Simulations and validation with real data for preclinical SPECT camera

Context

The group is developping a new method to enhance the radiosensitization of tumors with nanoparticles. Indeed, nanoparticules concentrated in a tumor could increase its sensitivity to X-rays. The noninvasive quantification of nanoparticules' concentration is a crucial task for radiotherapy treatment as this will determine the delivered dose. Combined with conventional radiotherapy, this new technique could be used for improved oncology treatments.

The main project of the group is the quantification of gadolinium nanoparticles coupled with radio-tracer In-111 in single photon emission tomography (SPECT) images. The SPECT is a common nuclear medicine tool in clinical diagnostic and preclinical researches, also used for image quantification.

The main concern for proper SPECT image quantification is image corrections, such as attenuation, scatter and partial volume effects. Currently, we work on a new correction method for the later. They are due to limited spatial sampling, and to limited spatial detection resolution. Thus, deep understanding of physics processes, image acquisition and reconstruction is essential. To better understand the corrections, simulations representing accurately real processes in scanner detectors and digitization of a signal are necessary. We already started developments on one of the configurations of the preclinical SPECT scanner. The aim of this internship is to develop simulations adapted for another configuration of the machine and validate the simulations against experimental results.

Objective

The purpose of this internship is to perform simulations (Monte Carlo) for preclinical SPECT scanner followed by validation on real data. Main focus will be on mice studies. Participation in preclinical data acquisitions is also possible.

You will be integrated and supported in a multidisciplinary project team, supervised by an engineer and researchers.

Tasks

- Understand the functionality of the exiting platform for Monte Carlo simulations (GATE)
- Develop simulations for a preclinical SPECT imaging system

- Adapt acceleration techniques for Monte Carlo simulations and perform distributed simulation on a cluster
- Validate the simulations on real data after deep understanding of physics processes in detector, collimator and patient body

Required skills

- Education: Master 2 student or equivalent in particle or nuclear physics, medical physics or computer science
- Scientific interests: medical imaging, Monte Carlo simulations, nuclear medicine
- Programming skills: C++, a wish to learn C++ based codes (ROOT, Geant4, GATE)
- Experience in Monte Carlo simulations, especially with GATE platform, would be a plus
- Languages: English and/or French

Practical information

Supervision: David Sarrut and Olga Kochebina
Location: Centre Lon Brard, Lyon, France
Period: 2018 (about 6 months)
Compensation: about 554€

Send CV and a motivation letter by email to
Olga Kochebina (**olga.kochebina@creatis.insa-lyon.fr**)
David Sarrut (**david.sarrut@creatis.insa-lyon.fr**)