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Segmentation Toolbox for Tomographic Image Data

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Poster Competition: The winner

H. Einarsdottir

Segmentation Toolbox for Tomographic Image Data DTU

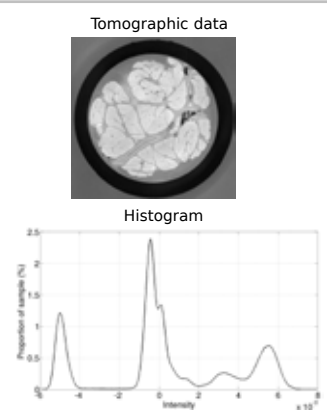
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Introduction

Motivation: Image acquisition has vastly improved over the past years, introducing techniques such as X-ray computed tomography (CT). CT images provide the means to probe a sample non-invasively to investigate its inner structure. Given the wide usage of this technique and massive data amounts, techniques to automatically analyze such data becomes ever more important. Most segmentation methods for large datasets, such as CT images, deal with simple thresholding techniques, where intensity values cut offs are predetermined and hard coded. For data where the intensity difference is not sufficient, and partial volume voxels occur frequently, thresholding methods do not suffice and more advanced methods are required.

Contribution: To meet these requirements a toolbox has been developed, combining well known methods within the image analysis field. The toolbox includes cluster-based methods to automatically determine parameters of the different classes present in the data, and edge weighted smoothing of the final segmentation based on Markov Random Fields (MRF). The toolbox is developed for Matlab users and requires only minimal background knowledge of Matlab..




Tomographic data

Histogram

Methods


- Given the large amount of data in tomographic images, we first sample at random a portion of the voxels.
- Next we fit a Gaussian mixture model (GMM) to the sampled data using the Expectation-Maximization algorithm. Here the user must specify the number of Gaussian desired.
- To determine the predominant structure direction and spatial coherence at each voxel, the structure tensor is calculated.
- Either an isotropic- or anisotropic MRF is used to incorporate spatial information in the segmentation process by modeling the *a priori* probability of neighbor dependencies.




Example

Three dimensional structure tensor

x-direction



y-direction



z-direction


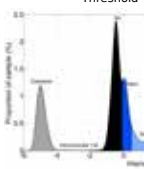
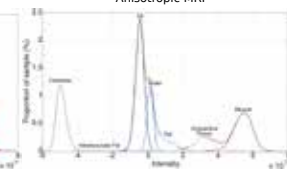


Image histograms

Threshold



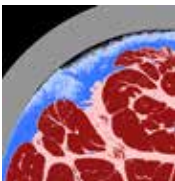
Anisotropic MRF



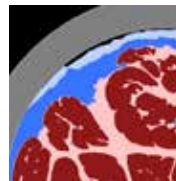
Results

- Significant gain is achieved in segmentation accuracy when considering the spatial context of the data.
- The toolbox provides a simple MATLAB framework to implement and visualize each step of the segmentation algorithm and requires only minimal background knowledge in MATLAB.
- Code will be published in near future along with a detailed description of the entire algorithm.

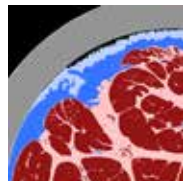
Threshold


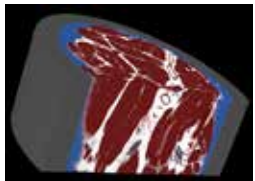


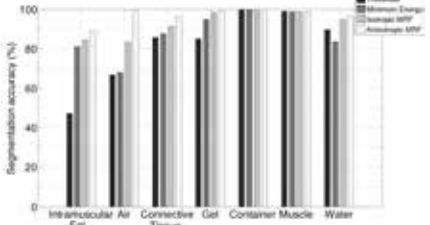
Isotropic MRF



Anisotropic MRF





DTU Compute
Department of Applied Mathematics and Computer Science