Automatic extraction of FASP biometrics from 2D antenatal ultrasound scans

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Biometric estimates

Measurements are part of routine US screening examination offered in every pregnancy. Standard biometrics (head circumference, femur length, etc.) are used for screening and dating of pregnancies.

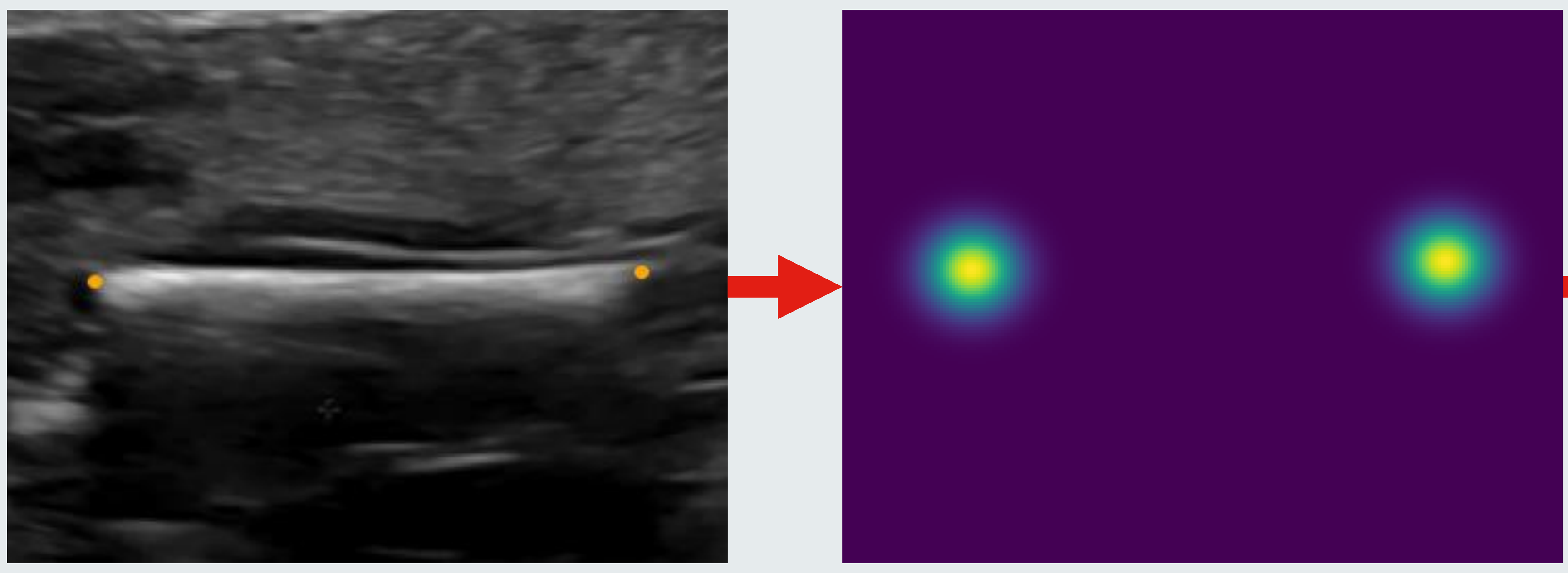
In NHS:

7 required measurements [1]
Each acquired 3x
Taking approx. 35% of scan time [2]

Observer bias also affects results and leads to measurements closer to the expected value [3].
Automating these measurements can save sonographer time and improve biometric accuracy.

Methods

We manually extract biometric measures (like femur endpoints) from recordings of 2000 ultrasound examinations. Human sonographers generate the training labels to FASP standard.



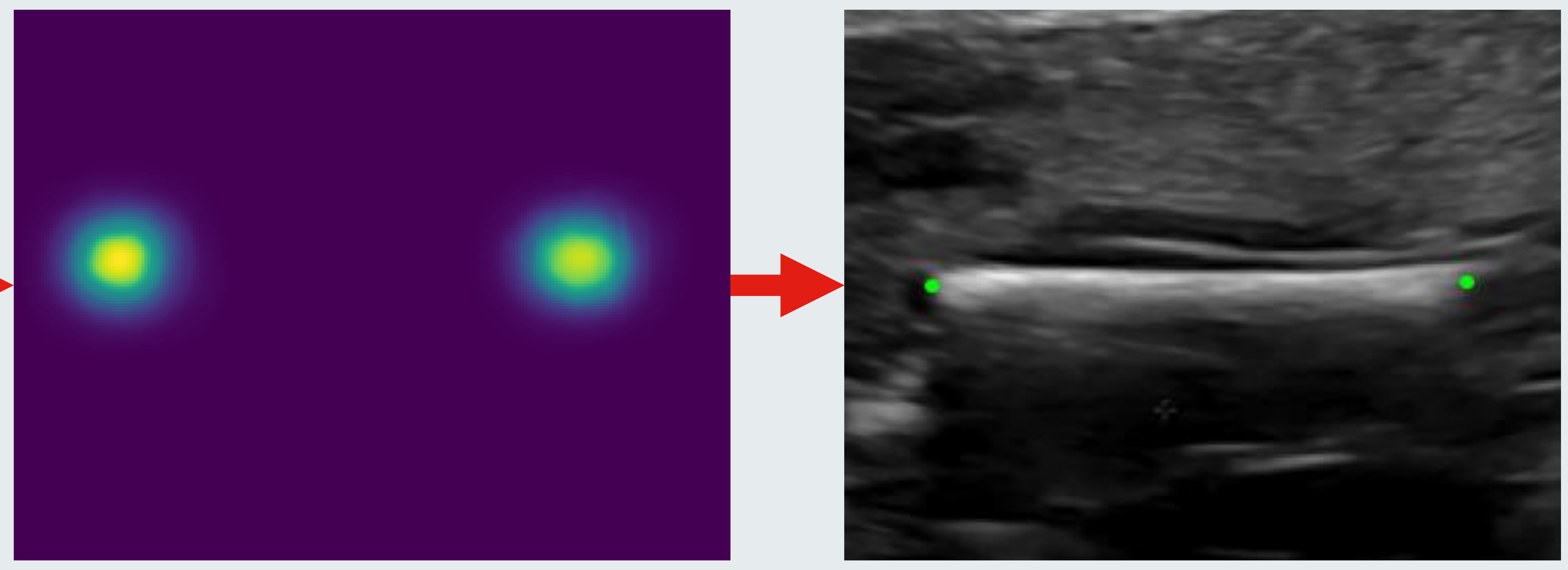
We encoded these as 2D Gaussian masks centered on the point and trained a U-Net based neural network [4] to predict this mask from each image in a scan identified as the correct plane.

The maximum of each predicted Gaussian function is then extracted and used as the predicted annotation and the length is measured between the predicted endpoints.

We used a similar approach for other biometrics, such as abdominal circumference or biparietal diameter. For elliptical biometrics, a mask of the ellipse serves as the training label.

Results

Measurements can be extracted for over 70% of frames identified as “femur”. Similar rates can be found for other biometrics. Across the test set, the predicted endpoint are a close match for sonographer annotations.



A high level of consistency is found between measurements of the same biometric in different frames of a scan, and between our automatic measurement and human expert measures.

Structure	Std. error	error vs human
Head	1.6%	1.6%
Abdomen	1.7%	2.4%
Femur	2.0%	1.8%

[1] Public Health England, NHS Screening Programmes Fetal anomaly screening programme handbook for ultrasound practitioners, 2015.
[2] Matthew, J, et al. Exploring a new paradigm for the fetal anomaly ultrasound scan: Artificial intelligence in real time. Prenatal Diagnosis, 2022.
[3] Drukker, L., et al. Expected-value bias in routine third-trimester growth scans. Ultrasound in Obstetrics & Gynecology, 2020.
[4] Ronneberger, O., et al. U-net: Convolutional networks for biomedical image segmentation. *MICCAI* 2015.

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