# Automatic segmentation of DECT images

In dual-energy computed tomography (DECT), model-based iterative 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 and the JS2018 [3] algorithm for the segmentation of bones in DECT using the 3D-Unet convolutional neural network (CNN). Now we would like to either extend the traditional segmentation algorithms to DECT or enhance the CNN JS2018 algorithm so that it could also segment additional organs or tissues.

**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 or enhance the deep-learning based JS2018 algorithm. In the latter case, the training data sets should be prepared for instance using existing traditional algorithms with manual adjustments.
3. Implement the 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 (Åsa Carlsson Tedgren, Michael Sandborg, Gudrun Alm Carlsson, Alexandr Malusek, Maria Magnusson). Student's location: Division of Radiological Sciences, Linköping University.

For more information, contact:


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**References:**


[1] Kardell, M., 2014. Automatic Segmentation of Tissues in CT Images of the Pelvic Region. Master's thesis, Linköping University.

[2] Jeuthe, J., 2016. Automatic Tissue Segmentation of Volumetric CT Data of the Pelvic Region. Master's thesis, Linköping University.

[3] Sánches, J. C. G., 2018. Segmentation of bones in medical dual-energy CT volumes using the 3D U-Net convolutional neural network. Project work, Linköping University, in print.


The project is announced on CareerGate: https://careergate.liu.se/sv/project/26570591/13