Marie Aguirre^{*1,2}, Esther Bartha^{*1}, Sébastien Clippe¹, Bertrand Fleury¹, Pascal Romy¹, and Nabil Zahra^{*1}

¹Centre Marie Curie (CMC) – Imagerie Médicale et Radiothérapie Drôme Ardèche – 159 boulevard Maréchal Juin, France

²Institut des Sciences Cognitives (ISC) – CNRS : UMR5015 – 67, boulevard Pinel 69675 BRON, France

Résumé

Introduction: Computerized Tomography (CT) scan provides Hounsfield Unit information (HU) and so Electronic Density (ED) which is necessary for planned dose treatment calculation in radiotherapy (RT). For prostate cancer and for delineation issues, MRI provides excellent soft tissue contrast compared to CT images and it is increasingly used for target delineation.

Our project was first to develop our own algorithm conversion and image transformation between MRI signal intensity into HU and then to evaluate the algorithm on prostate clinical case as previous studies have obtained encouraging results [1].

Methods: First, we set up MRI parameters (GE Signa 1.5T, Lava Flex sequence) so that signal information matches CT-scan ones (Philips Big Bore). We selected 4 pelvic patients that were installed on a flat table to have a close installation to that of CT-scan. Using *Matlab R2016a*, we developed our own algorithm of conversion and image transformation between MRI signal intensity and HU using *3D-Slicer 4.5* for specific density segmentation. MRI intensity signals for muscles and soft tissue were similar: we needed two conversion functions (soft tissues and bones).

Images produced thanks to conversion functions were compared to real CT-scan images used for RT. We compared the depth dose profile of a 6MV field over 5x5 cm² targeting the prostate and a 6MV Volumetric Modulated Arc (VMAT). VMAT dose distribution were compared in terms of Gamma Index criteria.

Results: Preliminary results gave distinct intervals function definition for different structures, which was similar to the Finish-Helsinki university hospital study [1, 2]. We identified spongy bone and cortical bone (bone function), fat, muscle, urine and prostate (soft tissue). Those distinct intervals testified the accuracy of our image conversion to produce the pseudo-CT.

Dose differences were less than 5% outside the build-up region between depth dose profiles of a 6MV beam. For the VMAT treatment plan, 99% of points passed the gamma criterion of 3% dose and 3 mm distance to agreement. Finally, the pseudo-CT produced using our model showed a small effect on dose differences compared to real CT images.

*Intervenant

Conclusions: This study revealed promising results to the possibility of using specific sequences of MRI for dose calculation in RT. Taking into account the potential limitation of our work, further investigation could be necessary. It could be particularly interesting to increase the number of patients, to improve the acquisition conditions and to integrate the different uncertainties of the MRI in the model. Finally, we plan to study the potential and feasibility of this model for other localization such as lung and head&neck.

References:

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