SERVICE DE METROLOGIE NUCLEAIRE

PARTICLES-MATTER INTERACTIONS: Nuclear medicine and radiotherapy

(in collaboration with Jules Bordet Institute)

1. From 2D planar to 3D SPECT ^{131}Iodine dosimetry

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Background:
In radiopharmaceutical therapy (RPT), a radionuclide is systemically or locally delivered with the goal of targeting and delivering radiation to cancer cells while minimizing radiation exposure to untargeted cells. Radiopharmaceuticals are a group of pharmaceutical drugs containing radioactive isotopes. The pharmacokinetic of radiopharmaceutical in the lesions and organs allows estimating the dose absorbed and so predict the effect of radiations. The pharmacokinetic is obtained by image quantification of the administered radiopharmaceutical. An example of current RPTs includes thyroid ablation with the administration of ^{131}Iodine. ^{131}Iodine is a radioactive isotope that has a link to thyroid and emits some beta- particle, but also additional gamma rays emissions.

These gamma rays are conventionally detected trough scintillation Gamma-Cameras to acquire multiple 2-D images (also called projections), from different time points or angulation. Software is further used to quantify the activity trough these time points to obtain pharmacokinetics.

2-D images are simple to acquire but difficult to correct for quantification. It is why quantification is preferred on 3-D images, where multiple corrections are applied. Single-photon emission computed tomography (SPECT) is the tomographic imaging technique using these 2-D projections to reconstruct 3-D corrected images. The Jules Bordet Institute had just acquired the last generation of Gamma-Cameras allowing ^{131}Iodine SPECT, leading a unique opportunity to make the step towards 3-D dosimetry.

Goal:
The goal of this master thesis is to define the procedure to quantify 3-D images to determine the pharmacokinetic of ^{131}Iodine administered. First, the Master student will review the available literature on the subject. Secondly, based on literature findings and discussion with the medical physics team and the physician, the student will determine a list of experiment to investigate. Thirdly she/he will prepare and acquire phantoms (plastic objects that mimics human abdomen) containing activity of ^{131}Iodine, with activities and geometries corresponding to the previous decisions. Then the student will reconstruct all acquired phantoms with each predefined reconstruction parameters and will perform image quality assurance on quantification. Finally, based on these results, the student will propose the new 3-D procedure for ^{131}Iodine dosimetry.