Monte-Carlo Modeling of Rotating Radiotherapy Unit

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Director: Luc SIMON (HDR)

Laboratory: CRCT Toulouse

Introduction: Monte-Carlo methods are considered as the reference computation for the medical applications that includes a transport of ionizing particles (radiation therapy, molecular imaging). During the last six years, our team developed a Monte-Carlo model (GAMMORA) of a linear accelerator (TrueBeam, Varian, Palo Alto, CA) commonly used in Radiotherapy, based on the open source platform Geant4/GATE. This open source model allows computing the dose distribution for simple or complex plans and was used for several studies such as assessment of output factor correction in case of small fields or interplay effect in presence of target motion. Our last development was to train a Generative Adversarial Network (GAN) to generate particles (using the *gaga* tool), to replace the large input files (phase space).

Objectives: The PhD candidate will first have to consolidate GAMMORA, and in particular, the user interface. Then, the candidate will add the models of one or two rotating radiotherapy units (Accuray Radixact and Varian Halcyon) in GATE/Geant4 (depending on the feasibility). It includes the geometry of these units, but also the dosimetric properties. The models will be validated by comparison with measurements (achieved at the IUCT-oncopole) and will be used for several applications (dose computation for complex geometries, breathing patient, presence of nano particles…). In a second part, the candidate should introduce a Deep Learning (DL) feature in GAMMORA to speed-up the computation by denoising fast MC simulated dose or pre-computing dose kernel with DL.

It would be better if you already know: French, Physics of Radiotherapy, C++, GATE, Geant4 (or another MC code such as EGS, Topas…), Python, Pytorch