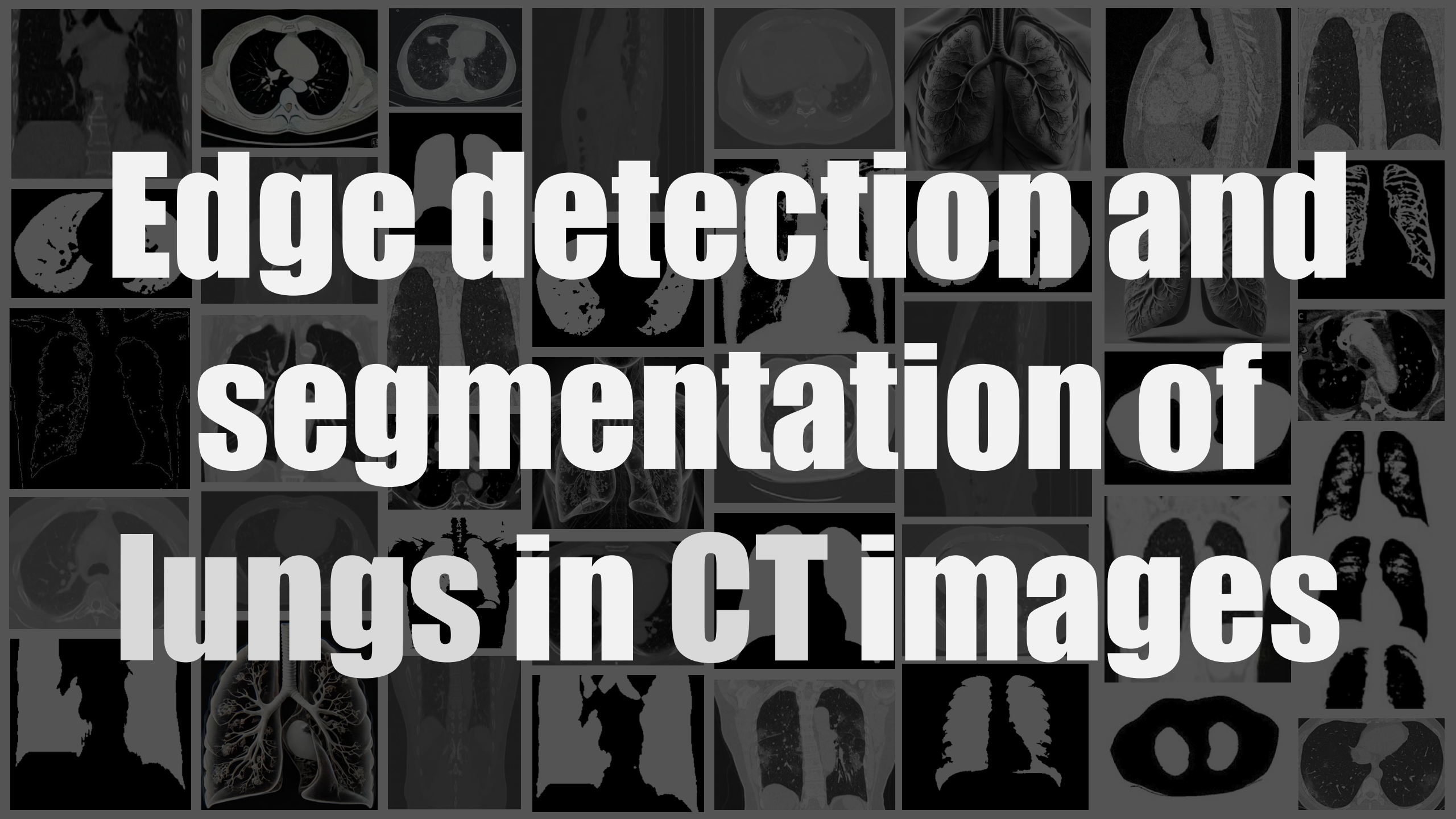
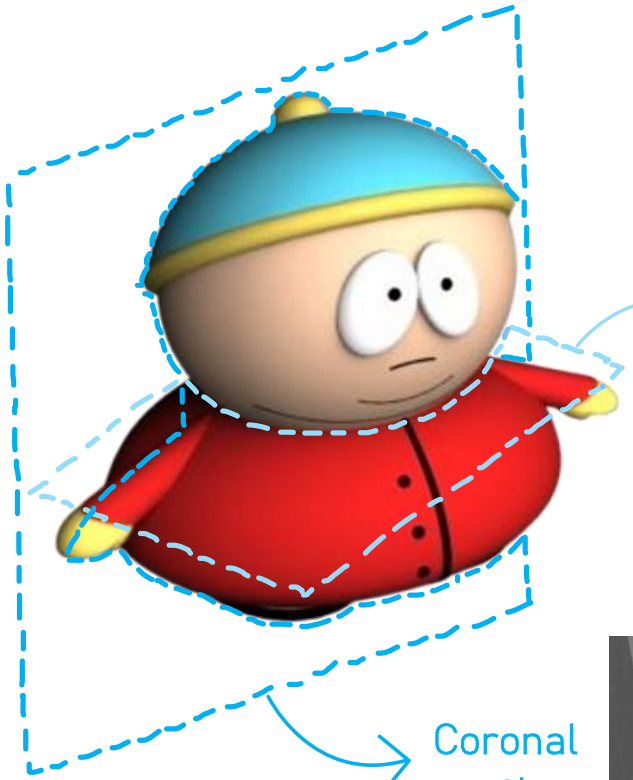
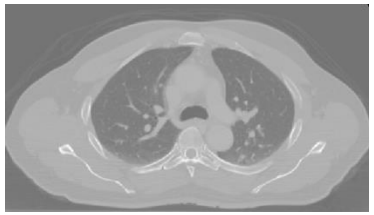

Edge detection and segmentation of lungs in CT images

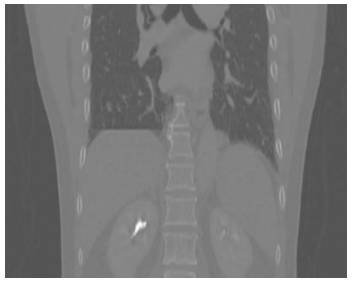
Challenges of lungs segmentation





Axial section

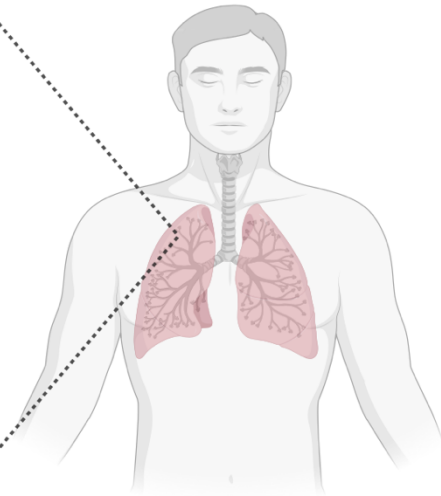
Coronal section



- Lung segmentation difficulties -

- Variability in lung shape and margins

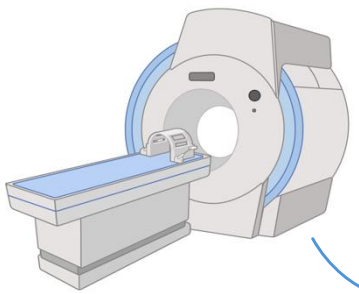
Due to...
- Pathology
- Imaging methods
- No universal solution



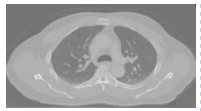
NEED FOR IMPROVEMENT...

General steps

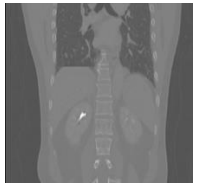
1. CT scan



Axial

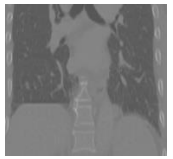


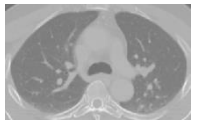
Coronal



2. Processing

Visualization & selection of slices





ROI Definition

Pre-processing

Binarization

Labeling

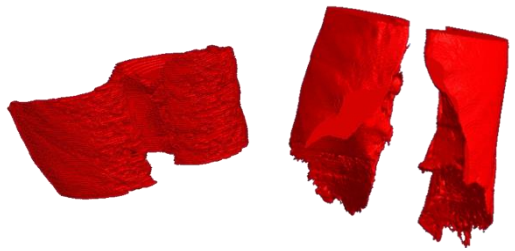
Mask creation

Segmentation

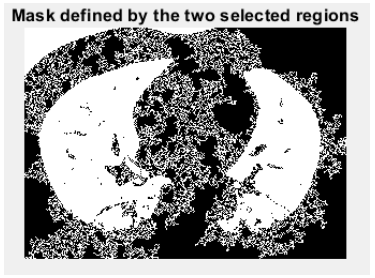
Calculations

Dimensions ↔ Volume

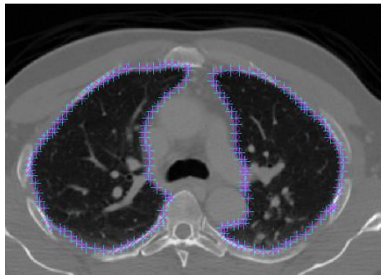
Visualization



3. Noises addition

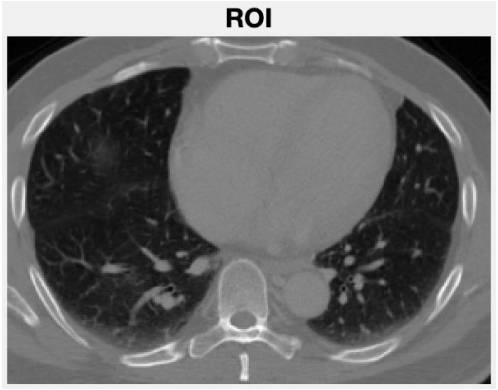


4. Manual VS Automatic segmentation

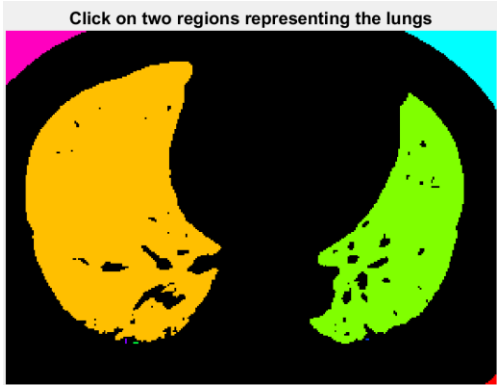


2. Segmentation of the axial slices

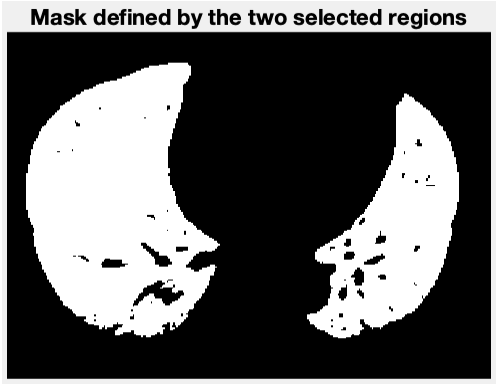
Definition of the ROI



Binarization + Labeling

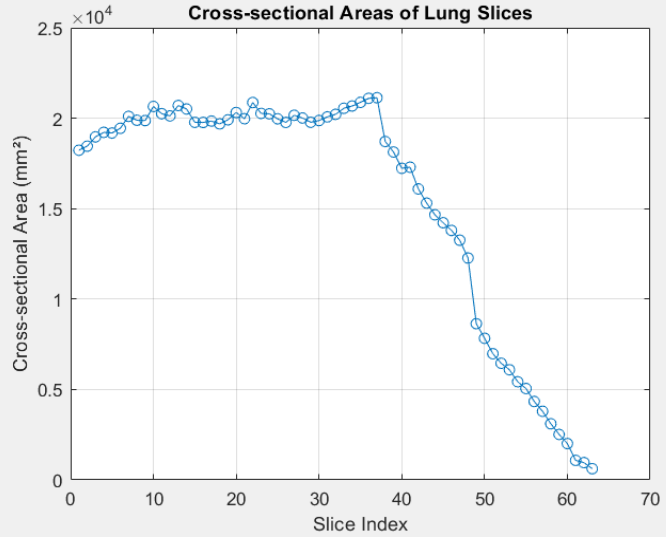


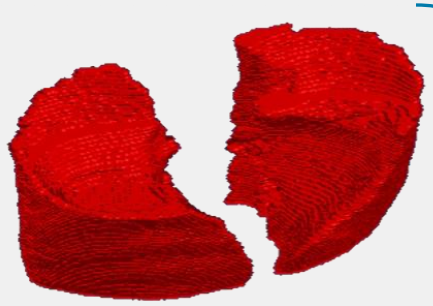
Creation of the mask



Segmentation

Parameters and Visualization



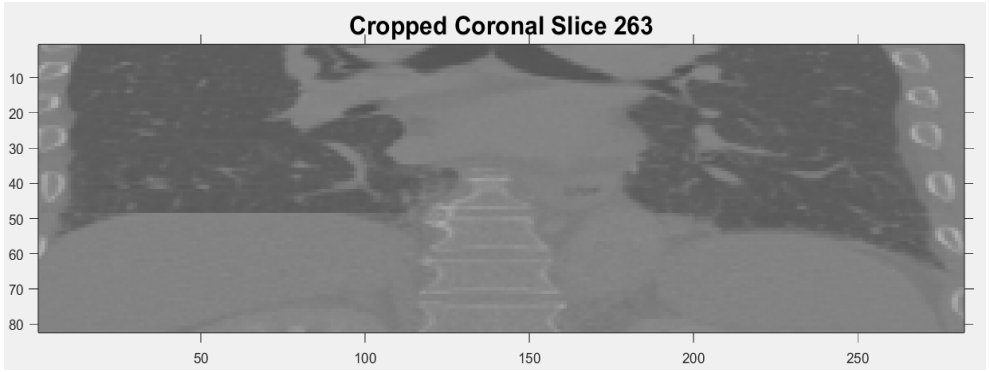


3D reconstruction

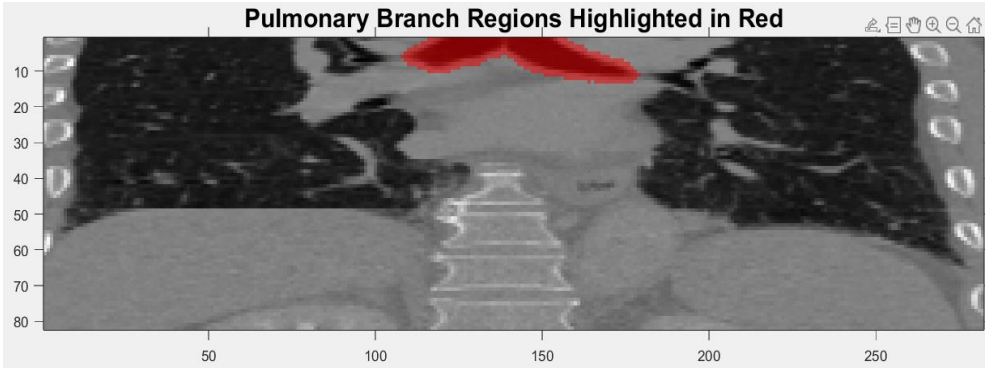
Parameters	Value
Largest cross-sectional area	20560.24 mm²
Height	15.75 cm
Volume	2.41 L

Metrics calculated

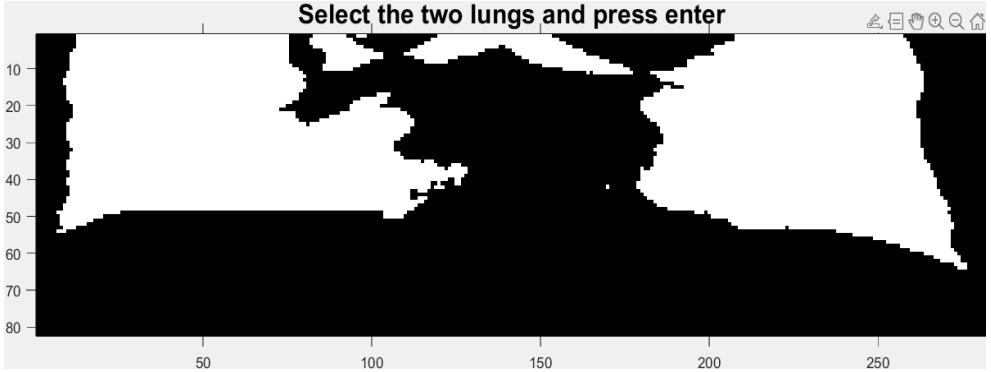
2. Segmentation of the coronal slices



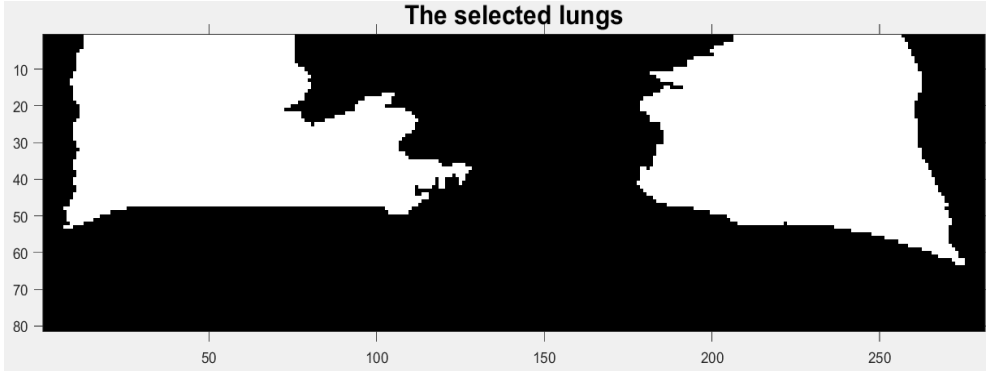
Identification of the bronchi



Binarization



Creation of the mask



Segmentation

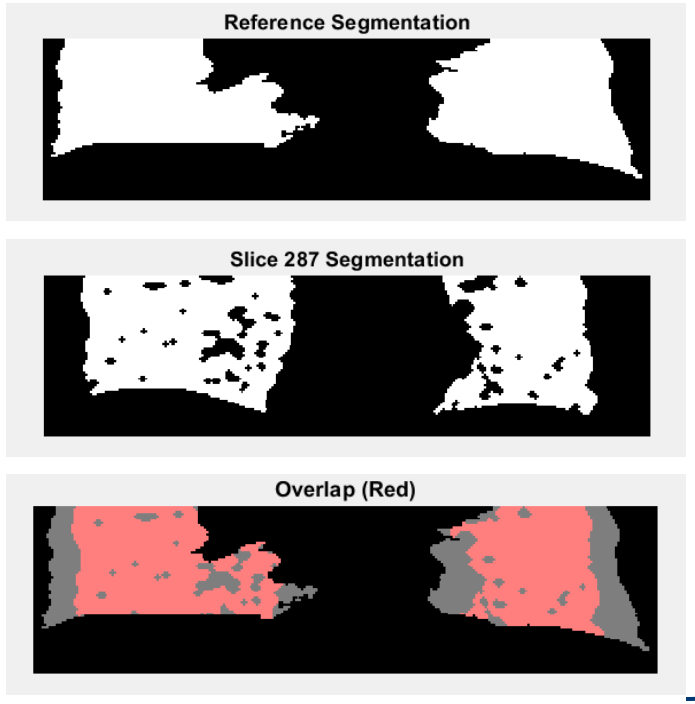
2. Segmentation of the coronal slices

Progress of segmentation

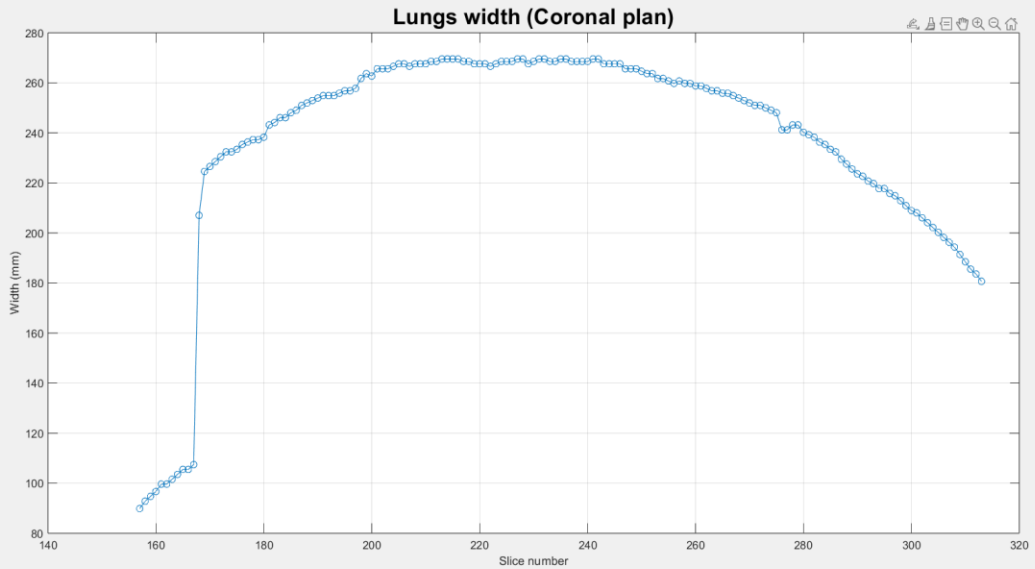
- Lungs are visible between slices 157 - 313

Loop between those slices

- Condition on the area
- Condition on the overlap region



Parameters and Visualization

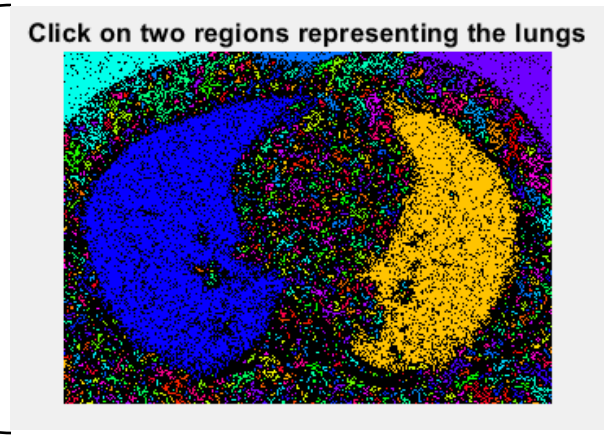
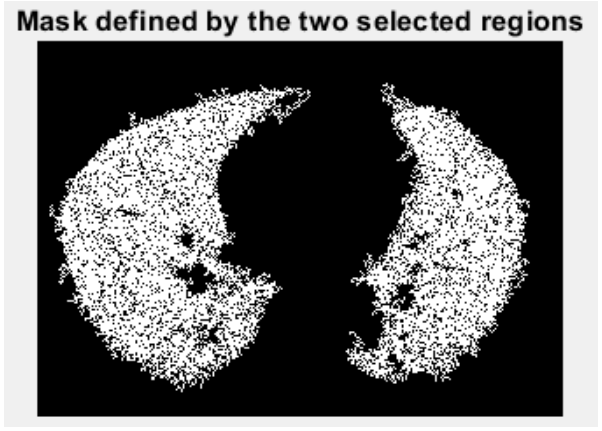
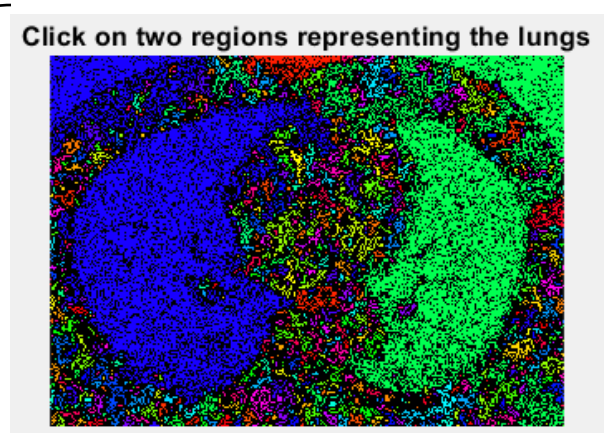
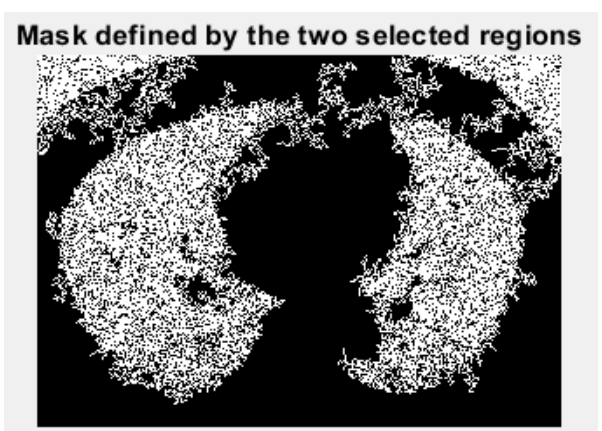


3D reconstruction

Parameters	Value
Height	7.91 cm
Volume	2.02 L

Metrics calculated

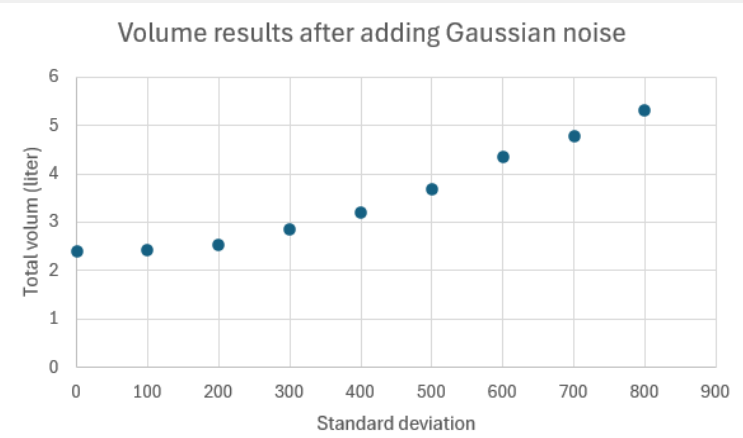
3. Noise add : Gaussian noise

	Labeling	Mask
Standard Deviation 500		
Standard Deviation 750		

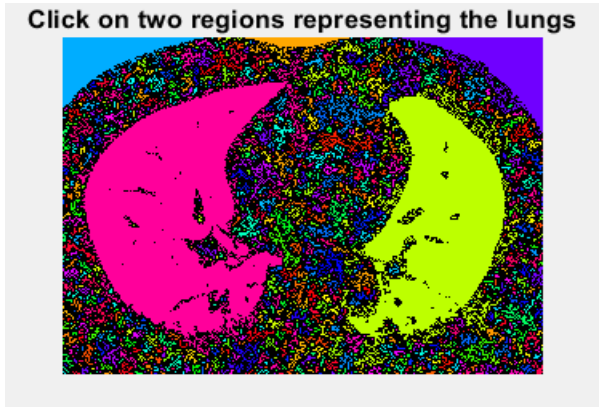
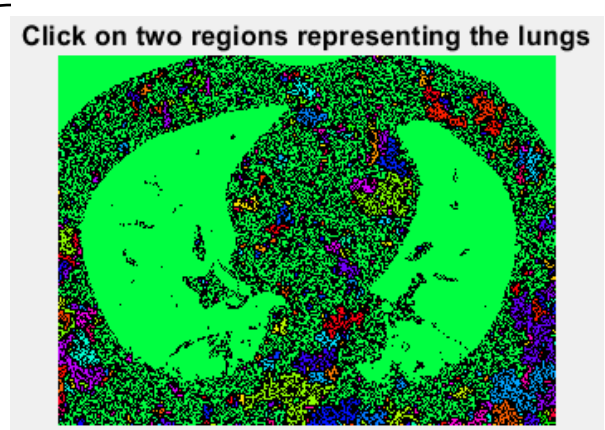
Add of the gaussian noise – influence on labeling & mask creation

Influence of noise on Parameters and Visualization

3D reconstruction

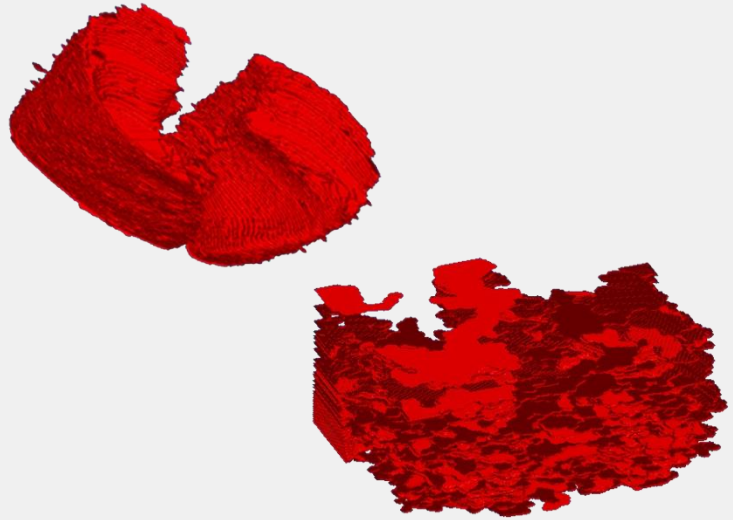


Noise add : Salt and pepper noise

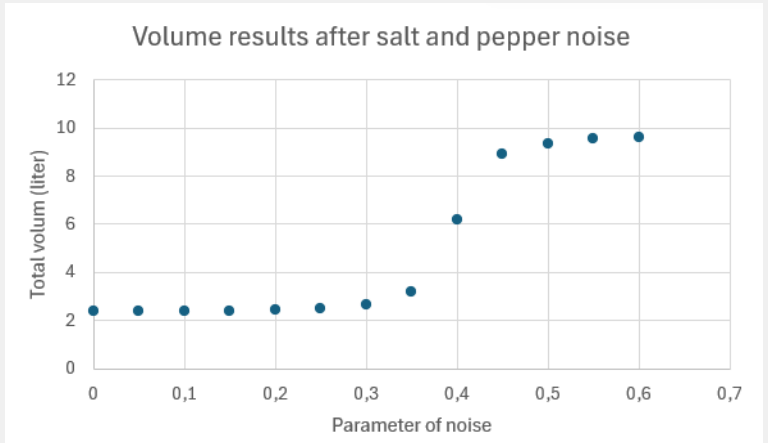
	Labeling	Mask
density 0,2		
density 0,4		

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

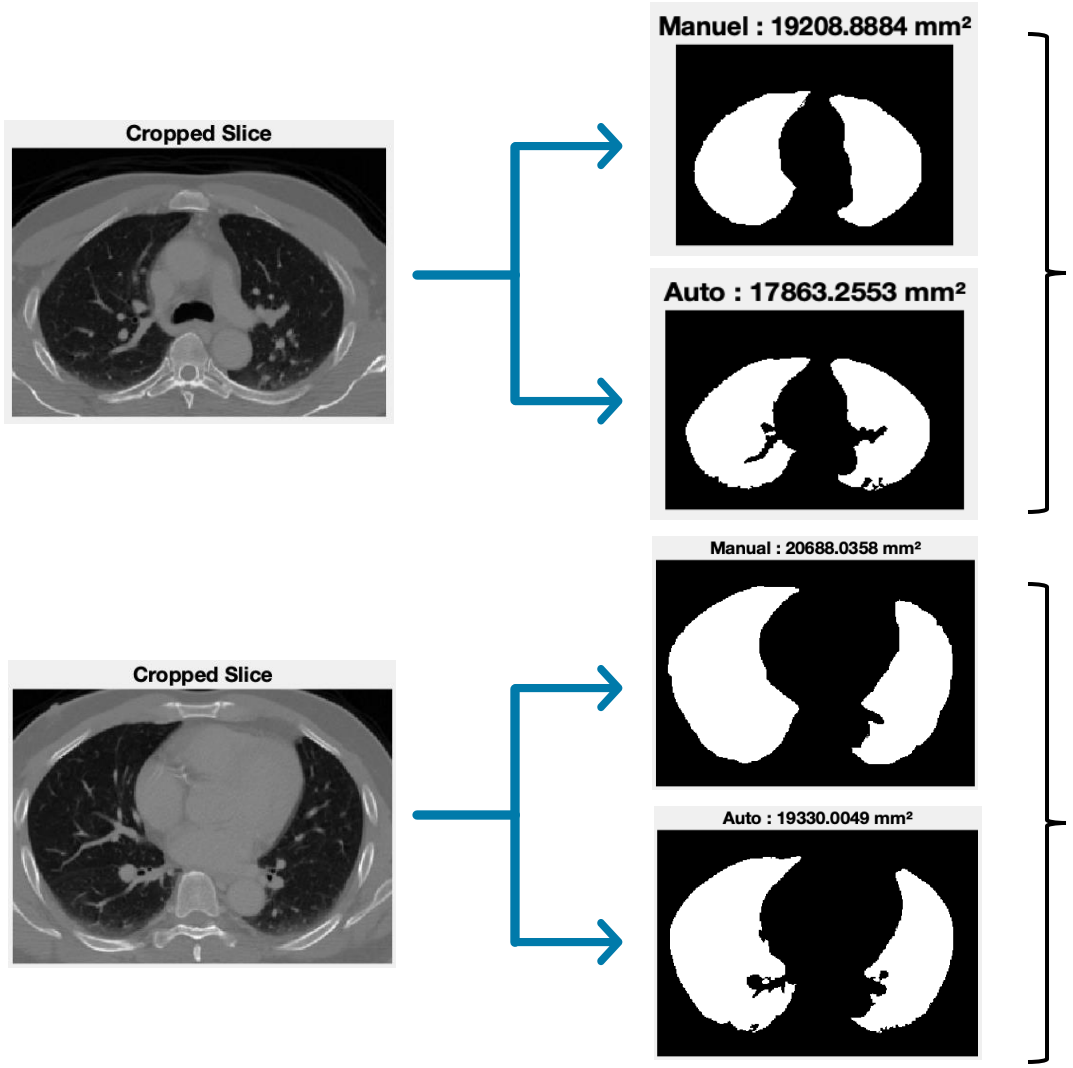
Influence of noise on Parameters and Visualization



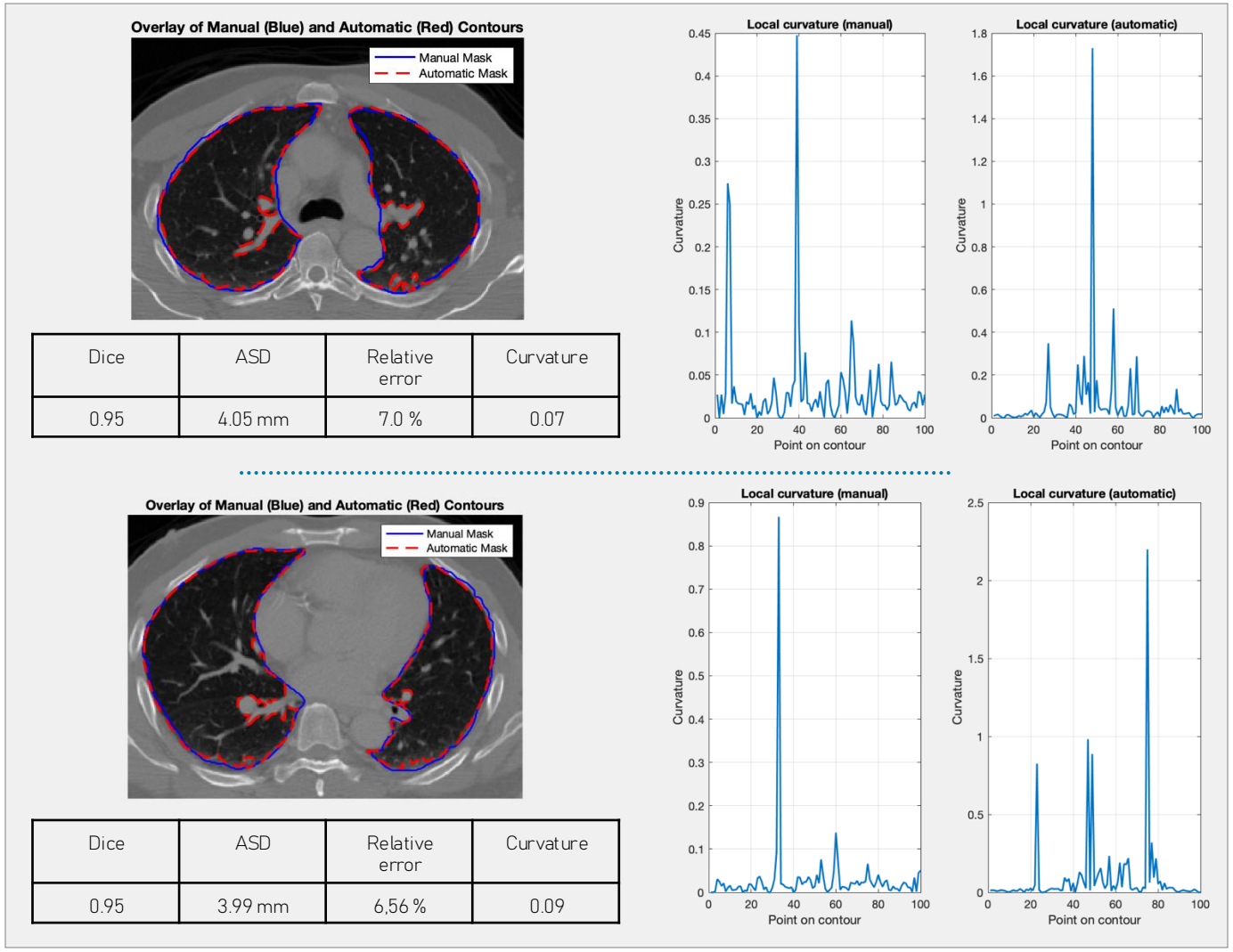
3D reconstruction



4. Manual VS Automatic Segmentation : Axial



Manual & automatic segmentation

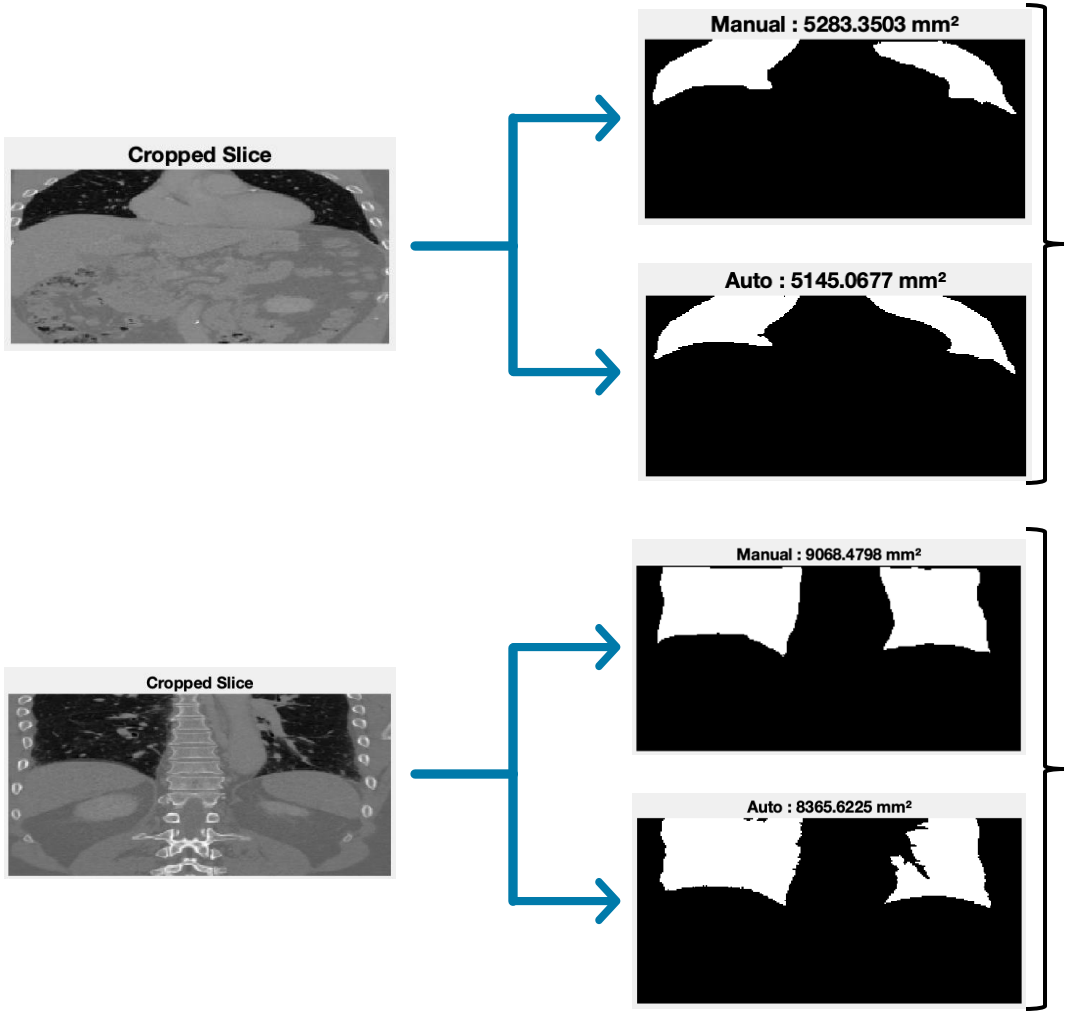


Dice	ASD	Relative error	Curvature
0.95	4.05 mm	7.0 %	0.07

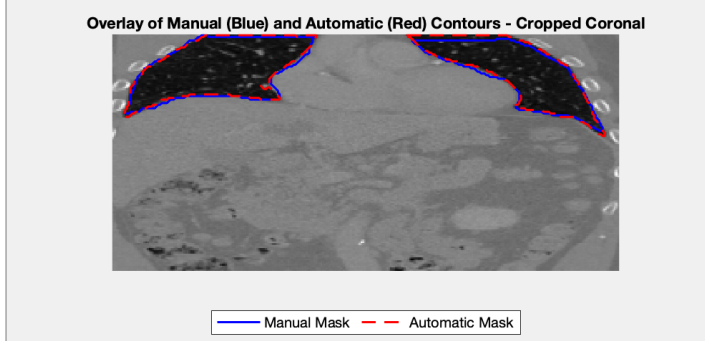
Dice	ASD	Relative error	Curvature
0.95	3.99 mm	6,56 %	0.09

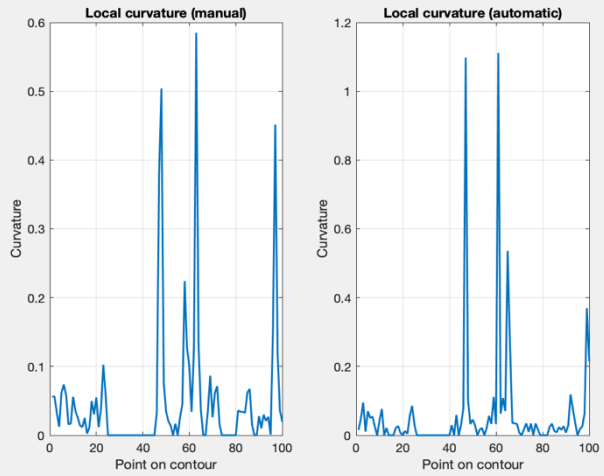
Results of the comparison

4. Manual VS Automatic Segmentation : Coronal

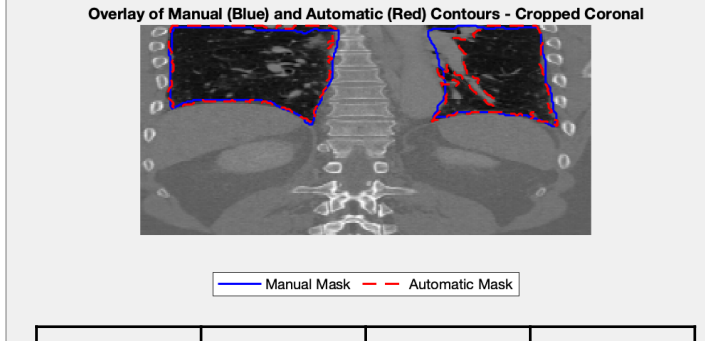


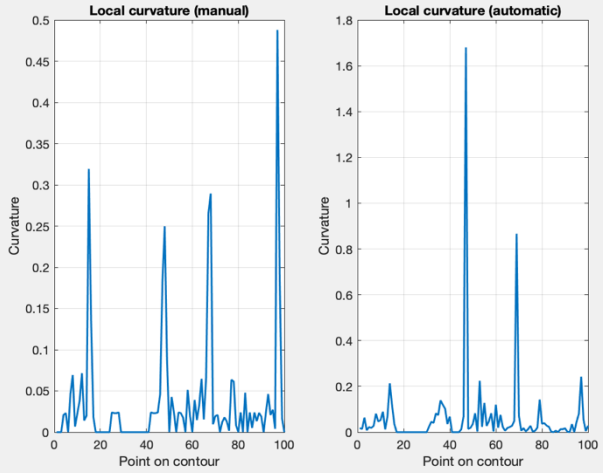
Manual & automatic segmentation





Dice	ASD	Relative error	Curvature
0.96	1.14 mm	2.6 %	0.07

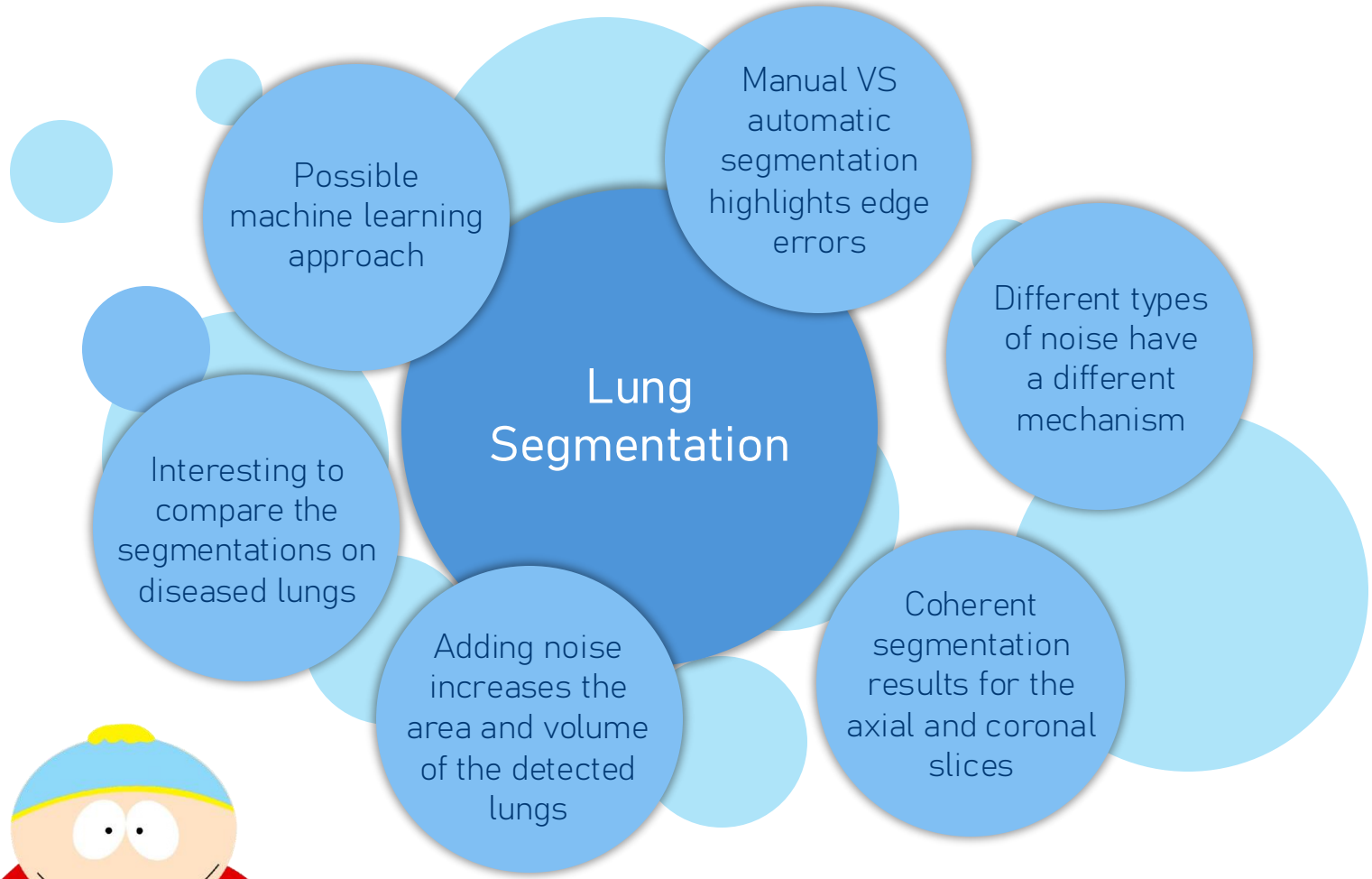




Dice	ASD	Relative error	Curvature
0.93	1.39 mm	7.75 %	0.23

Results of the comparison

The results show that...



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