

EP05.14 : Automatic segmentation and volumetric analysis of normal fetal lungs in MRI using a deep learning-based approach

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Background and Objectives

- Manual segmentation on motion-corrupted 2D MRI slices is time-consuming and variable
- Develop an algorithm for automatic fetal lung segmentation and volume estimation
- Benchmark across multiple deep learning models

Dataset and Acquisition

- 193 healthy pregnancies in total acquired from 1,5T GE, SSFSE T2w centered on the fetus
- 98 with good/moderate 3D reconstruction quality
- 20 with excellent 3D reconstruction quality

Methods

- 3DSVRTK motion correction algorithm for 3D volume reconstruction as preprocessing
- DL Segmentation models : nnU-Net and Custom 3D U-Net trained on LUMIERE’s data

- Pretrained DL Segmentation models : SVRTK, SAMMed3D, nnInteractive (promptable)
- Evaluation : Dice score (segmentation) and TLV comparison with Meyers et al, 2018¹ (volumetry)

Results

Deep Learning models	Dice Score ↑	Volume errors (mL) ↓	Inference time ↓
nnU-Net	0.93 ±0.02	10.57 ±10.71	<10s
3D U-Net	0.91 ±0.04	15.43 ±11.6	<10s
SVRTK (3D-reconstructed data)	0.98 ±0.01	11.99 ±11.09	<10s
nnInteractive (non-reconstructed data)	NA	11.28 ±11.3	15s + 3min of manual refinement
SAMMed3D	0.67 ±0.17	27.01 ±17.68	2-3 min

Conclusion

- SVRTK and nnU-Net achieved the highest segmentation accuracy
- Accurate volume estimation is possible even without successful 3D reconstruction with nnInteractive
- Extension to CDH and clinical workflows

¹ Meyers et al, Fetal lung volumes by MRI: normal weekly values from 18–38 weeks’ gestation, 2018

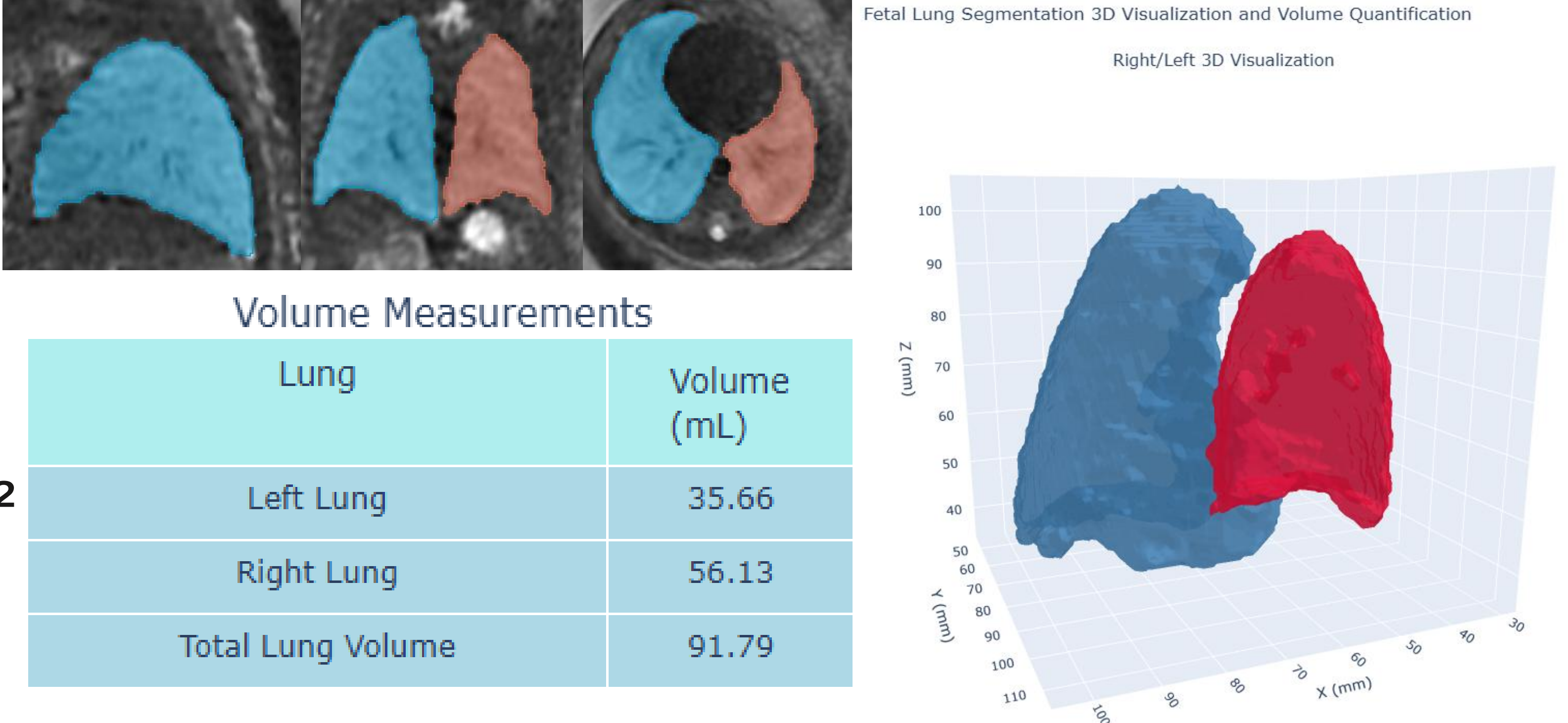


Figure 1. Lung Segmentation example performed with nnU-Net on 3D-reconstructed LUMIERE’s data and volume measurements (GA=33 weeks)

