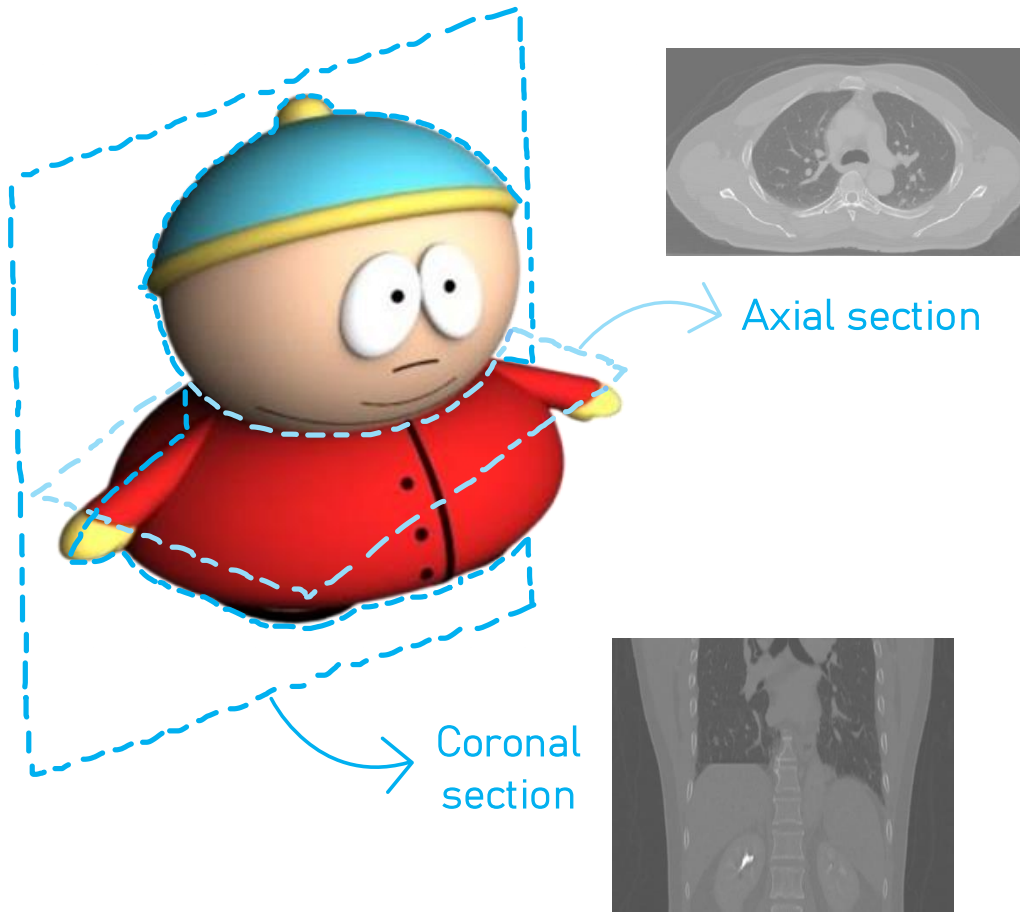
The background is a dense collage of CT scan images of human lungs. The images are arranged in a grid-like fashion, with some showing original grayscale scans and others showing the same scans with edge detection applied, resulting in high-contrast, black-and-white outlines of the lung structures. The text is overlaid in the center of this collage.

Edge detection and segmentation of lungs in CT images

Challenges of lungs segmentation



- Lung segmentation difficulties -

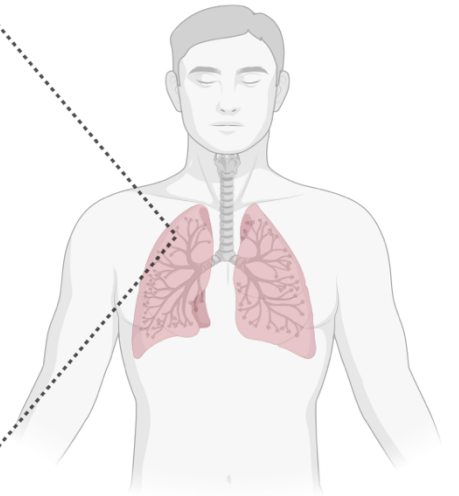
- > Variability in lung shape and margins

- > Pathology

Due to...

- > Imaging methods

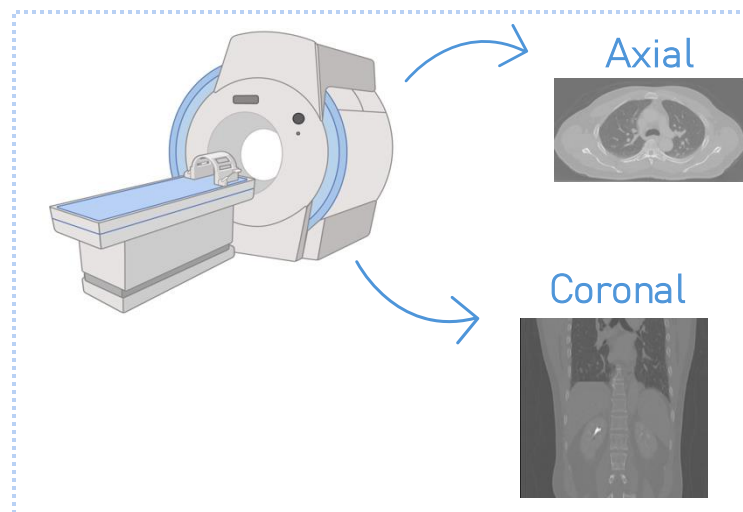
- > No universal solution



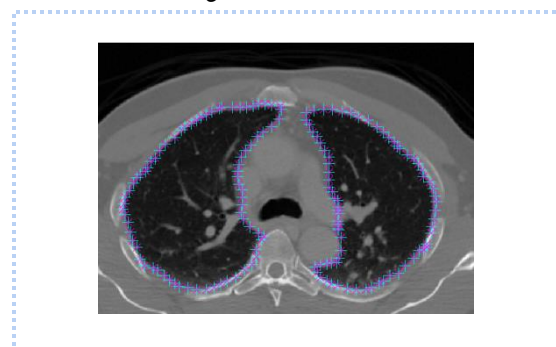
>>> NEED FOR IMPROVEMENT...

General steps

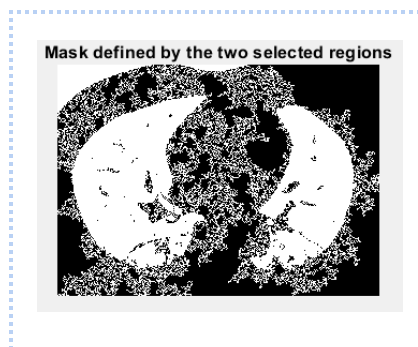
1. CT scan



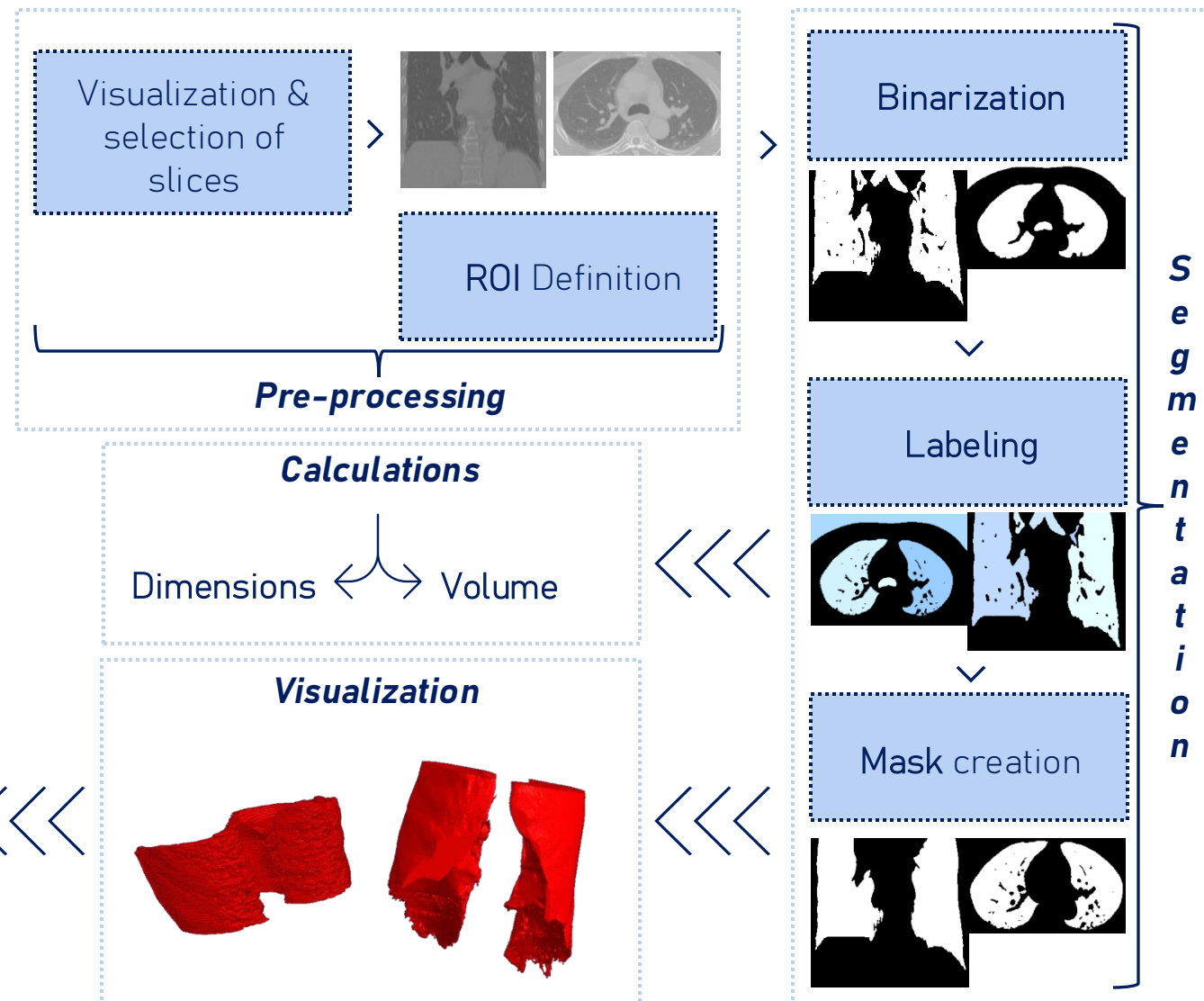
4. Manual VS Automatic segmentation



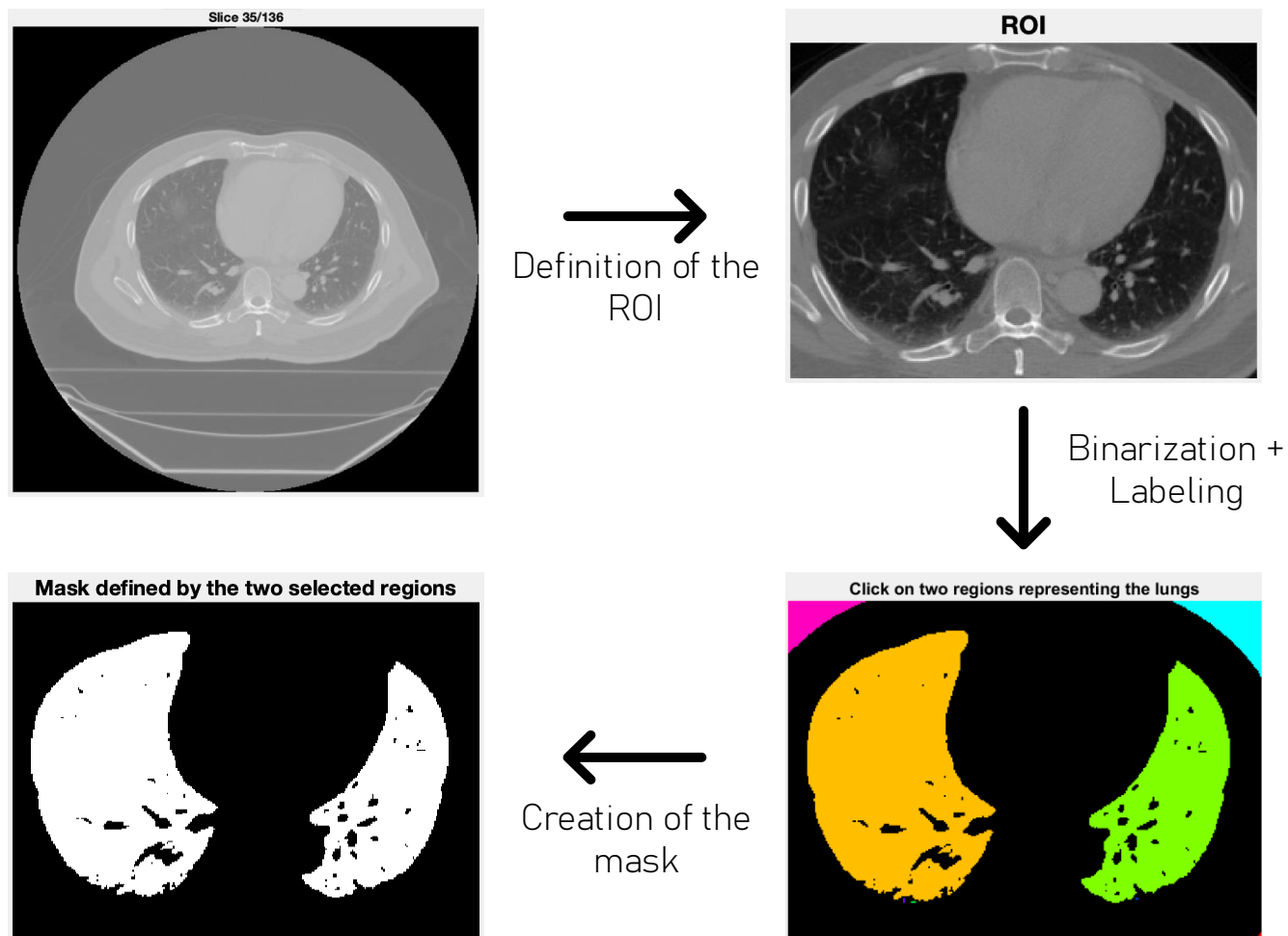
3. Noises addition



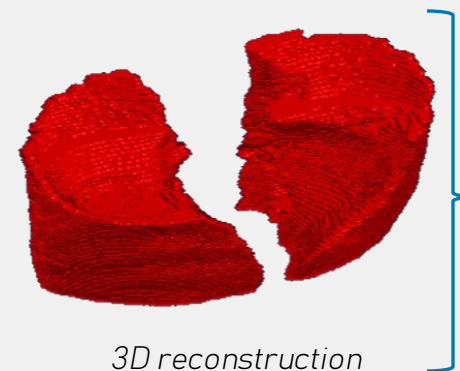
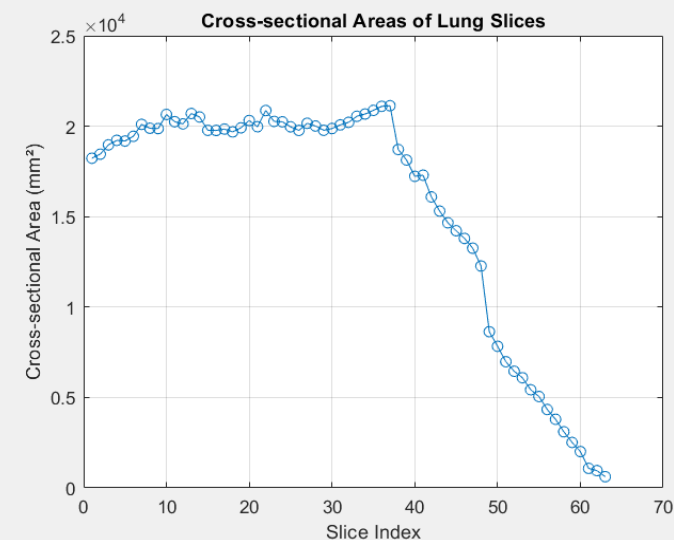
2. Processing



2. Segmentation of the axial slices



Parameters and Visualization



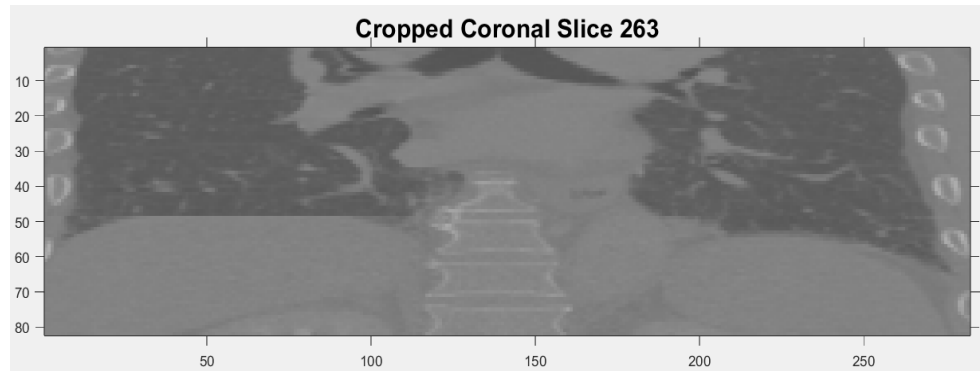
3D reconstruction

Parameters	Value
Largest cross-sectional area	20560.24 mm ²
Height	15.75 cm
Volume	2.41 L

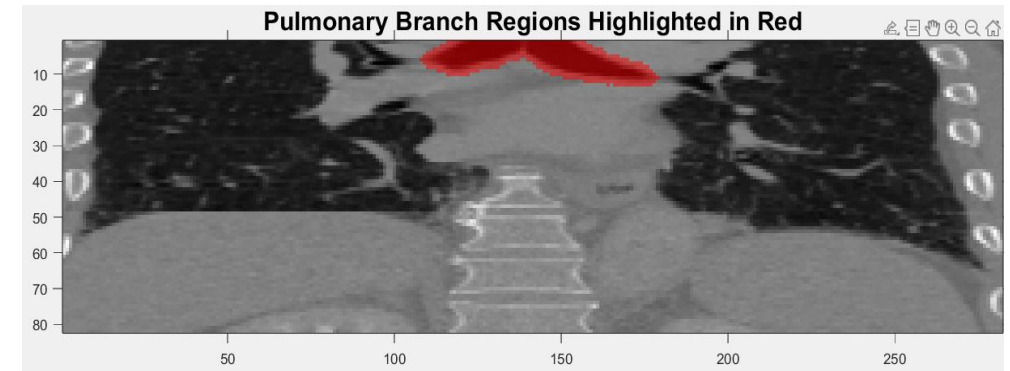
Metrics calculated

Segmentation

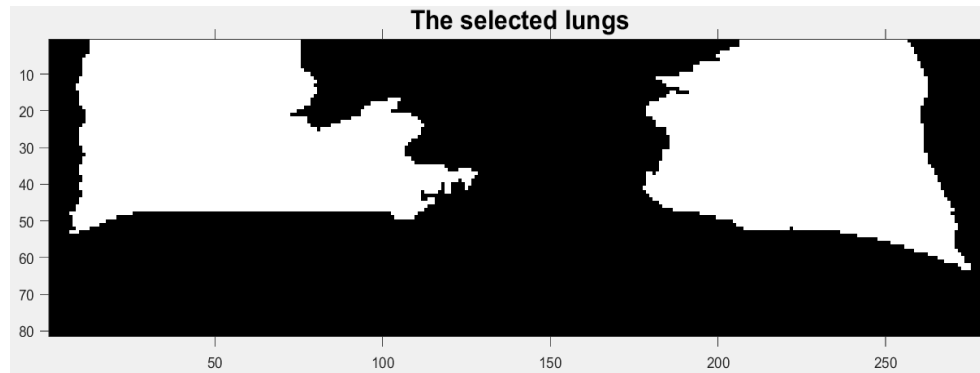
2. Segmentation of the coronal slices



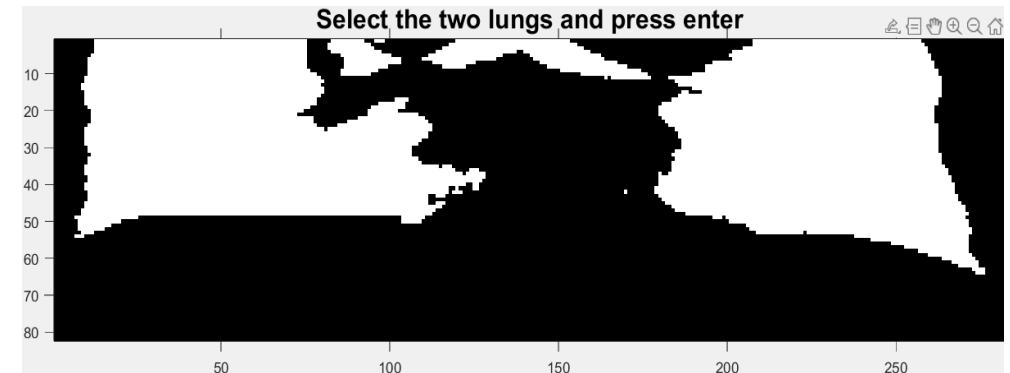
→
Identification
of the bronchi



↓
Binarization



←
Creation of
the mask



Segmentation

2. Segmentation of the coronal slices

Progress of segmentation

- Lungs are visible between slices 157 - 313



Loop between those slices

- Condition on the area
- Condition on the overlap region



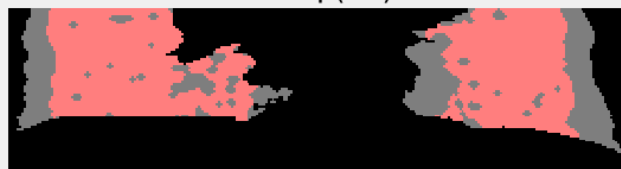
Reference Segmentation



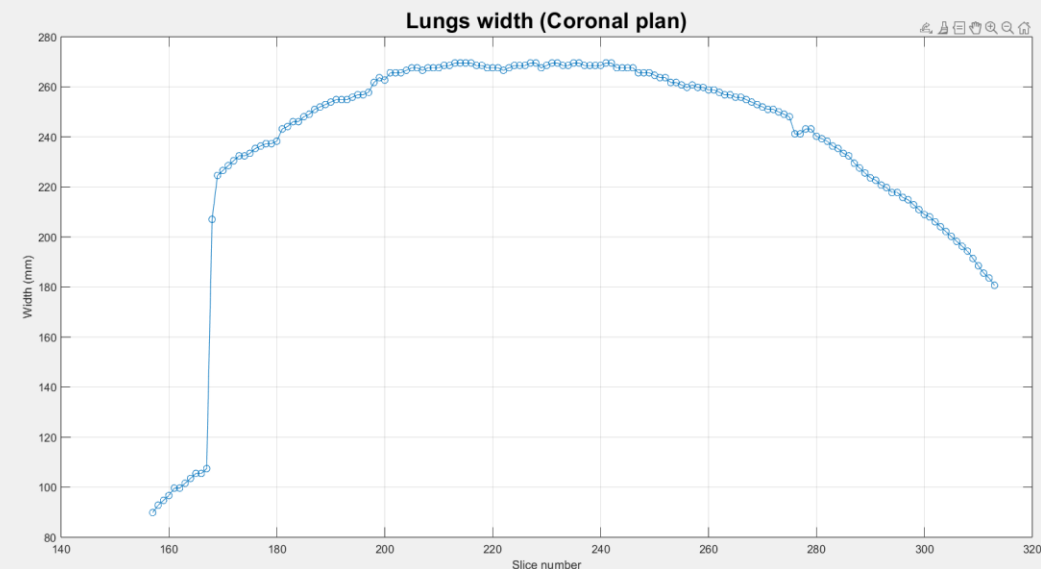
Slice 287 Segmentation



Overlap (Red)



Parameters and Visualization



3D reconstruction

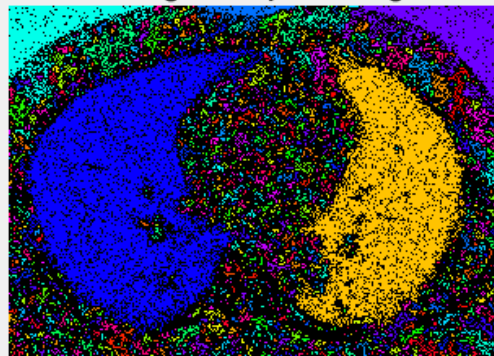
Parameters	Value
Height	7.91 cm
Volume	2.02 L

Metrics calculated

3. Noise add : Gaussian noise

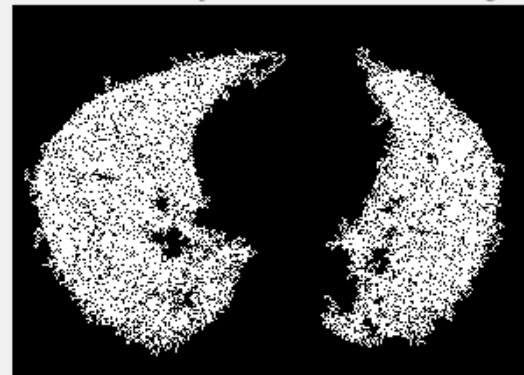
Labeling

Click on two regions representing the lungs

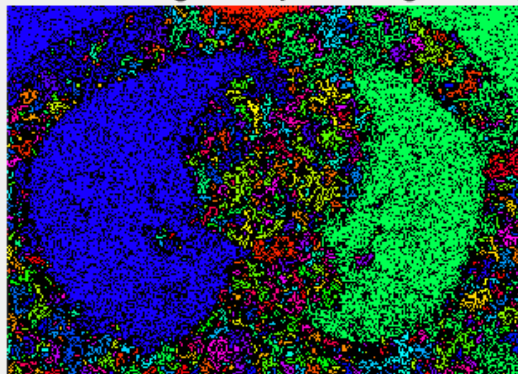
Standard
Deviation 500

Mask

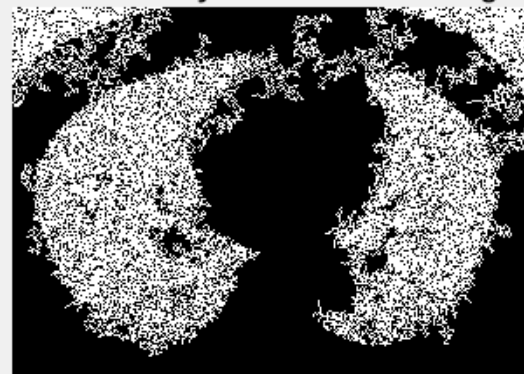
Mask defined by the two selected regions



Click on two regions representing the lungs

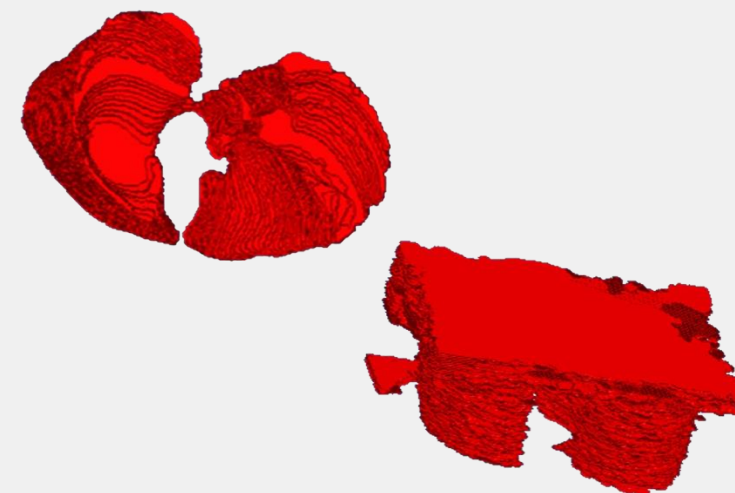
Standard
Deviation 750

Mask defined by the two selected regions



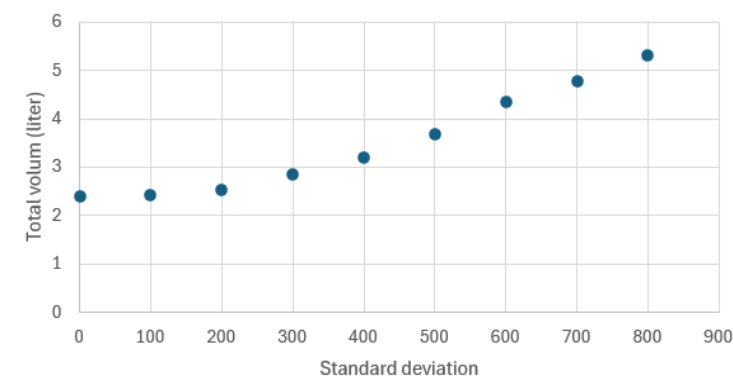
Add of the gaussian noise - influence on labeling & mask creation

Influence of noise on Parameters and Visualization



3D reconstruction

Volume results after adding Gaussian noise

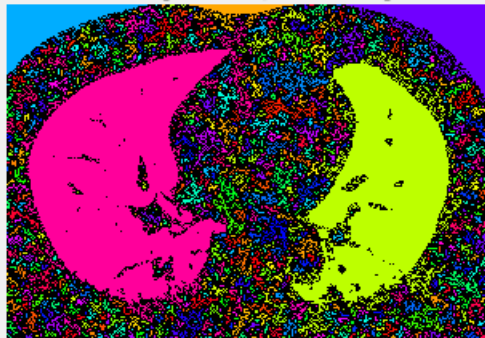


Noise add : Salt and pepper noise

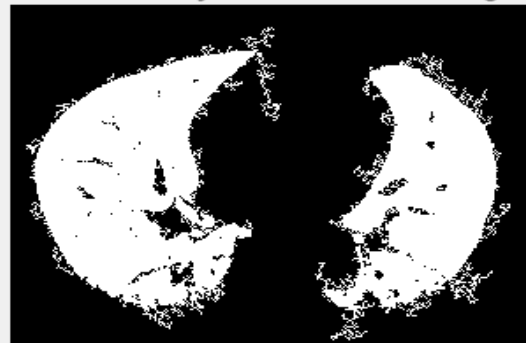
Labeling

Mask

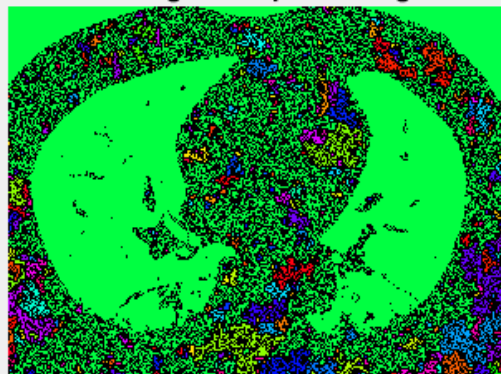
Click on two regions representing the lungs



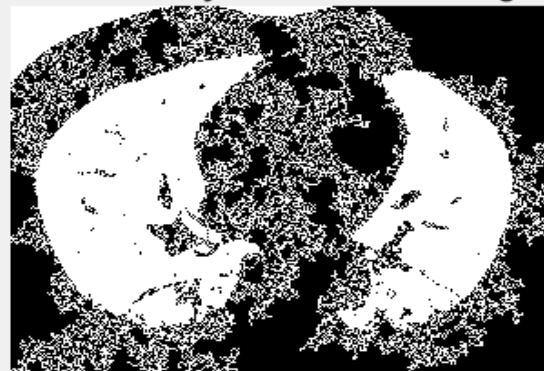
Mask defined by the two selected regions



Click on two regions representing the lungs

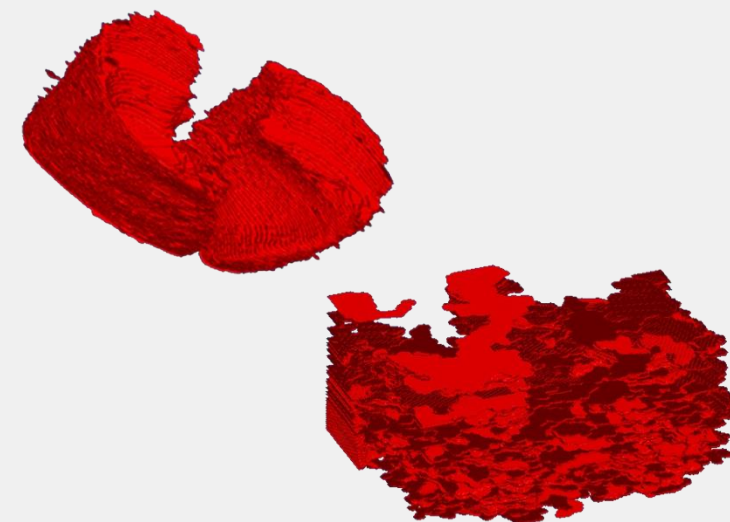


Mask defined by the two selected regions



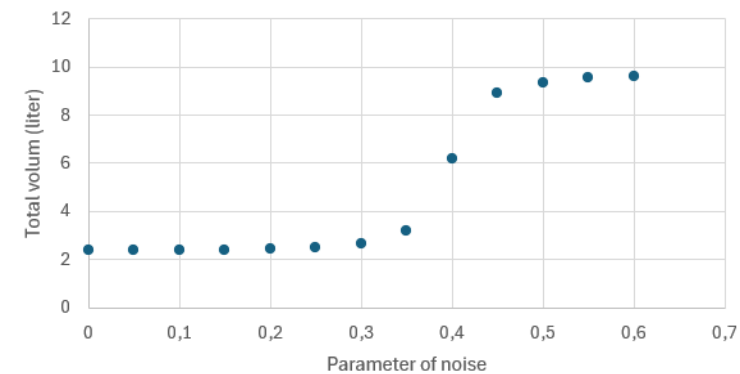
Add of the pepper noise - influence on labeling & mask creation

Influence of noise on Parameters and Visualization

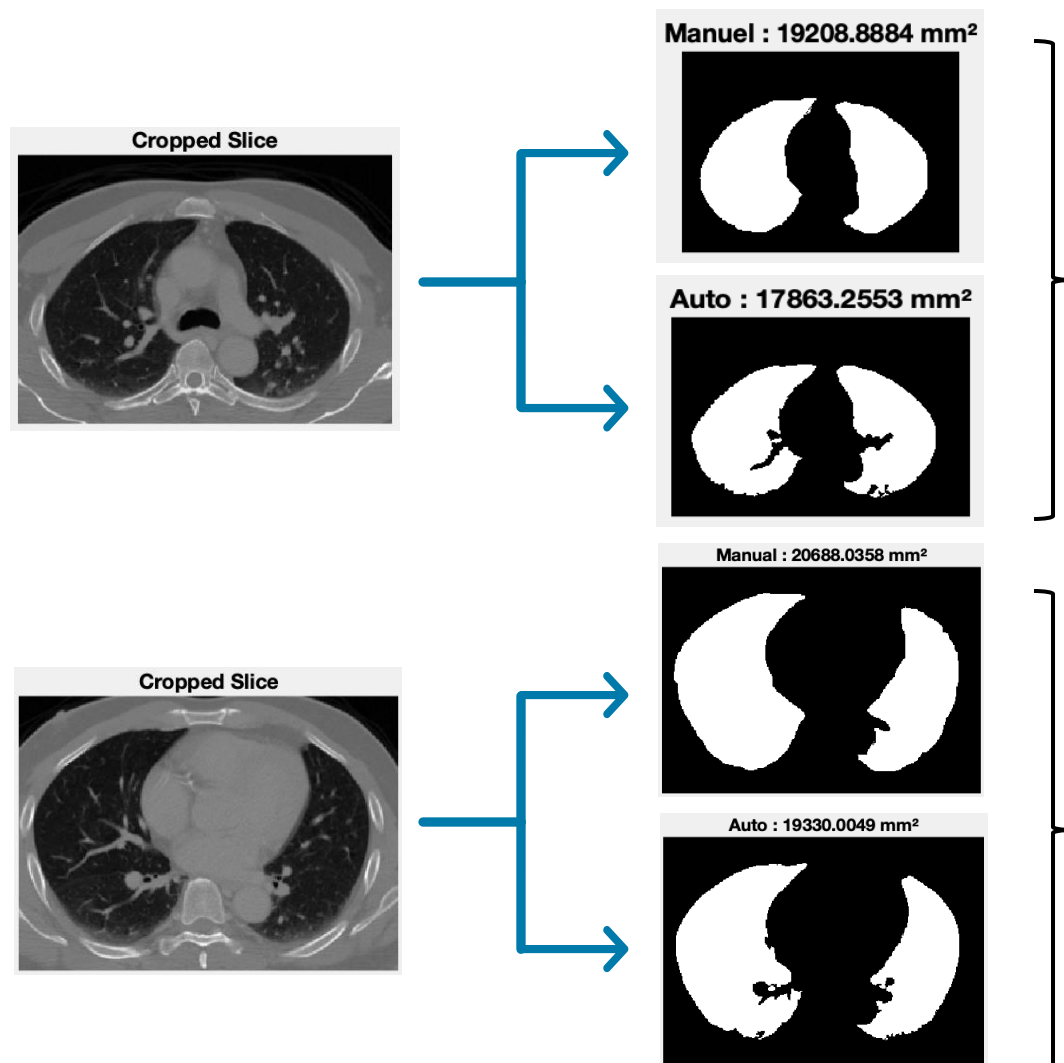


3D reconstruction

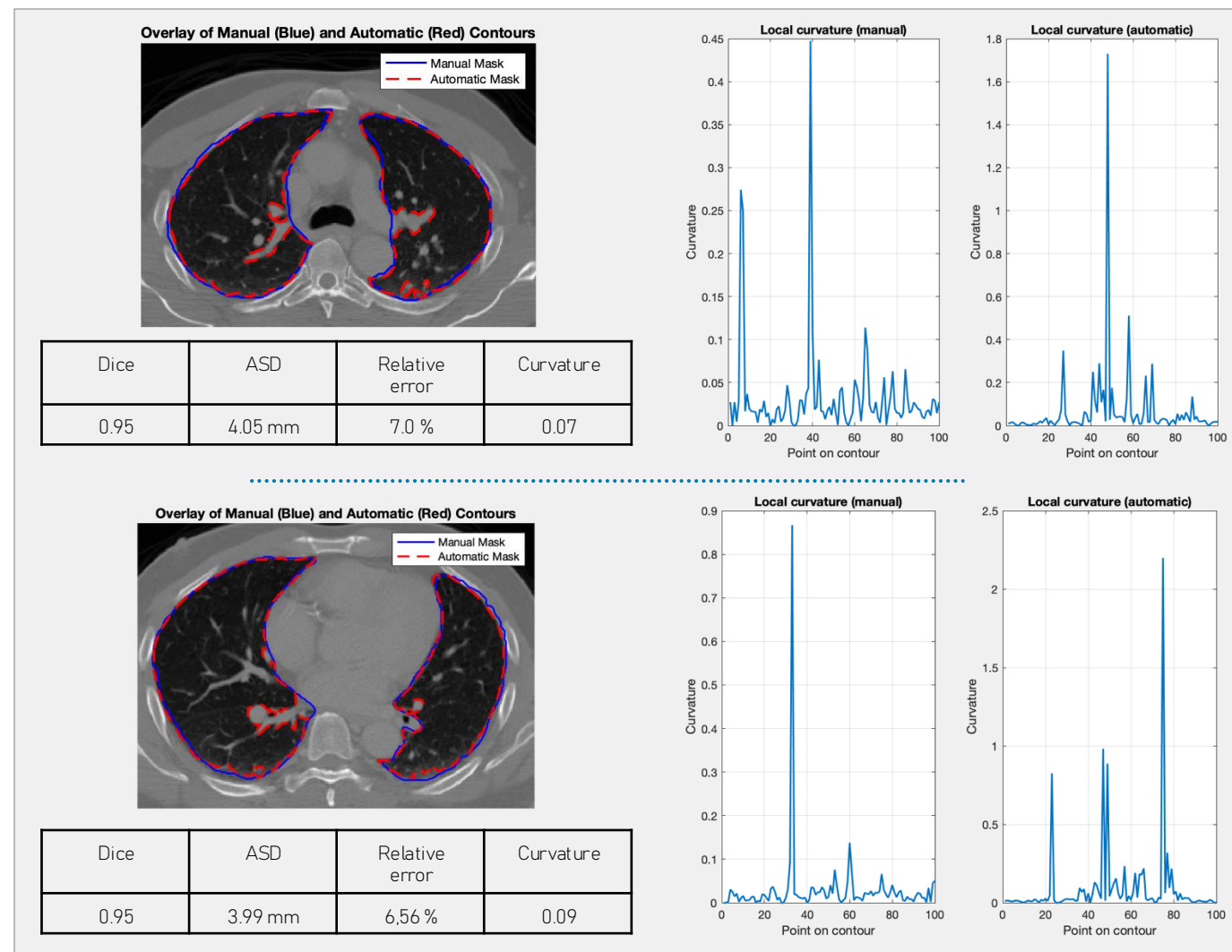
Volume results after salt and pepper noise



4. Manual VS Automatic Segmentation : Axial

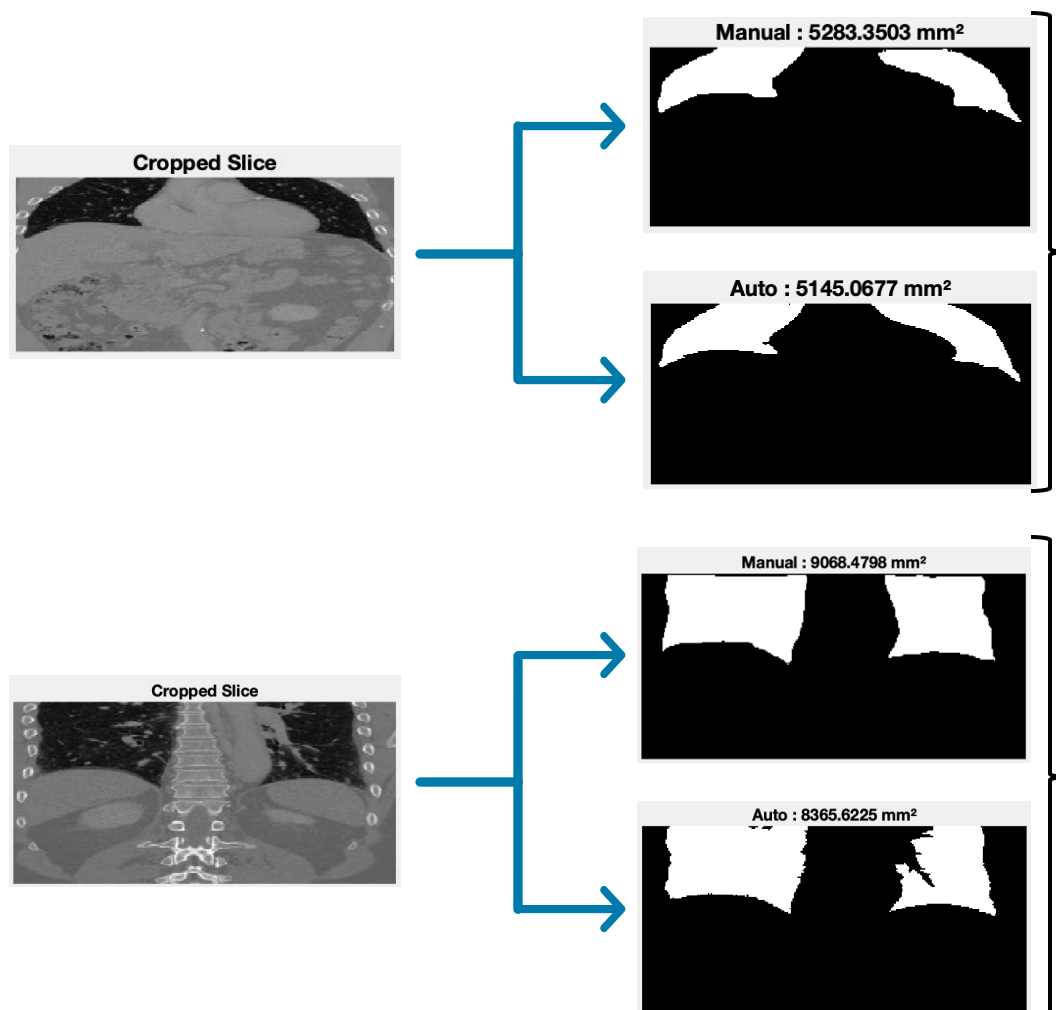


Manual & automatic segmentation

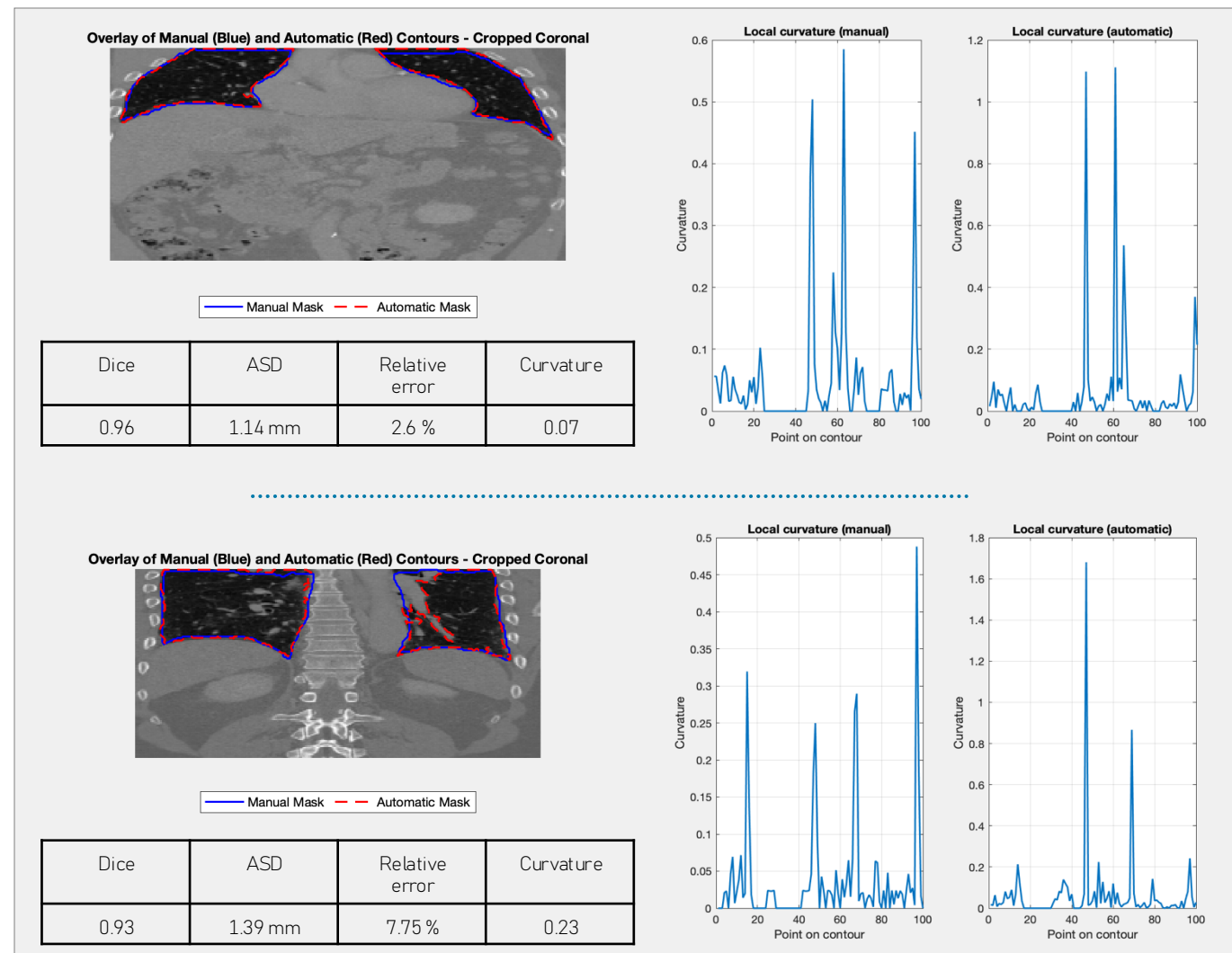


Results of the comparison

4. Manual VS Automatic Segmentation : Coronal



Manual & automatic segmentation



Results of the comparison

The results show that...

Lung Segmentation

Possible machine learning approach

Manual VS automatic segmentation highlights edge errors

Different types of noise have a different mechanism

Interesting to compare the segmentations on diseased lungs

Adding noise increases the area and volume of the detected lungs

Coherent segmentation results for the axial and coronal slices



References

- [1] S. Candemir & S. Antani, "A review on lung boundary detection in chest X-rays". *Int. J. Comput. Assist. Radiol. Surg.*, vol. 14, no. 4, pp. 563-576. April 2019.
- [2] A. Mansoor & al. "Segmentation and Image Analysis of Abnormal Lungs at CT : Current Approaches, Challenges, and Future Trends". *RadioGraphics*, vol. 35, no. 4, pp. 1056-1076. July 2015