Department of Medical Physics
Faculty of Physics

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LMU

Imaging dose validation for proton computed tomography

1 MSc thesis project available

The current practice in radiation therapy of cancer with protons is planning the treatment on a x-ray computed tomography (CT) image. In that case, the proton stopping power in the patient is deferred from the photon attenuation coefficient, which results in systematic errors of up to 3%. Proton CT (pCT) has been proposed and is investigated as a candidate for providing high accuracy stopping power maps in the patient. It has been shown, both experimentally and in simulations, that pCT can achieve stopping power accuracy better than 1%. Furthermore, due to the different shape of dose deposition of protons compared to photons, pCT can deliver a much lower imaging dose to the patient. This makes pCT also a favorable modality for frequent imaging, as this is required for treatment plan adaptation and image guided proton therapy.

LMU Munich has been one of the key players in the field of pCT and a partner institution of the collaboration which operates and phase-II prototype pCT scanner, built by the Loma Linda University and the University of California at Santa Cruz, and hosted at the Northwestern Medicine Chicago Proton Center. Furthermore, LMU is responsible for the software platform for simulating the entire imaging chain with the phase-II scanner.

The goal of the proposed MSc thesis is to validate the simulation platform with imaging dose measurements and object scans that are planned to be acquired at the Northwestern Medicine Chicago Proton Center in May 2022. The student will work together with a team of supervisors in analyzing the experimental data, reconstructing pCT images and simulating the dosimetry and and imaging scans with our highly realistic simulation platform. The end goal is to quantify the accuracy of imaging dose simulation and to provide for the first time pCT images with validated and experimentally measured imaging dose estimations.

The ideal candidate has:
• A strong interest in computational aspects
• Experience with some of the listed tools: C/C++, Python or MATLAB, and Linux
• Any familiarity with Monte Carlo transport and interaction codes, preferably Geant4 is highly welcomed
• Knowledge of basic imaging physics and image reconstruction concepts
• 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

The LMU Department of Medical Physics is located in Forschungszentrum Garching, which is well connected with public transportation to the city of Munich. A flexible/hybrid working scheme including home office hours can be arranged. The MSc student will work in a highly motivated and well-established team within a multidisciplinary and international network embedded in a stimulating scientific environment with a long tradition of collaboration and excellence in biomedical research, with outstanding research and clinical infrastructures.

In case of interest, please contact:

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