

EP05.50. Artificial intelligence-based detection of fetal structures in first-trimester ultrasound using novel imaging approaches

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Introduction

Congenital anomalies contribute substantially to fetal morbidity and mortality. First trimester anomaly screening (FTAS) with two-dimensional (2D) ultrasound (US) is operator-dependent and time-intensive. While three-dimensional (3D) US enhances visualization, automated multi-organ detection in early pregnancy remains lacking.

Methods

Population: 3D US scans from 100 first-trimester pregnancies (11⁺⁰–14⁺⁶ weeks) of the VR FETUS study.

Annotation: Twelve fetal structures using virtual reality:

- Full segmentations: stomach, kidneys, bladder,
- Landmarks: choroid plexus, cerebellum, orbits, nasal bone, upper lip, mandible, heart, lungs, spine.

Atlas-derived segmentations: Landmark annotations are used to guide atlas-based registration, generating segmentations (micro-CT scans of the Dutch Fetal Biobank; INTERGROWTH-21st brain atlas) (see **Figure 1**).

Model training: Segmentations are used to train a deep learning detection model (80%/20% train-test split).

Evaluation: Performance assessed by detection rate (%) and mean Euclidean distance from annotations to prediction (mm).



Aim

Develop a deep-learning model that automatically detects multiple fetal structures in first-trimester 3D US scans

Results

Detection performance: 9/12 structures were detected in 100% of test cases; lower rates were observed for the nasal bone (67%), upper lip (83%), and stomach (95%).

Localization accuracy: High, with mean distances of 0.3-1.9 mm. The spine showed the lowest accuracy. Representative predictions are shown in **Figure 2**.

Conclusion

We introduce a novel, fully automated deep learning approach for multi-structure detection in first-trimester 3D US.

Our method achieved high detection and localization performance across most fetal structures.

Further validation needed in larger and more diverse cohorts, including anomalies.

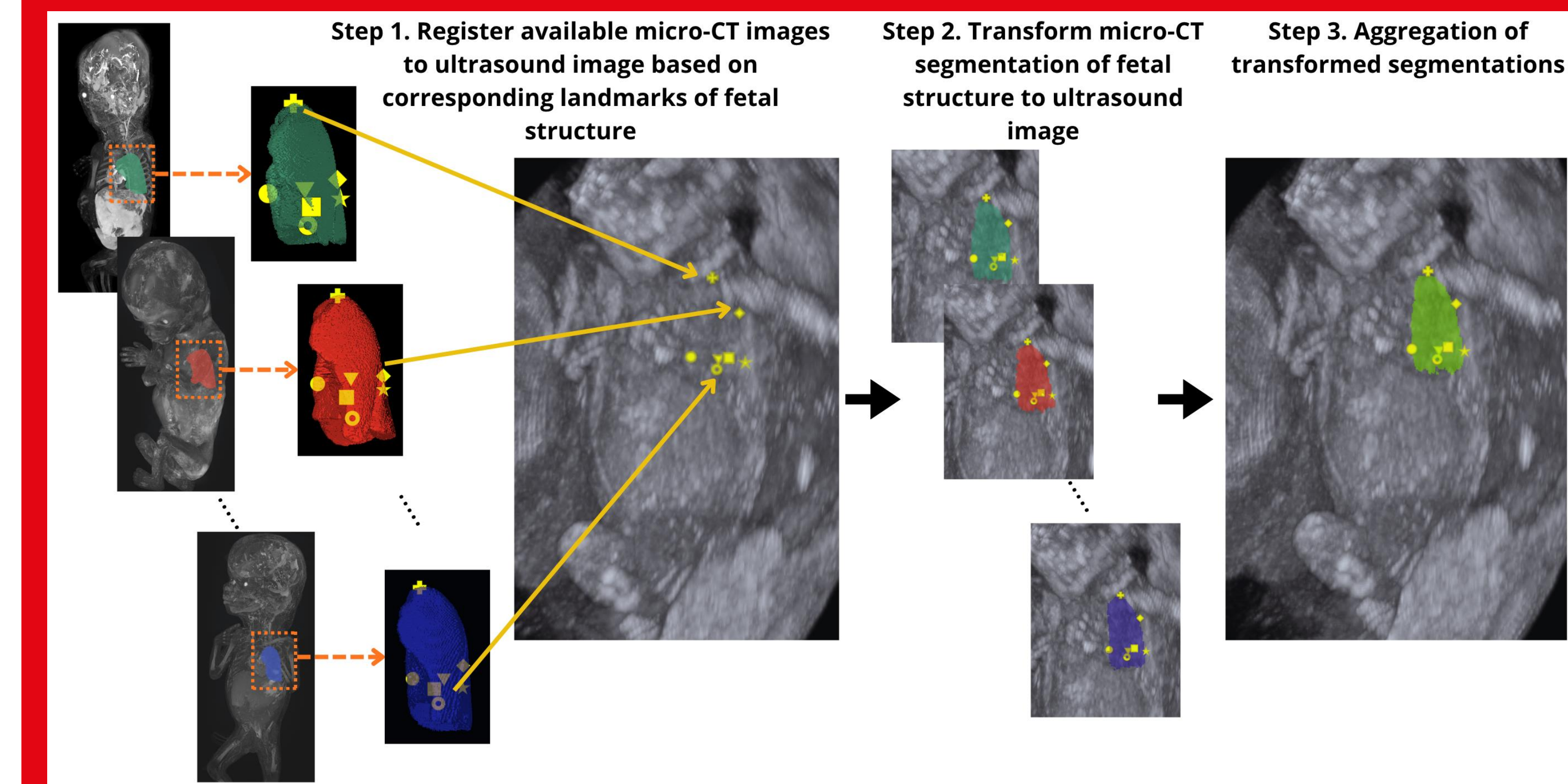


Figure 1. Generation of atlas-derived segmentation for the left lung.

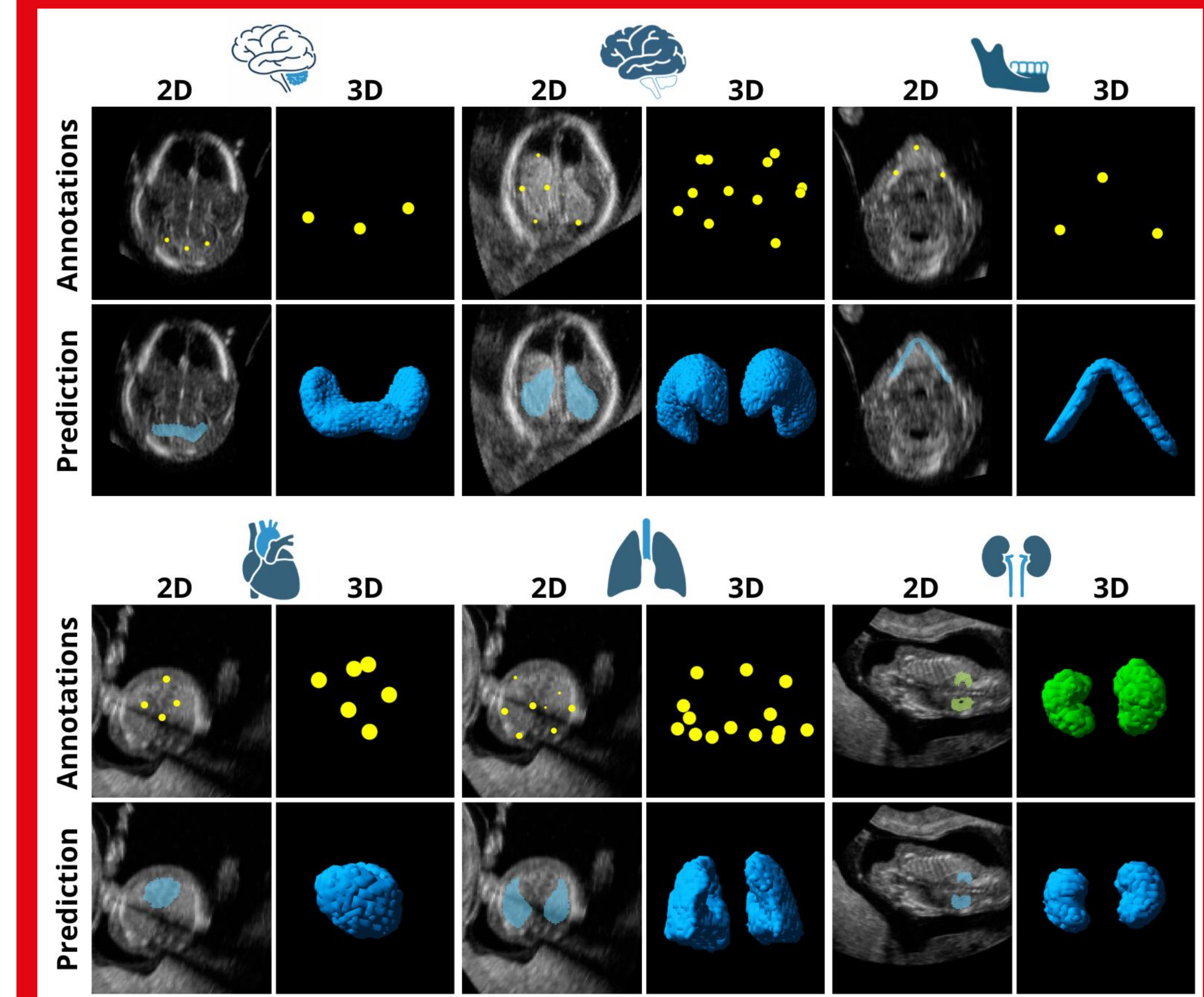


Figure 2. Annotations and predictions for several fetal structures in a 12-week-old fetus. Per structure (icon): 2D slices (left) and 3D renderings (right)