Automatic classification of tissues in the model-based iterative image reconstruction algorithm DIRA

In dual-energy computed tomography (DECT), model-based iterative image reconstruction (MBIR) algorithms use projections obtained at two different x-ray tube voltages to reconstruct an imaged volume. Compared to a conventional single-energy CT, the additional information provided by DECT allows a better approximation of the material composition of the imaged volume. Our research group is developing an MBIR algorithm DIRA. DIRA approximates each tissue with a combination of two or three base materials; this classification is done in each iteration step of the MBIR algorithm. Noise and image artefacts complicate this process. As the typical anatomy of the imaged region is a priori known, it is possible to use segmentation algorithms that take the region's topology into account (e.g., bone marrow is inside bones, brain is in the head only,...). The aim of this work is the development and application of advanced automatic tissue classification (segmentation) algorithms in DIRA. Targeted area is radiation treatment planning in general. Special focus is on brachytherapy, where the knowledge of elemental composition of imaged tissues may significantly improve the accuracy of dose delivery.

The task:

1. Implement several well-known automatic tissue classification algorithms in DIRA. You are free to implement your own solution.
2. Test your implementation on simulated projections of mathematical phantoms. You may need to propose and implement these phantoms. You can use the CTsim simulation package from Siemens for the simulation of projections that include statistical noise.

Requirements:

The student should be familiar with image segmentation methods, general principles of computed tomography, and Matlab. Suitable for students with image processing background.

The work will consist of software development and computer simulations. Physics of CT and possible medical applications will also be discussed. Active approach to problem solving will be encouraged; results will be discussed in a research group. Student's location: the Division of Radiological Sciences, Linköping University.

For more information contact
- Gudrun Alm Carlsson, Prof em , (Gudrun.Alm.Carlsson@liu.se) or
- Michael Sandborg, Prof, (Michael.Sandborg@liu.se) or
- Alexandr Malusek, PhD (Alexandr.Malusek@liu.se) or
- Maria Magnusson, PhD, (Maria.Magnusson@liu.se)