Monte Carlo modelling of cone beam computed tomography scanners for dual energy imaging

1 MSc project available

The use of dual energy imaging in proton therapy is motivated by improvements in relative stopping power estimation. Dual energy computed tomography (DECT) is currently performed with state-of-the-art scanners used for treatment planning. However, changes in patient anatomy require imaging of the patient on the treatment table to maximize treatment precision. This is currently performed with gantry-mounted cone beam computed tomography (CBCT) scanners, which typically suffer from lower image quality due to the detection of scattered photons by the large flat panel detectors employed. Currently, dual energy CBCT (DE-CBCT) is not available.

The general goal of this project will be the development of DE-CBCT methods. To achieve this scatter correction methods will be implemented on simulations of the CBCT scanners of the Radiation Oncology of the University Hospital of the LMU. The student will implement and validate Monte Carlo simulations for which parameters will be obtained from measurements. Based on the simulations, DE-CBCT approaches will be developed and tested.

The project will be a close collaboration between the Department of Medical Physics of the Faculty of Physics and the Department of Radiation Oncology of the Faculty of Medicine. The project will draw on extensive experience of the supervisors with CBCT imaging, scatter correction, deformable image registration and MC simulation.

The ideal candidate has
- A strong interest in computational aspects
- Experience in programming with either C/C++, Python or MATLAB, and Linux
- Experience with Monte Carlo transport and interaction codes, preferably MCNP
- Knowledge of imaging physics and image reconstruction
- Highly ranked BSc in Physics, preferably in Medical Physics or Biomedical Engineering
- Fluent English knowledge (spoken and written)
- Technical proficiency, scientific creativity, team working skills

Please contact both supervisors:

Prof. Dr. Marco Riboldi (Marco.Riboldi@physik.uni-muenchen.de)
Department of Medical Physics,
Faculty of Physics,
Ludwig-Maximilians-Universität München (LMU Munich),
85748 Garching, Germany

Prof. Dr. Guillaume Landry (Guillaume.Landry@med.uni-muenchen.de)
Department of Radiation Oncology
Medical Center of the University of Munich
Campus Grosshadern
Marchioninistr. 15, 81377 Munich