Post-Doctoral Fellowship:
Advanced Treatment Planning System in Radiotherapy

Scientific context

A treatment planning system (TPS) in radiotherapy consists of determining and optimizing a number of parameters associated with the irradiation protocol based both on hardware but also biological constraints. Although analytical models may be used, most accurate and personalized treatment plans are achieved by estimating the predictive dose deposited to the patient by using advanced numerical simulations called Monte Carlo simulations (MCS). These simulations are using random sampling methods for solving the different physical processes and interactions between particles and matter (tissues). However, MCS are also associated with long execution times, which is one of the major issues preventing their use in routine clinical practice for dosimetry applications. A solution can be based on the use of graphics processing units (GPU). However, in the case of MCS-based treatment planning systems, where thousands of optimization steps are required, GPU-based simulations are still not fast enough. In addition, newer approaches in external beam radiotherapy (including the use of non-coplanar beams and/or newer technologies such as MRI-Linac) put additional burden in the overall optimization options and associated times of execution. New approaches in rupture with state of the art have to be proposed to overcome these intensive computational time issues.

Job description and missions

The aim of this project is to propose a new TPS that has the accuracy of MCS-based simulation and a computation time suitable for clinical application. Different approaches can be explored. A first one may consist in speeding up MCS by developing new Variance Reduction Techniques dedicated to GPU architectures. Another approach that can be exploited is a hybrid approach mixing analytical simulation (for speed) and MCS (for accuracy). A last approach to be considered will be the use of Convolutional Neural Networks (CNN) to facilitate a fast treatment plan without long simulations and loss of accuracy. Few MCS-based optimization steps may be necessary to refine this treatment plan in order to ensure the plan quality. The main aim is to drastically reduce the number of optimization steps. The candidate will be free to explore any of these approaches and/or propose alternative solutions. The proposed treatment planning system will be evaluated using simulated, experimental and patients' data against a standard clinical treatment planning system available in the LaTIM.

Profile

We look for a candidate with a PhD in computer sciences, control engineering, applied mathematics. Previous relevant experience in radiotherapy is welcomed but not required. Good programming skills is an important requisite. Autonomy, open-mindedness and motivation, as well as good English speaking/writing skills, are also expected.

Position context

The postdoc will join the Laboratory of Medical Information Processing (LaTIM, Brest, France) in the team "ACtion Thérapeutique guidée par l'Imagerie multimodale en ONcologie" (ACTION, INSERM, UMR1101). The position will be for an initial duration of one year, renewable up to three years. Salary is about 2000-2200 € net/month, depending on the candidate's experience.

Contact and additional information

In order to apply for this post, a folder that contains a CV, motivation letter, resume of the previous work including thesis and any prior postdoctoral positions, a complete list of publications, as well as letters of recommendation, should be sent to:

Julien Bert (julien.bert@univ-brest.fr)