Bi-dimensional

EchoNet-Dynamic Dataset

Introduction

The dataset contains **10,030 apical-4-chamber echocardiography videos.**

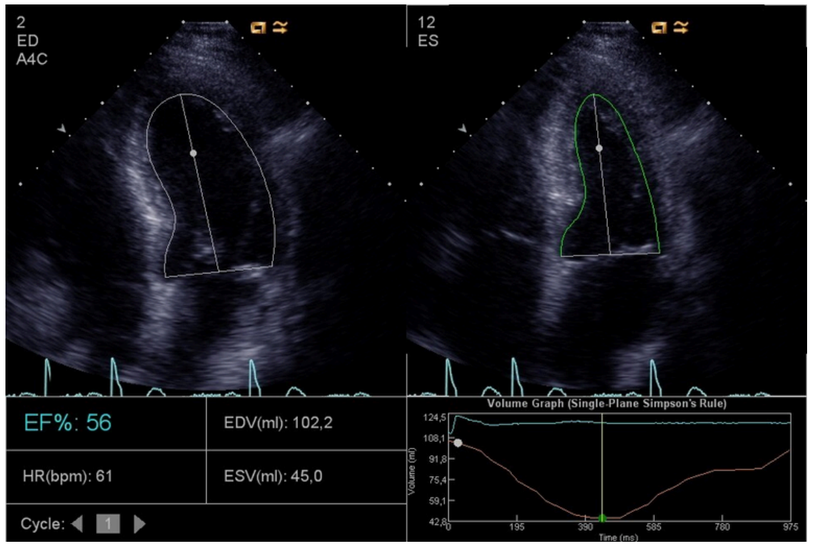
Each video was cropped and masked to remove text and information outside of the scanning sector. The resulting images were then downsampled by cubic interpolation into standardized **112x112** pixel videos.

Each study is linked to clinical measurements and calculations obtained by a registered sonographer and verified by a level 3 echocardiographer in the standard clinical workflow.

The **left ventricle** is traced at the endocardial border at two separate time points representing end-systole and end-diastole.

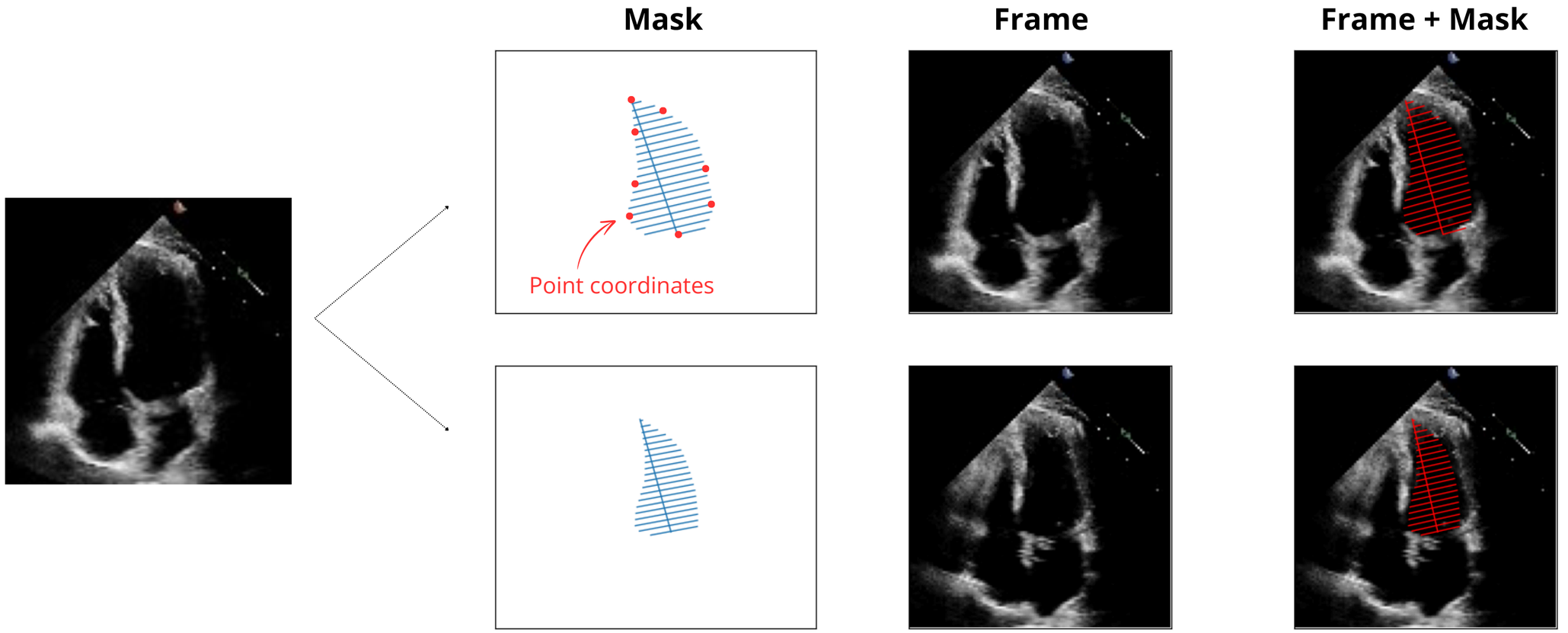
We chose to extract the annotated frames and perform image segmentation.

Dataset Videos Example



Tracing the Endocardial Border

Preprocessing: Raw Data Example



Preprocessing: Enhancing Frame

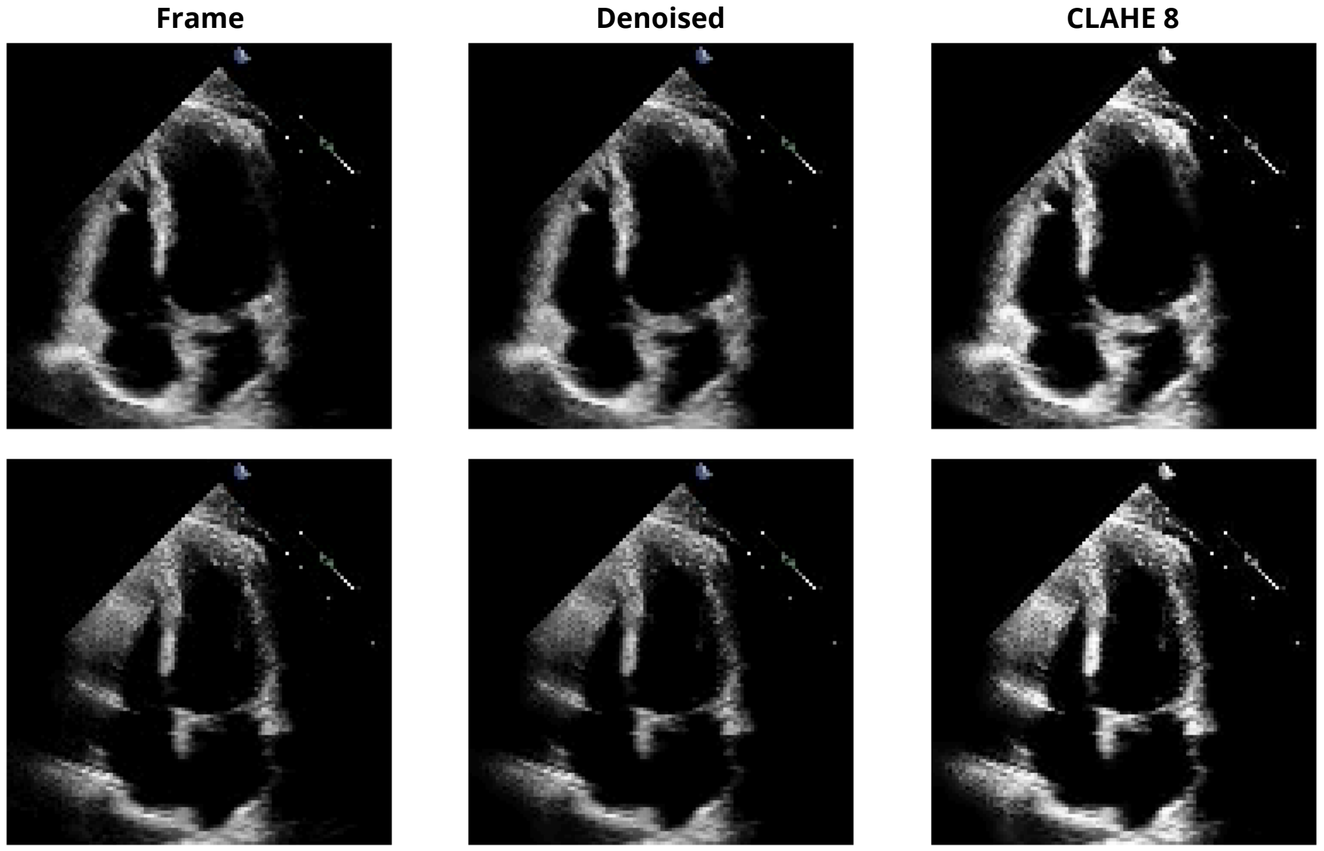
Denoising

- used 5 frames around the masked frame
- cv.fastNlMeansDenoisingMulti(): works with image sequence captured in short period of time (grayscale images).
- window search=35, template size=7, h=4

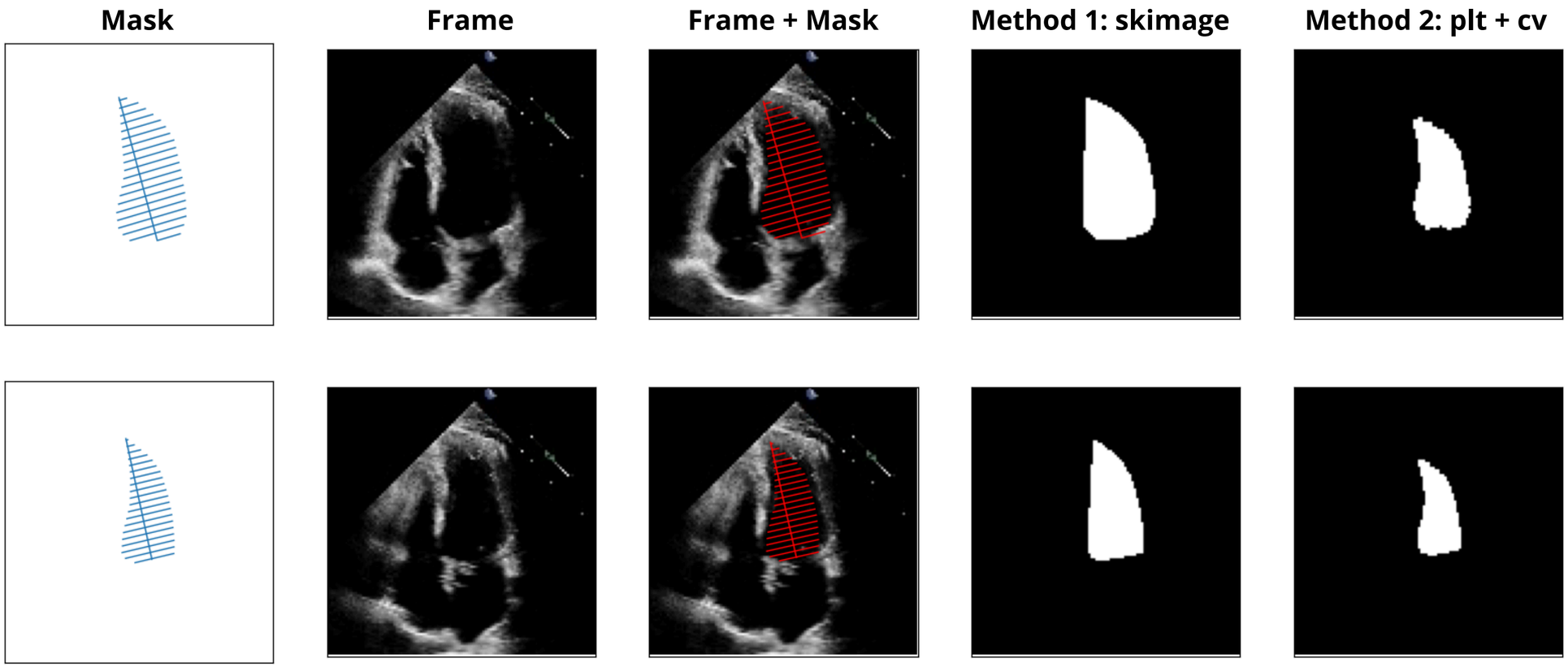
Histogram Equalization

We went from images whose pixel values are confined to low values, to images with a more balanced distribution. The final result is an image with higher contrast.

- clip limit=2, default tile size=8



Preprocessing: Binary Mask



Preprocessing: Steps

10,030 Videos

1 **Extracted** 2 frames - masks

2 Enhanced **Frames**

3 Obtained **Binary Masks**

4 **Scaled Frames into [0,1]**

19,214 Frames Masks

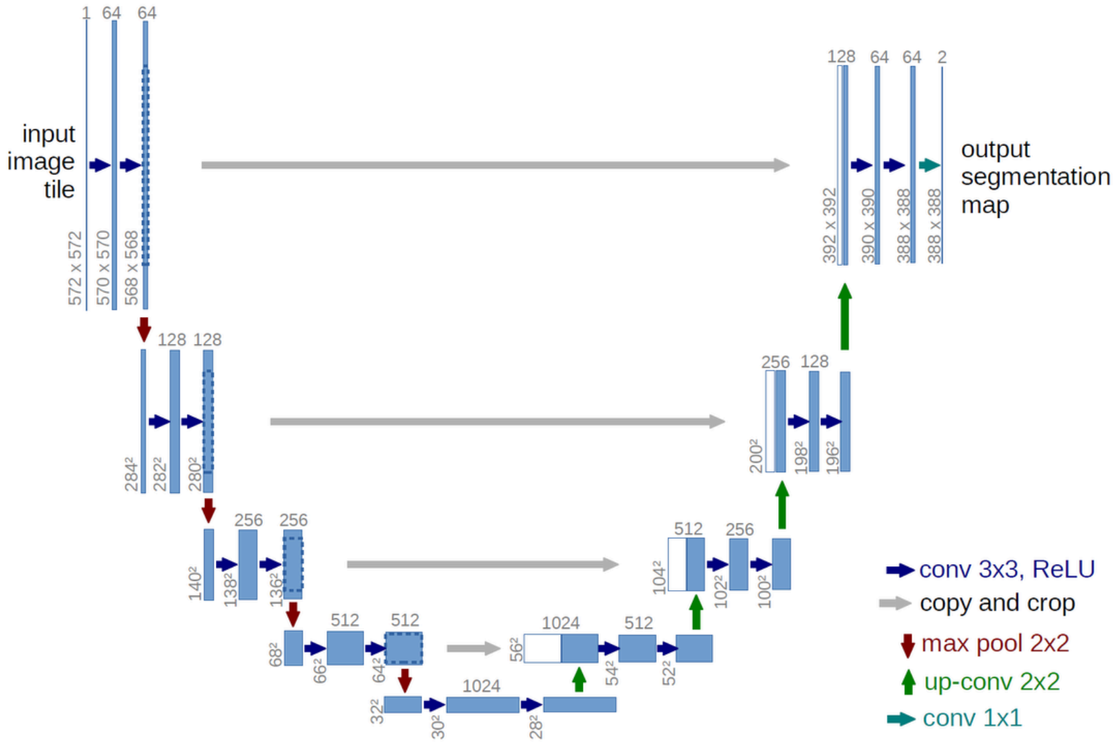
Split into Train, Val, Test according to the original dataset (80%, 10%, 10%)

5 **Feature-wise Normalization** mean=0, std=1

6 In Batch Random Transformations H/V Flipping Rotation (20°)

Model: U-Net

Architecture



Configuration

Loss	BCE with Logits Loss
Optimizer	Adam
LR	1e-4
LR Scheduler	Step 10, Gamma 0.1
Batch Size	32
Epochs	50
Early Stopping	Patience 3 on Val Loss

Metrics

- Intersection over Union (IoU)
- Dice score

Model: Using all Data

We used the same configuration as before, changing only the convolutional blocks features.

Model	**Features**	**Num Parameters**	**Epochs**	**Dice Score** (Train - Val)	**IoU Score** (Train - Val)
base	64 - 128 - 256 - 512	31,036,481	28	0.9257 **0.92**11	0.8617 **0.85**38
exp1	32 - 64 - 128 - 256	7,762,465	34	0.9245 **0.92**07	0.8597 **0.85**32
exp2	16 - 32 - 64 - 128	1,942,289	37	0.9201 **0.91**78	0.8522 **0.84**82
exp3	8 - 16 - 32 - 64	486,409	33	0.9125 **0.91**07	0.8392 **0.83**61
exp4	4 - 8 - 16 - 32	122,021	41	0.8965 **0.89**67	0.8127 **0.81**30
exp5	2 - 4 - 8 - 16	30,715	33	0.8833 **0.88**60	0.7912 **0.79**56

Model: Using 50 Samples

We used the same configuration, changing only batch size and the convolutional blocks features.

Model	**Features**	**Num Parameters**	**Epochs**	**Dice Score** (Train - Val)	**IoU Score** (Train - Val)
dbase	64 - 128 - 256 - 512	31,036,481	22	0.8636 **0.82**95	0.7613 **0.71**05
dexp1	32 - 64 - 128 - 256	7,762,465	26	0.8765 **0.75**82	0.7808 **0.61**09
dexp2	16 - 32 - 64 - 128	1,942,289	22	0.8245 **0.73**00	0.7031 **0.57**57
dexp3	8 - 16 - 32 - 64	486,409	24	0.7823 **0.74**91	0.6440 **0.59**93
dexp4	4 - 8 - 16 - 32	122,021	23	0.0964 0.1514	0.0508 0.0819
dexp5	2 - 4 - 8 - 16	30,715	23	0 0	0 0

Results: Predictions Comparison