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Overview of my work

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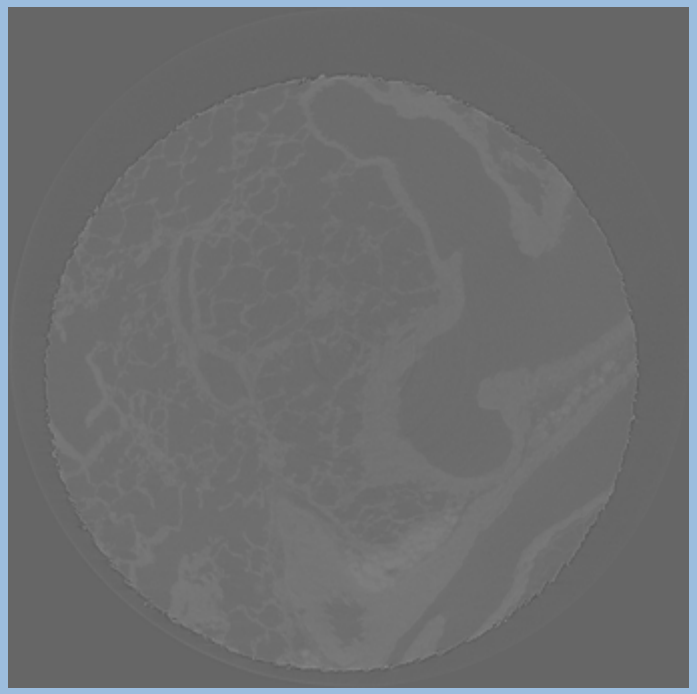
Background

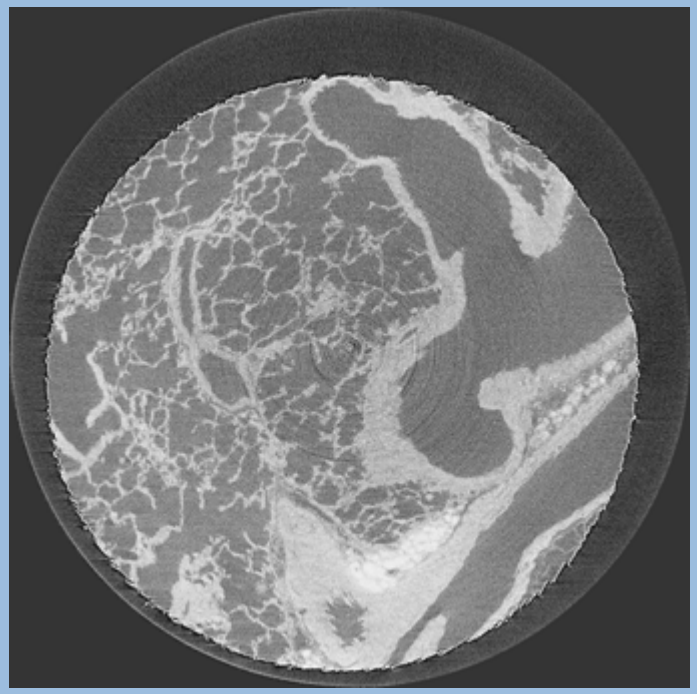
- Re-Definition of current lung development paradigm
  - Late alveolarization happens
  - Formation of septa after point that has been thought
- Generation of 3D images of the lung enables further work that cannot be done without it
  - Study of the underlying structures
  - Comparison between modified and wild type mice (genome)
  - Study of alveolar airflow with structural data

Overview

- XTM work done here at the SLS
- Refinement of process
- Process data up to now
- 3D-reconstruction is a well known process, but not for the small samples we have
- Troubles arise through small sample size and Image acquisition process > Signal to noise ratio

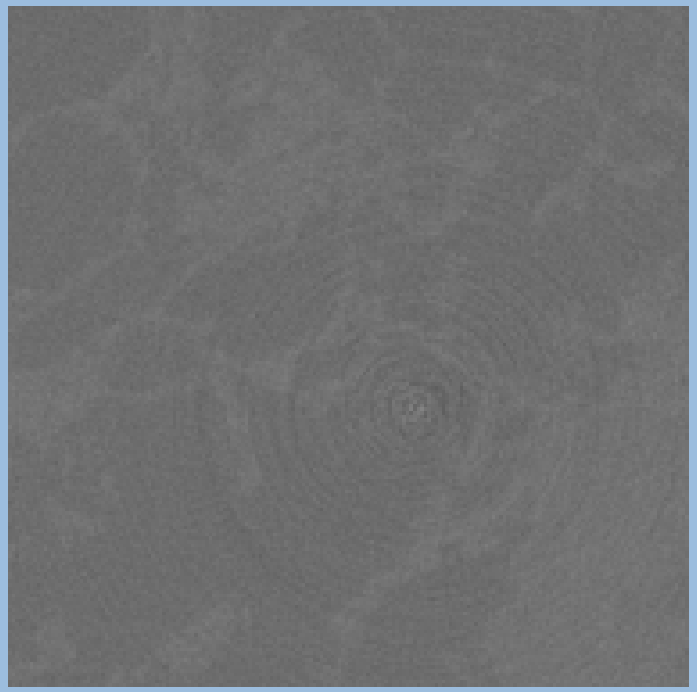
Data acquisition

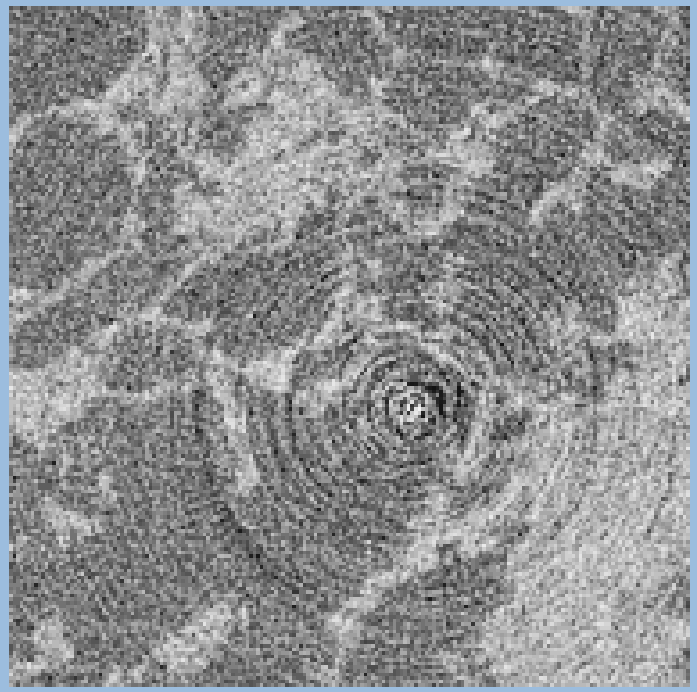




- Image stack of 1024 images
- 16bit Tiff-files, one reconstructed image is 2 MB > full stack ~2 GB

Image Noise





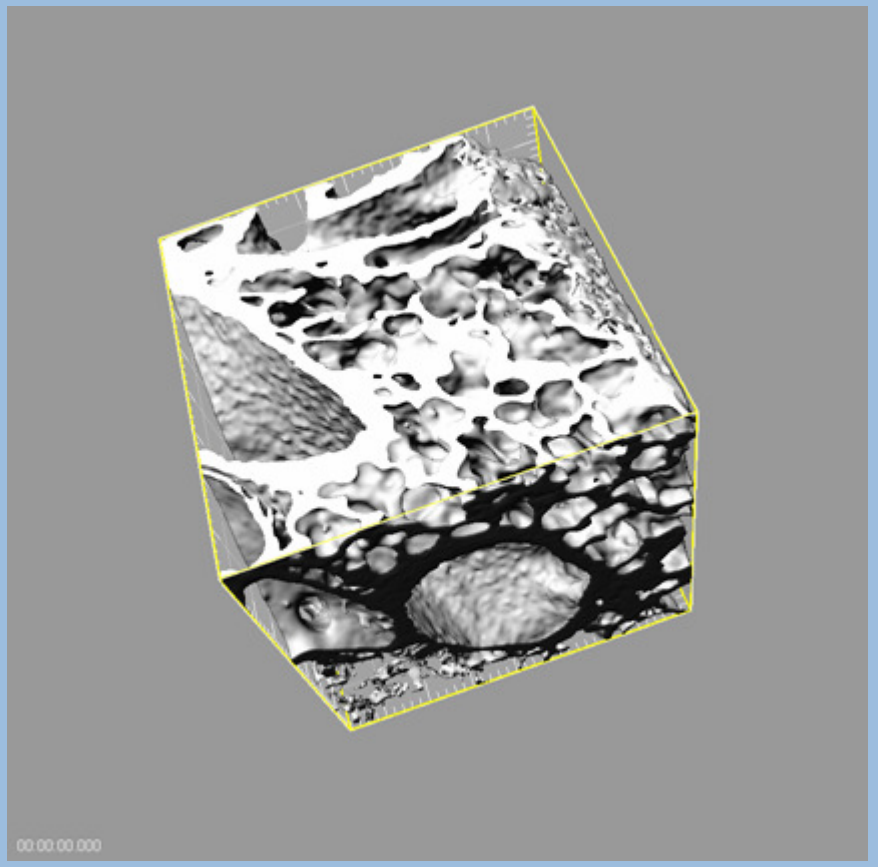
- Contrast is low, Noise in enhanced images is high
- Circular Artefacts in raw data through acquisition process
- Filtering > Good for generation of images, bad for data

Image Filtering

- Different filtering algorithms
  - Smoothing > averaging area, lost data
  - Median Filter > value sorting, noise removal
  - Kuwahara Filter > mean and variance smoothing, good edge protection
  - Anisotropic Diffusion > encourages intraregion smoothing while inhibiting interregion smoothing, very slow (+2h for 1 sample)

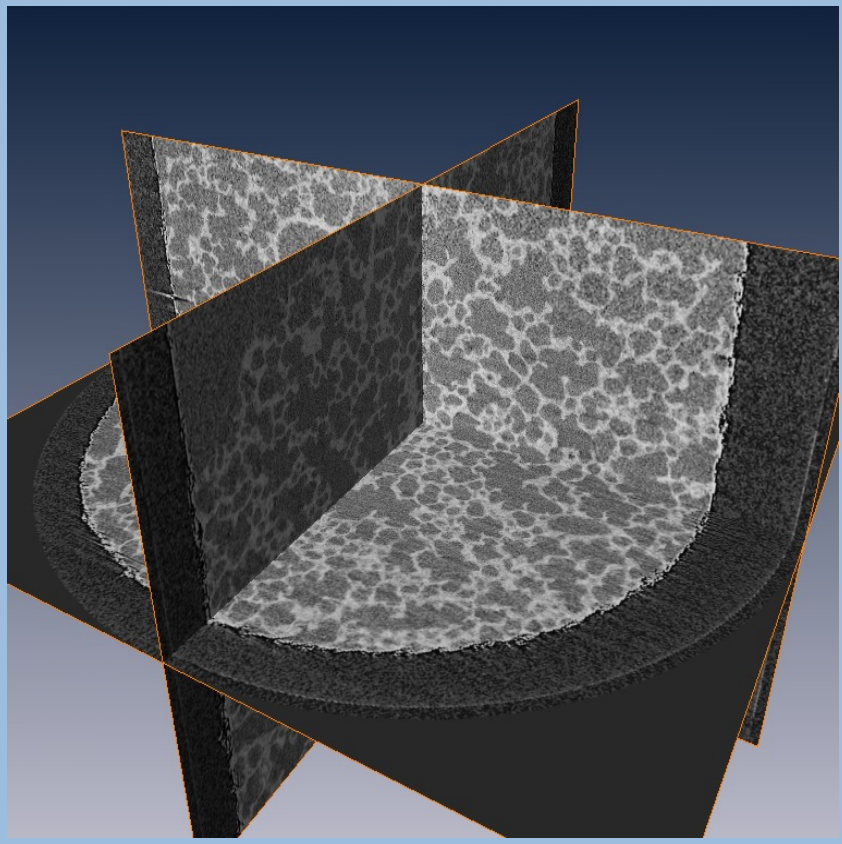
Imaris

- Reconstruction software, marketed for interpreting protein expression patterns
- Segmentation through thresholding
- Only portion of sample can be visualized > not good for our big image stacks



Amira

- Visualization Software for 3D data sets, also used at the SLS
- Licence through MEMcenter of the University of Bern > coreferee of my thesis
- Powerful segmentation methods, which have not been applied yet
- More suited for work with large data arrays



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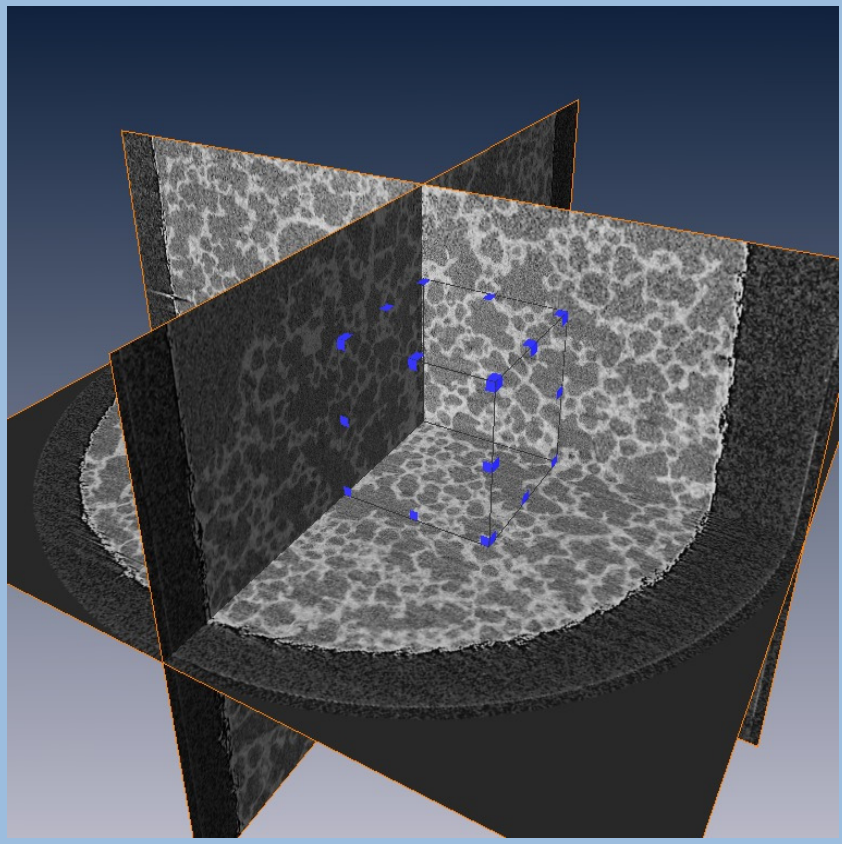

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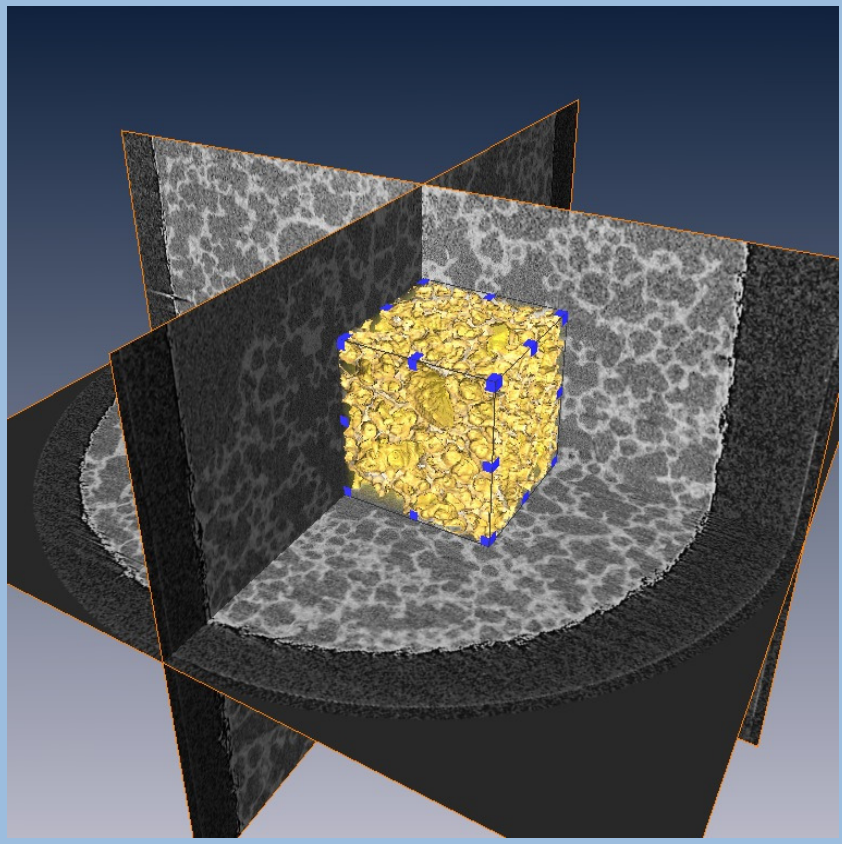

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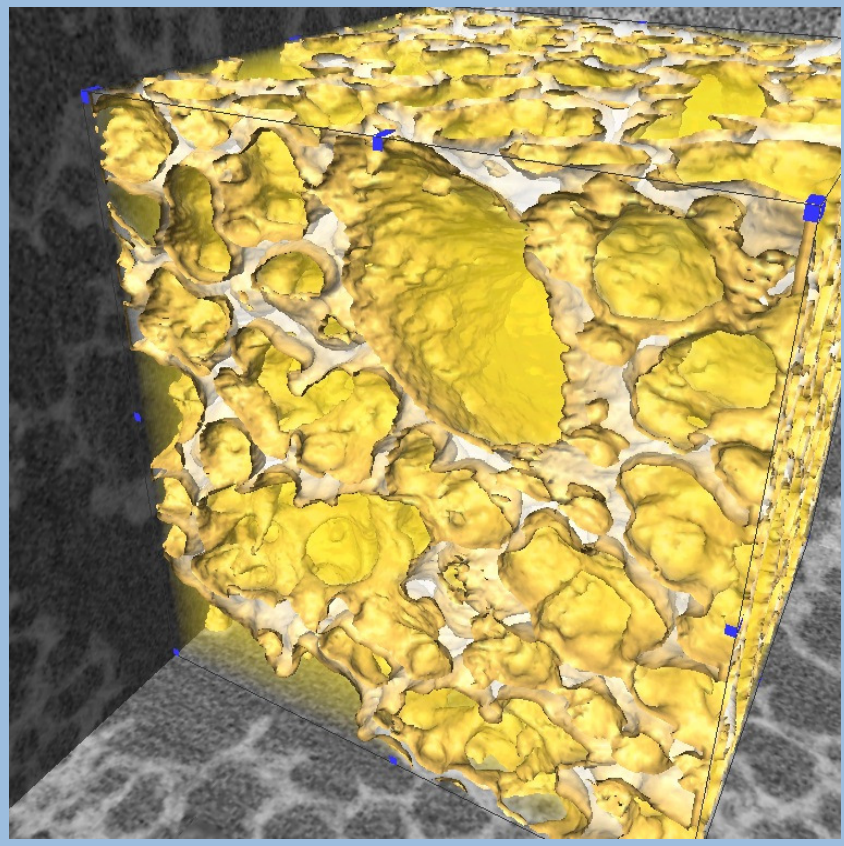

3D Reconstruction

- Segmentation is done through thresholding
- Threshold value is relevant for thickness of lung structures > correct value is vital
- Adaptive thresholding algorithms or skeletonizing images could help for reconstruction
- Generate wireframe skeleton of lung
- We are altering our data > Reconstruction error or pores?

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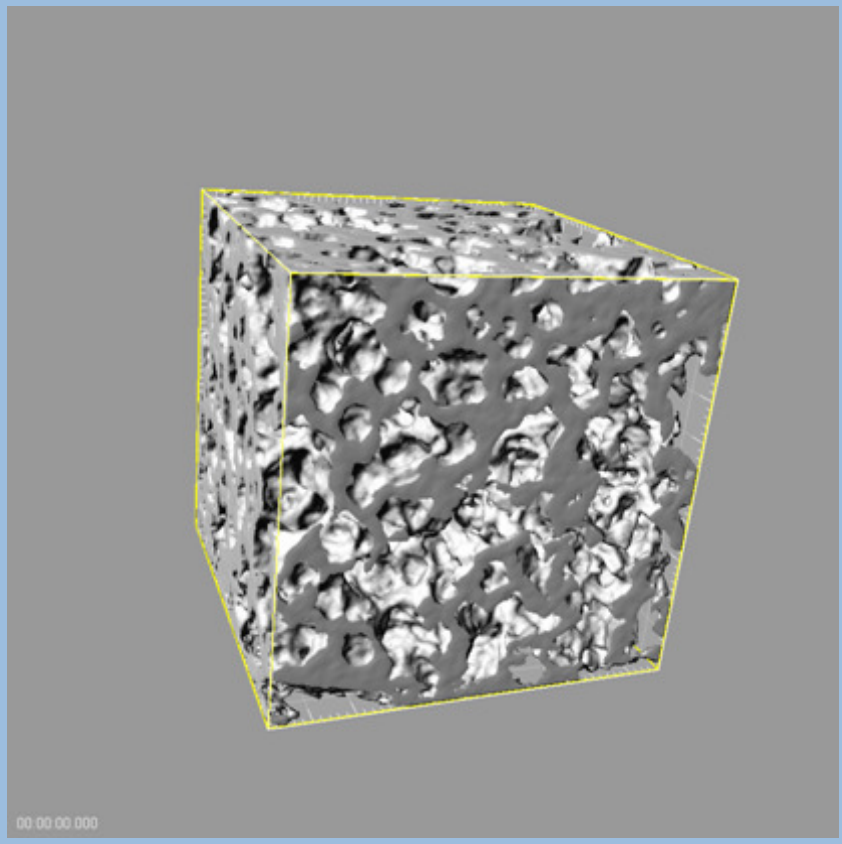
Pores

- Overview
- Cube of 196 pixels edge length
- Arbitrary crop
- Automatic thresholding by Imaris



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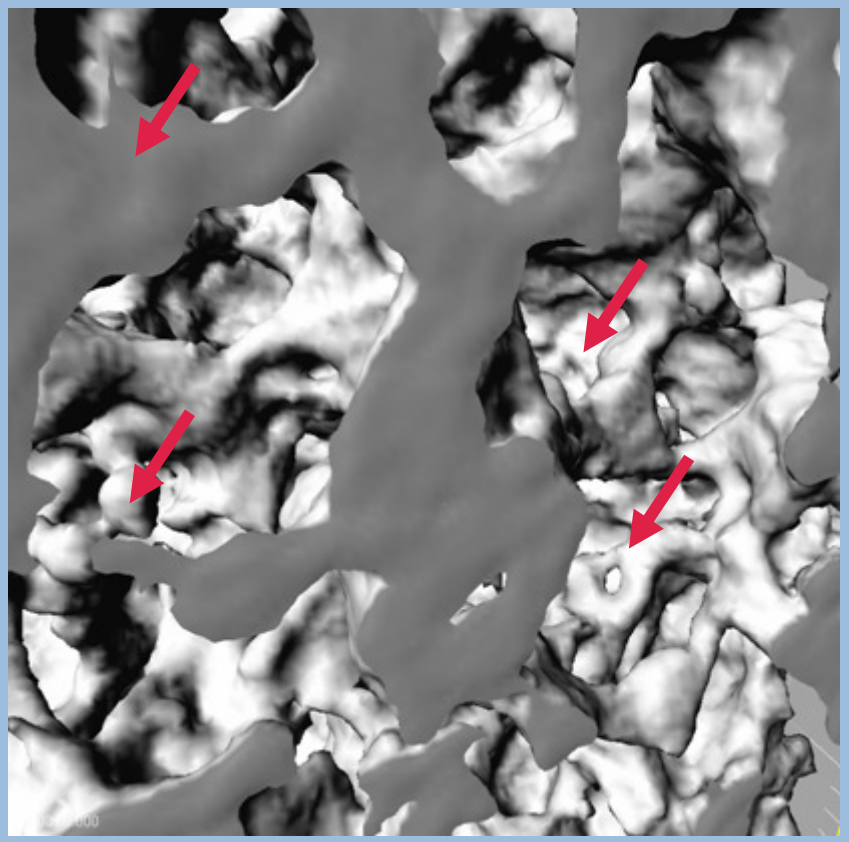
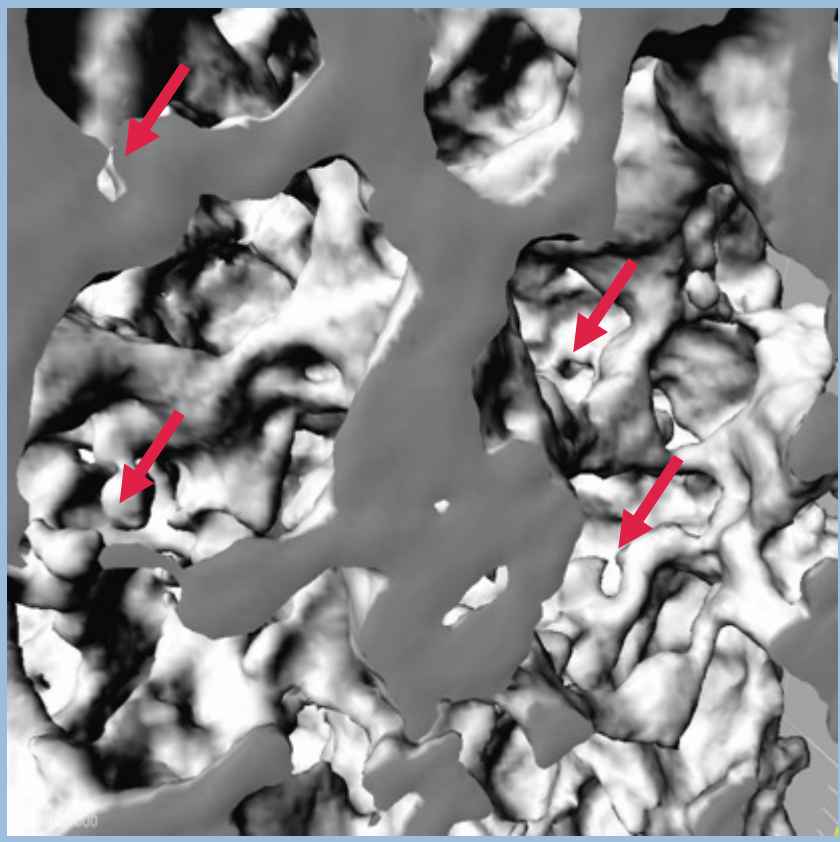
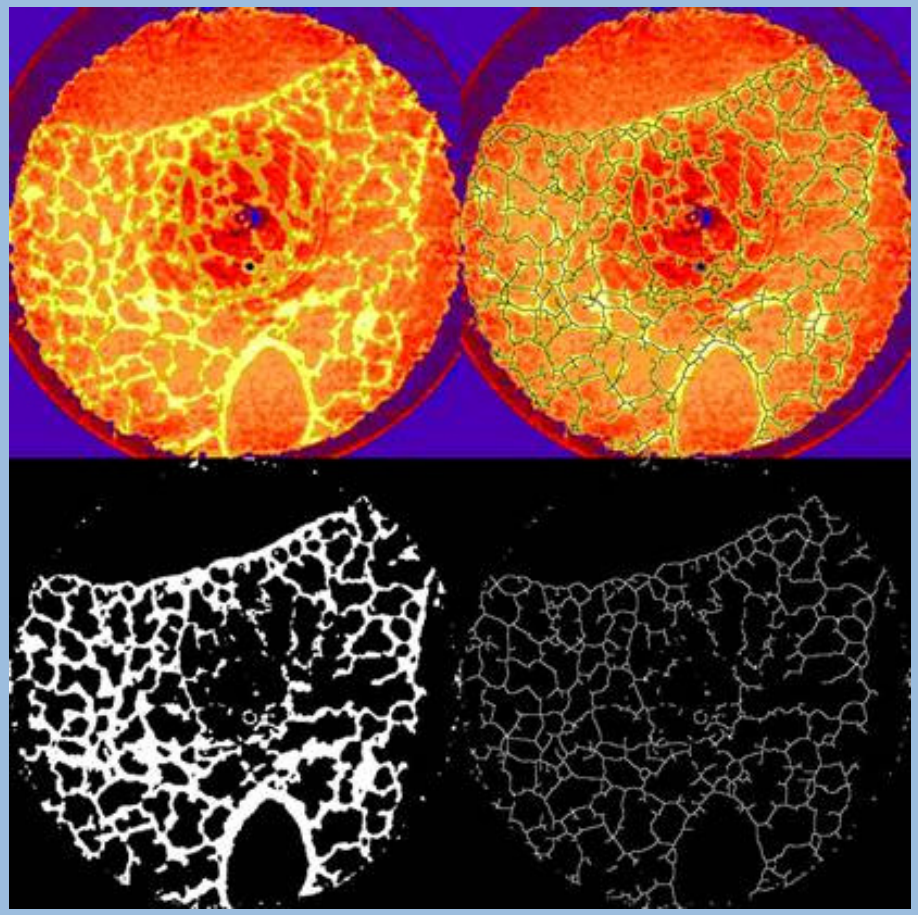




Skeletonizing Images

- Filtered image
- Binarized image (> threshold)
- Skeleton (IDL-Function)
  - — Non destroying
- Problematic, not everything is an alveolar septa
- Merged image



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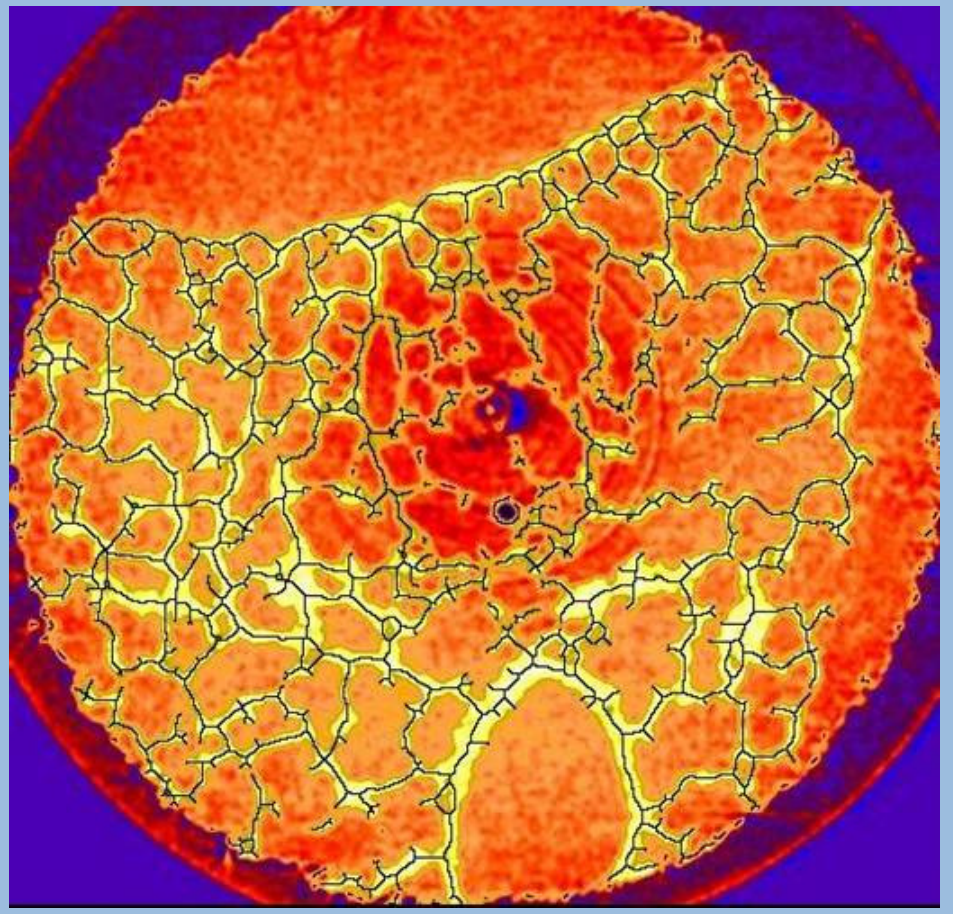

Outlook

- Image Reconstruction
- Measuring/Comparison of data measured up to now
- Refinement of imaging-process
- Workflow adaptation

> Thanks for listening!