Automatic segmentation of DECT images

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 object. Compared to a conventional single-energy CT, the additional information provided by DECT allows better estimation of the object’s material composition. This may notably improve the accuracy of dose delivery in radiation therapy (which is our area of interest).

DECT does not provide enough data to accurately determine mass fractions of all elements in the imaged object. Instead, assumptions must be made (i) on the typical material composition and (ii) how the composition can deviate. The automatically segmented images provide hints on how to choose the typical material composition. So far, our group has developed the MK2014 [1] and JJ2016 [2] algorithms for single-energy CT. Now we would like to develop an algorithm for DECT.

![Figure 1: 3D visualisation of segmented bone, adipose tissue, prostate, rectum and remaining soft tissue. The segmentation was done using the JJ2016 algorithm. Source: Ref. [2].](image)

**The task:**

1. Review existing segmentation algorithms that can work with DECT data. Select those that are suitable for the task.
2. Propose changes to the existing (single-energy CT) segmentation algorithm JJ2016 so that it can be used with DECT data. Implement some of those changes and evaluate the performance of the resulting algorithm.

**Requirements:**
The student should be familiar with image segmentation methods, general principles of computed tomography, and Matlab. The project is suitable for students with image processing background who want to develop or implement segmentation methods.

The work will consist of reading technical literature, 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.

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**References:**