Automated Left Ventricular Ejection Fraction (LVEF) measurement in 2D Echocardiography using DL-based Segmentation

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Motivation

- Relative change in left ventricular end-systolic (ES) and end-diastolic (ED) volumes remains one of the most critical indicators of the heart functioning.
- Need for an automated imaged-based mechanism to assist clinical experts during large retrospective studies where no clinical indices are available.
- LVEF index has high inter-observer variability ranging from 7.6 to 13.9 EF units.

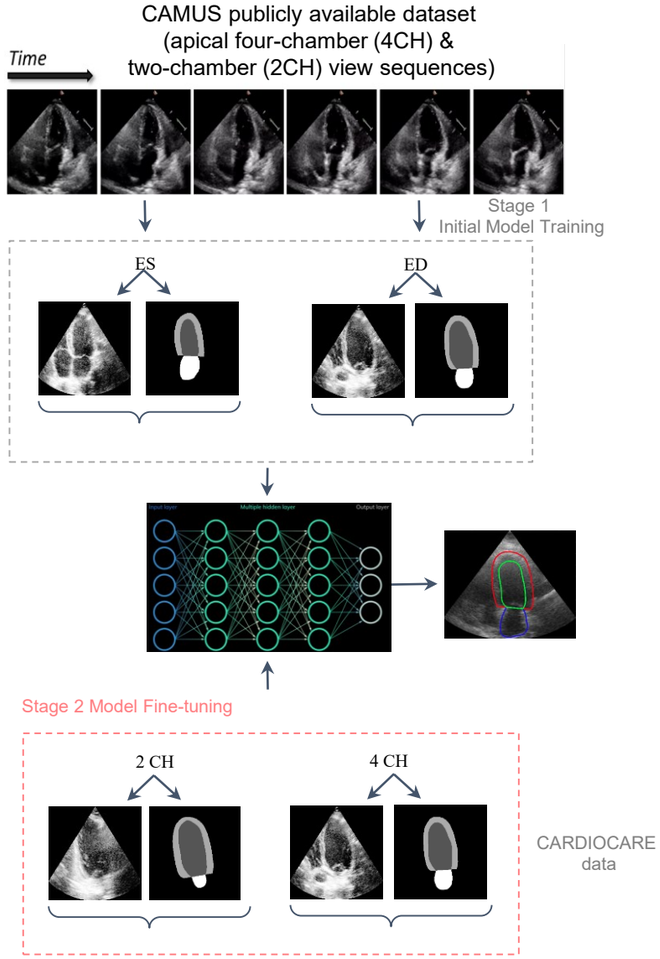
Data

- CAMUS dataset - clinical exams from 450 patients.
- 2D apical four-chamber & two-chamber view sequences.
- Clinical indices, ED/ES volume.
- Three cardiac structures: left ventricle, myocardium, left atrium.

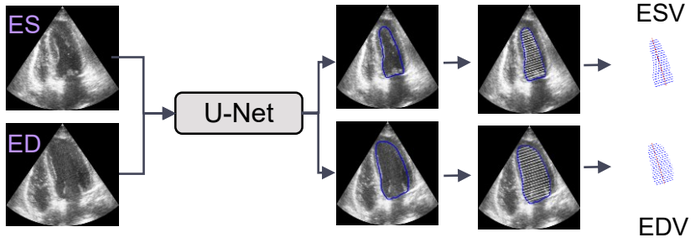
Deep Learning Model

- Encoder-decoder deep convolutional neural network.
- Small network with a total number of ≈ 2.0M parameters.
- Fixed input size of 256 × 256 pixels.
- Network outputs an image of the same size representing a segmentation mask with four classes: background, left ventricle, myocardium, and left atrium.

Segmentation of Cardiac Structures



Measure LVEF



Experimental Results

- Independent sub-cohort of 50 patients
- Volumes are calculated using Simpson's method with 20 disks,
- GT average LVEF = 50.74%
- Calculated LVEF
  - 4CH = 44.26%
  - 2CH = 50.15%
- Our method has considerably lower variability (-6.5% and 0.59%)

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