

Referen- -ce	Author	Publication year	Echo views	AI Model	Dataset	Heart chamber	Ground truth	Performance/accuracy method
<b>Low level processing-based methods</b>								
1	Melo SA et al	2010	Apical 4 chamber views	Low level processing: Watershed algorithm	Echo images of 12 healthy individuals	LV	Manual contour tracing by cardiologist	cross-correlation coefficient (CCC) $0.985 \pm 0.011$ for high quality images, root mean squared distance (RMSd) , percent error (PE) and error sum (ES)
2	Dawood FA et al	2011	NA	Low level processing: Thresholding and morphological appearance	Echo images of 10 patients	LV	Manual contour tracing by expert	Pratt's Figure Of Merit (FOM) Similar performance than ground truth
3	Dietenbeck T et al	2014	Parasternal short axis Apical 2-chamber Apical 4-chamber	Low level processing: motion constrained level-set	15 echo sequences (5 per view) from 11 healthy individuals 290 frames from PSA, 300 frames of A2C, 300 frames of A4C views	LV	Manual contour tracing by 2 experts	NA
4	John, A et al	2014	Apical 4 chamber views	Low level processing: phase symmetry approach and levelset segmentation algorithm (To remove the speckle noise, Speckle Redusing Anisotropic Diffusion(SRAD) filter is used)	NA	All four chambers	NA	NA

## Deformable-based methods

5	de Alexandria AR et al	2014	parasternal short axis	Deformable model: active contouring (pSnakes algorithms)	Echo images from 17 patients (total of 34 echo images)	LV	Manual contour tracing	RMS (radial maximum error), RMSE (root mean square) and ADPV (average deviation of pixel values)
6	Marsousi M et al	2010	apical 2 and apical 4-chamber views	Deformable Model: Active contouring (adaptive B-Spline snake algorithm)	50 echo images	LV	Manual contour tracing by expert	Dice's coefficient 91.13% for boundary detection accuracy
7	Marsousi M et al	2011	apical 2 and apical 4-chamber views	Deformable Model: Active contouring (B-Spline Snake and Active Ellipse Model)	85 echo images	LV	Manual contour tracing by echo expert	Dice's coefficient 92.30±4.45% for boundary detection accuracy
8	Nandagopalan S et al	2010	Parasternal Long Axis and Short Axis Views Apical 4-chamber view	Deformable model: K-Means Clustering and active contour model	NA	LV	NA	NA
9	Belaid A et al	2010	Apical 4 chamber views	Deformable model: Phase-based level set evolution	20 echo images	LV	Manual contour tracing by 2 experts	dice similarity coefficient and Mean Absolute Deviation showed results close to the ground truth
10	Antunes SG et al	2011	apical 4-chamber	Deformable Model: Phase-based level set evolution	240 echo images	All four chambers	Manual contour tracing by expert	Pixel mean error
11	Alessandrini M et al	2010	Parasternal Short Axis Views	Deformable model: Constrained Level-Sets	Echo images of 5 patients	LV	Manual contour tracing by 2 cardiologists	Mean Absolute Deviation (MAD) = $3.1 \pm 0.5$ pixels and Hausdorff Distance (HD) = $9.2 \pm 2$ pixels. The correlation coefficient was $R = 0.98$

### Statistical-based methods

12	Guo Y et al	2013	Fetal 4-chamber	Statistical model: active appearance model (AAM)	Two Fetal datasets: synthetic and clinical echo images	All four chambers	NA	Segmentation accuracy of 84.12% for synthetic and 84.39% for clinical datasets
13	Vargas-Quintero L et al	2016	Fetal 4-chamber	Statistical model: Active appearance model (AAM)	143 images	All four chambers		average Dice coefficient of 0.8631
14	Zhang Y et al	2015	apical 4-chamber	Statistical model: active shape model (ASM)	simulated and real echo image sequences	LV	NA	NA
15	Zhang Y et al	2014	apical 4-chamber	Statistical model: active shape model (ASM) and ant colony optimization	simulated and real echo image sequences	LV	NA	NA
16	Belous G et al	2013	Apical chamber views	Statistical model: Random Forest and active shape model (ASM)	echo images dataset of 85 patients	LV	Manual contour tracing by expert	Dice metric of 90.09%
17	Li Y et al	2017	Apical 2, 3 and 4chamber views	Statistical model: Random Forest and active shape model (ASM)	Echo images of 21 individuals (total of 242 images)	LV	Manual contour tracing by expert	NA

### Machine learning-based methods

18	Zhou SK et al	2010	apical 4-chamber	Machine learning approach (classification): shape regression machine (SRM)	527 images	LV	Manual contour tracing by sonographer	NA
19	Hansson M et al	2014	apical 2-chamber	Machine learning approach (classification): Bayesian Probability Maps	28 echo images	LV	Manual contour tracing by a senior expert	Contour Average Distance $2.58 \pm 0.85$ mm (compared to ground truth)

20	Guo Y et al	2017	Fetal 4 chamber view	Machine learning approach (classification): Adaptive Group Dictionary Learning	Echo images of 40 fetuses	All four chambers	NA	Mean classification accuracy reached 94.37% compared to other segmentation algorithms (KSVD [11] , LC-KSVD [19] D-KSVD [18] and FDDL [20])
21	Qin X et al	2013	apical 4-chamber (RV focused)	Machine learning approach: Sparse matrix transform and level set	Echo images form 7 healthy individuals	RV	Manual contour tracing by cardiologist	Dice coefficients were $90.8 \pm 1.7\%$ for epicardial and $87.3 \pm 1.9\%$ for endocardial boundaries

### 1. Deep learning-based methods

22	Zhang et al	2018	PLAX, parasternal short axis, A2C, A3C and A4c.	Deep learning model: CNN	14035 echo studies	LV, LA, RV, RA	Manual contour tracing by expert	Dice metric of 94.1% for LV segmentation
23	Fei Liu et al	2021	apical 4-chamber	Deep learning model: CNN	CAMUS dataset (500 patients) 2500 echocardiograms from EchoNet-Dynamic	LV	NA	NA
24	Xu L et al	2020	Fetal 4-chamber	Deep learning model: CNN	895 fetal's echo images	All four chambers	Manual contour tracing by clinicians	Dice Similarity Coefficient (DSC) of 0.827, the Pixel Accuracy (PA) of 0.933 and AUC of 0.990
25	Smistad E et al	2017	Apical chamber views	Deep learning model: CNN	Echo images dataset of 100 patients (over 1500 echo images)	LV	Manual contour tracing by expert	Dice metric of 87.0 +- 6%
26	Lei Y et al	2021	apical 4-chamber	Deep learning model: CNN	450 patient's echo images	LV, LA	NA	DSC 0.939-0.965 for LV and 0.94-0.926 LA.
27	Carneiro G et al	2013	apical 4-chamber	Deep learning model: combined with multiple dynamic models (database-guided)	496 images	LV	NA	Dice metric 90.7%, mean absolute distance 6.7+- 0.7 mm

28	Leclerc S et al	2019	apical 2 and apical 4-chamber views	Deep learning model: CNN (Encoder-Decoder)	CAMUS dataset: 500 patient's echo images	LV	Manual contour tracing by 3 cardiologists	84%
29	Leclerc S et al	2020	apical 4-chamber	Deep learning model: CNN (Multistage attention network)	CAMUS dataset 500 patient's echo images	LV	Manual contour tracing by 3 cardiologists	Mean correlation of 0.96 and a mean absolute error of 7.6 ml.
30	Hu Y et al	2019	apical 4-chamber	Deep learning model CNN: Bilateral Segmentation Network	87 children's echo images	LV, LA	NA	Dice index 0.932 for LV, and 0.908 for LA
31	Yu L et al	2016	Fetal 4-chamber	Deep learning model Dynamic CNN	51 fetal images	All four chambers	Manual contour tracing by clinician	Dice coefficient 0.945
32	Chen H et al	2016	Apical 2, 3, 4 and 5 chamber views	Deep learning model: CNN multi-domain Fully Convolutional Networks (FCNs)	Echo images dataset of 566 patients	LV	NA	Dice score of 88%
33	Arafati A et al	2020	apical 4-chamber	Deep learning: fully convolutional networks (FCNs) and adversarial training	dataset of 1395 annotated images from 100 patients	LV, LA, RV, RA	Manual contour tracing by expert	Dice metric of 92.1%, 86.3%, 89.6% and 91.4% for LV, RV, LA and RA
34	Jafari et al	2019	apical 2 and apical 4-chamber views	Deep learning: fully convolutional networks (FCNs)	Echo images dataset of 427 patients	LV	NA	Dice score of 92% for LV segmentation
35	Jafari et al	2018	apical 4-chamber	Deep learning: Recurrent fully convolutional networks (FCNs) and optical flow framework	echo images dataset of 566 patients	LV	NA	mean accuracy of 97.9%, and mean Dice score of 92.7%
36	Jafari et al	2019	apical 4-chamber	Deep learning model: CNN: Cycle generative adversarial network (cycleGAN)	NA	LV	NA	Dice metric of 91.9+-3.6 %

NA: Not available, LV: left ventricle, LA: left atrium, RV: right ventricle, RA: right atrium, CNN: convolutional neural network