Development of mathematical anthropomorphic voxel phantoms for the validation of DIRA

Cancer is a leading cause of death worldwide. Even when treated and cured, cancer patients may still suffer from decreased quality of life. To improve the efficiency of cancer treatment and lower its side effects, researchers in radiation therapy develop more accurate systems for radiation treatment planning. Our group develops a model-based iterative reconstruction (MBIR) algorithm DIRA, which determines elemental composition of patient tissues from dual-energy computed tomography (DECT) scans. Knowledge about the tissue composition allows more accurate computation of spatial distribution of absorbed dose in radiation treatment planning systems. The DIRA algorithm needs testing and validation. The aim of this project is to prepare a set of realistic mathematical anthropomorphic phantoms (mimicking for instance the fat invasion in muscles or the trabecular bone structure) that can be used for the testing of segmentation and tissue classification routines in DIRA.

The task:

1. Design several anthropomorphic voxel phantoms representing the pelvic region.
2. Adjust the TAKE code so that it can calculate fan-beam x-ray projections of these phantoms.
3. Evaluate the performance of DIRA for these x-ray projections.

Requirements:

The student should be familiar with general principles of computed tomography and interactions of x- rays (10 – 150 keV) with matter. Knowledge of Matlab and C is needed. The project is suitable for medical physics, biomedical engineering, electrical engineering and computer science and engineering students.

The work will consist of modelling and evaluation of data. The student will learn about DECT. Active approach to problem solving will be encouraged; results will be discussed in a research group (Åsa Carlsson Tedgren, Michael Sandborg, Gudrun Alm Carlsson, Alexandr Malusek, Maria Magnusson). Student's location: Division of Radiological Sciences, Linköping University.

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The project is announced on CareerGate: https://careergate.liu.se/sv/project/26567764/13