

Development of a machine learning model for estimation of amniotic fluid index using blind ultrasound sweep videos in the third trimester of pregnancy

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Clinical Background

Amniotic Fluid Index (AFI) is a key measure of fetal well-being. Abnormal AFI levels can lead to complications:

Oligohydramnios (low AFI **<5 cm**) — linked to growth restriction, stillbirth, and labor issues

Polyhydramnios (high AFI **>24 cm**) — associated with preterm labor and placental problems

Motivation

Accurate estimation of **Amniotic fluid index (AFI)** requires trained personnel and high cost ultrasound (US) machines. Automating AFI assessment using blind sweeps using portable low cost probes and machine learning could improve access to prenatal care in low resource settings.

Objective

The aim is to automate AFI estimation using machine learning(ML) from blind US sweep videos.

Methodology

- Workflow: The two-stage workflow consisted of 1.Identification of amniotic fluid pockets in blind US sweep videos using an object detection model (YOLO11) and segmentation (Otsu’s threshold method), 2. Compute the area of these pockets on 200 random frames followed by a regression model to predict AFI (Figure 1).

- **Data:** Blind US sweep videos from the participants (N = 290) of GARBH-Ini pregnancy cohort (1), collected using CALOPUS protocol (2).
- **Train dataset:** Object detection model is trained on 544 blind sweep videos from varying gestational ages. 17 radiologist-annotated videos used for the development of regression model.
- **Test dataset:** 100 blind sweep videos post 30 weeks of gestation were used to validate two-stage modelling pipeline.
- **Evaluation metric:** Model performance was assessed using Root Mean Square Error (RMSE) with 4-fold cross-validation.

Results

- We achieved RMSE of **1.689±2.035 cm** during training with cross validation (*Figure 2*).
- On he test set we achieved RMSE of **3.638±4.993 cm**.

Conclusion

- Machine learning successfully predicted AFI from blind US sweep videos.
- **Clinical utility:** The model has potential to assist in diagnosing oligohydramnios and polyhydramnios, especially in resource-limited settings.

References

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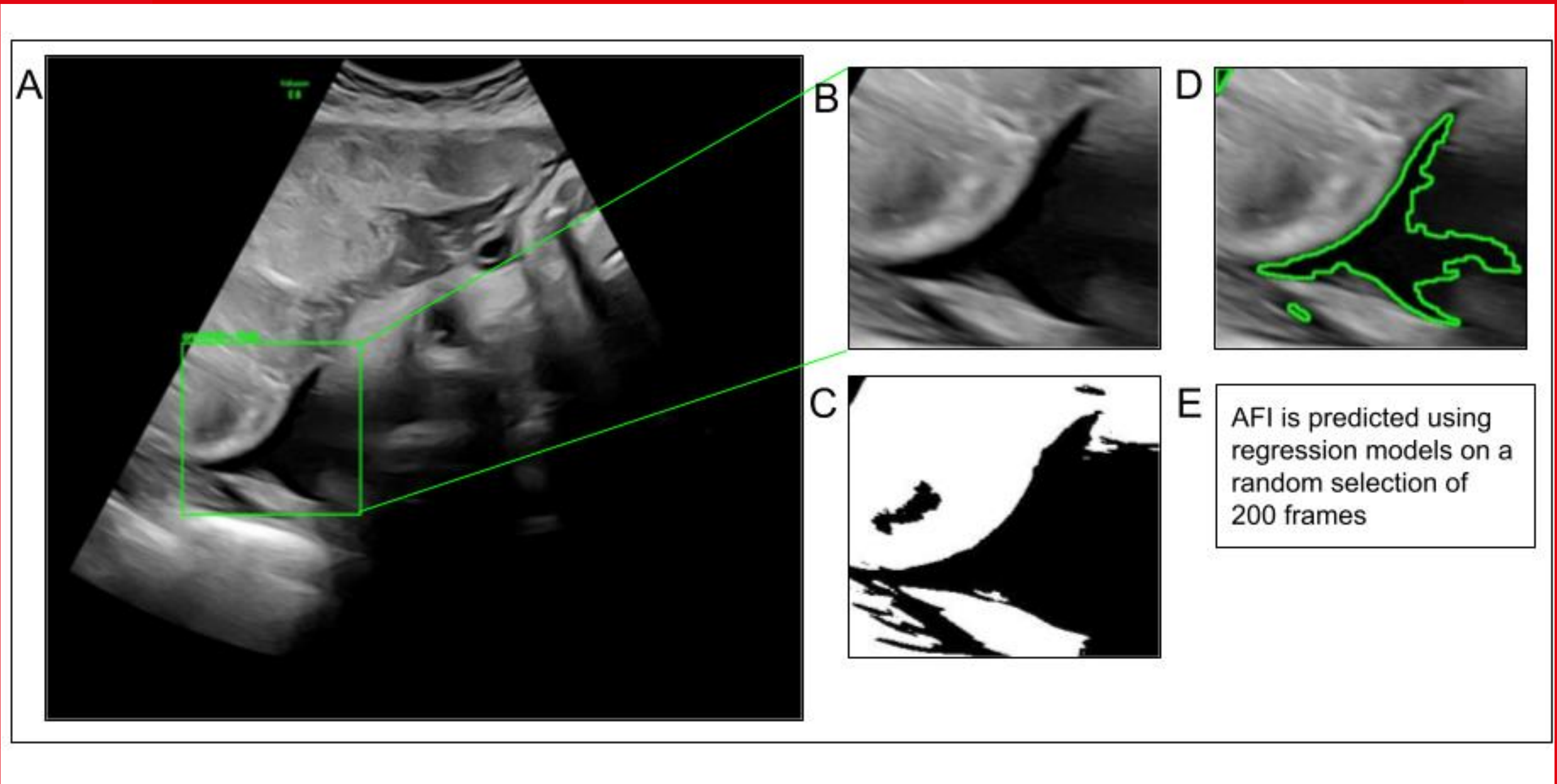


Figure 1: Two-Stage Model Output on a Sample Frame

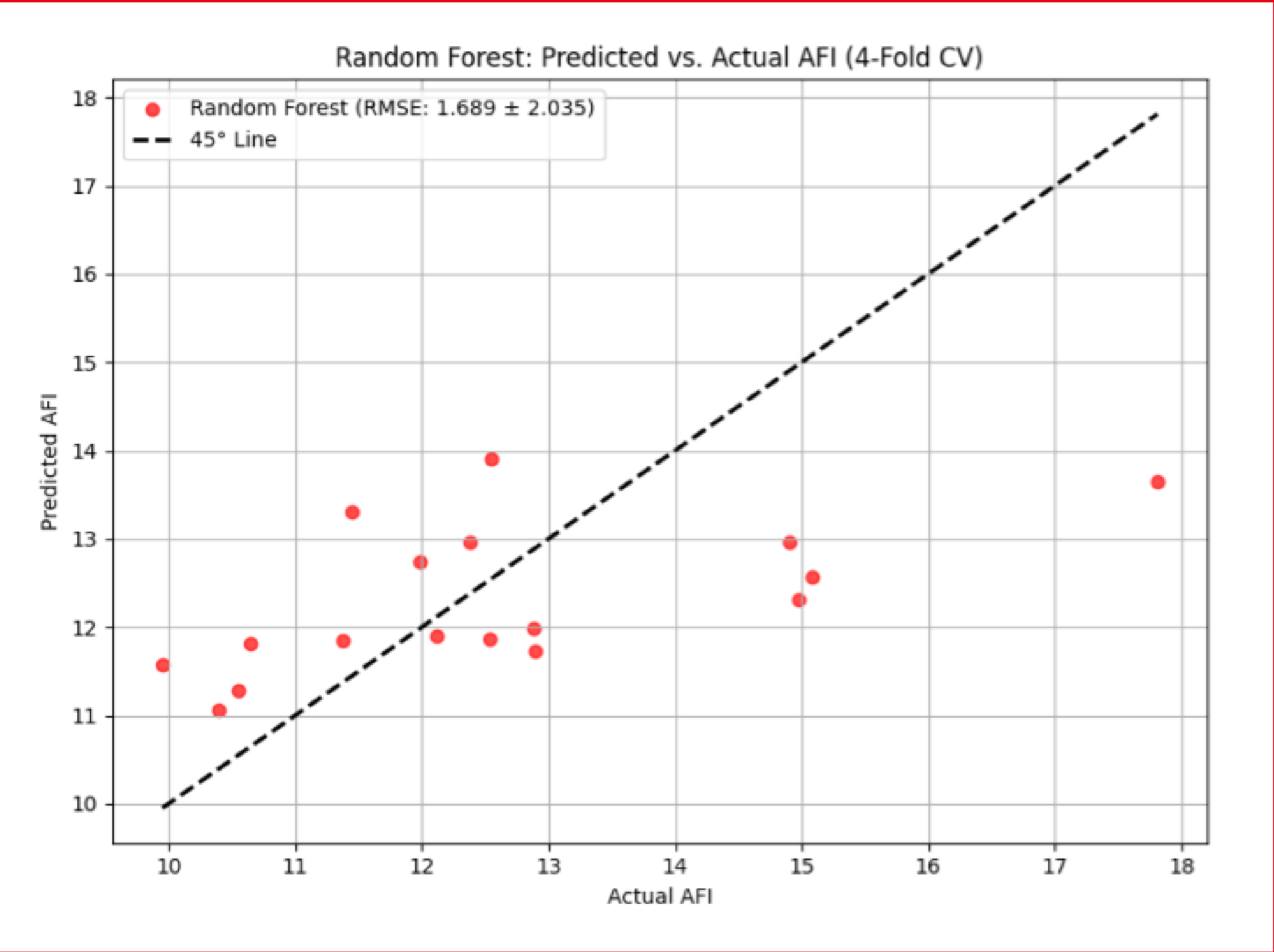


Figure 2: Predicted versus ground truth amniotic fluid index (AFI) values , with the line of identity (y=x) indicating perfect agreement.