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Segmentation of Connective Tissue in Meat from Microtomography Using a Grating Interferometer

Hildur Einarsdóttir[1], Bjarne K. Ersbøll[1] and Rasmus Larsen[1]

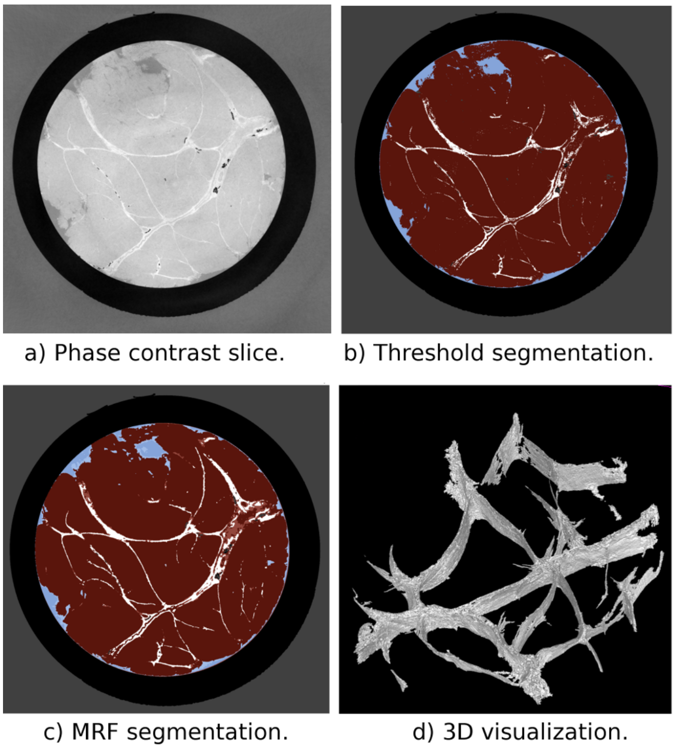

Figure: *In a) a single slice from the phase contrast tomogram is shown, b) illustrates the results from a conventional threshold segmentation, c) shows the results from the anisotropic MRF segmentation and d) shows a 3D visualization of part of the segmented connective tissue.*

It has been demonstrated that phase contrast imaging provides superior contrast of soft tissues in biological material over typical absorption tomography [1-2]. In meat science, this imaging modality can provide valuable information of the effects of heat treatment on muscle tissue. Although microtomography provides high resolution, the thin structures of the connective tissues are difficult to segment. This is mainly due to partial object voxels, image noise and artifacts. The segmentation of connective tissue is important for quantitative analysis purposes. Factors such as the surface area, relative volume and the statistics of the electron density of the connective tissue could prove useful for understanding the structural changes occurring in the meat sample due to heat treatment.

[1] Department of Applied Mathematics and Computer Science, Technical University of Denmark, Denmark

✉ Hildur Einarsdóttir, hildr@dtu.dk

In this study a two step segmentation algorithm was implemented in order to segment connective tissue from phase contrast microtomograms obtained by a grating-interferometer. This segmentation has previously been demonstrated for the segmentation of the optic nerve head from microscopic images of stained slices [3]. The first step is to model the data as a mixture of Gaussians using an expectation-maximization (EM) algorithm [4]. This iterative process finds the maximum likelihood of parameters where the model depends on unobserved latent variables. The spatial information of the data is next incorporated into the segmentation process by modeling the data as a Markov random field (MRF) [5]. It models the a priori probability of neighborhood dependencies, and the field can either be isotropic or anisotropic. For the segmentation of connective tissue, the local information of the structure orientation and coherence is extracted to steer the smoothing (anisotropy) of the final segmentation. The results show that the segmentation provides a superior classification of connective tissue over conventional threshold segmentation. Additionally modeling the data as a mixture of Gaussians made it possible to segment the connective tissue into two separate classes. The segmentation results provide the means for further analysis of the structural changes in the meat due to heat treatment.

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