



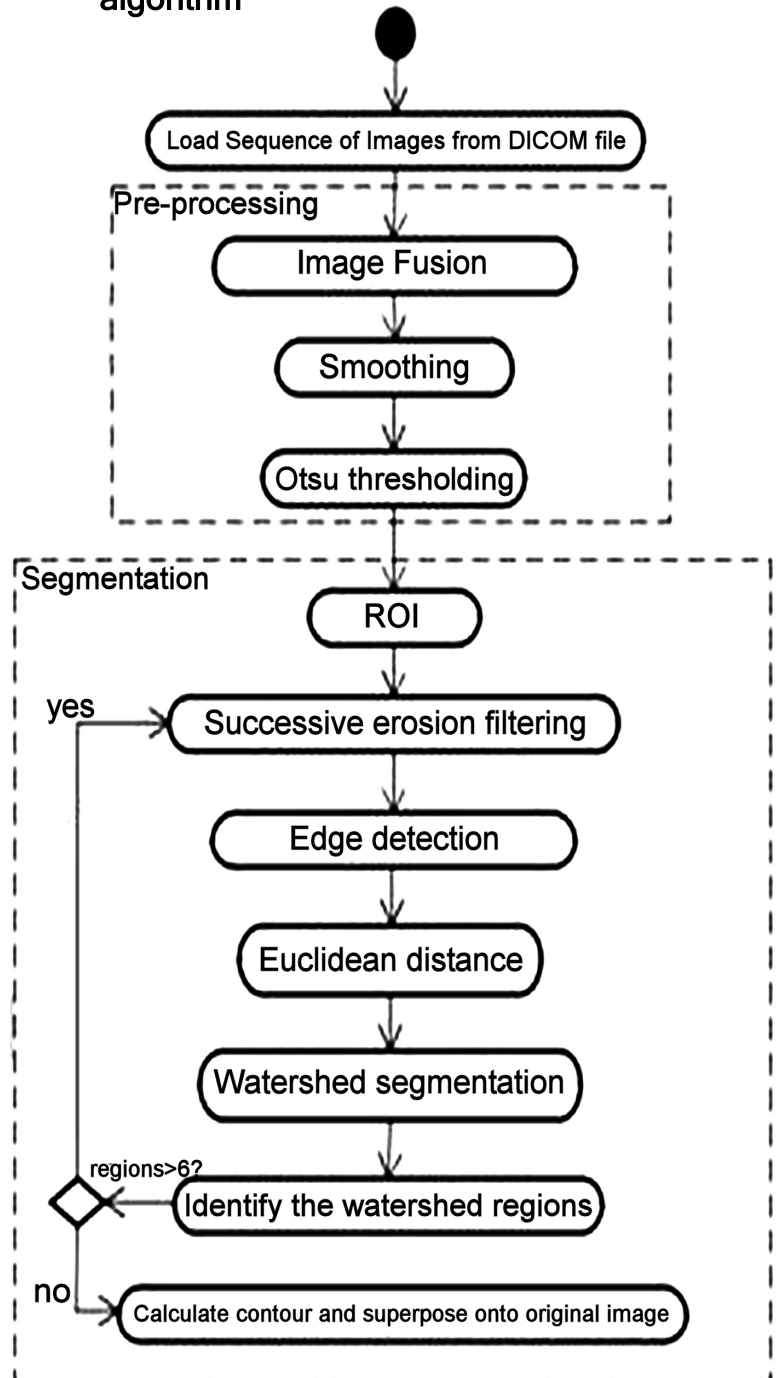
Improved Segmentation of Echocardiographic Images Using Fusion of Images from Different Cardiac Cycles

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- Detection of the left ventricular border in two-dimensional long axis echocardiographic images
- Pre-processing: image fusion was applied to a sequence of images composed of three cardiac cycles
 - similar images are merged to reduce noise and enhance the contrast of the left ventricular wall.
- Segmentation: watershed transformation

Flowchart of the left ventricle segmentation algorithm

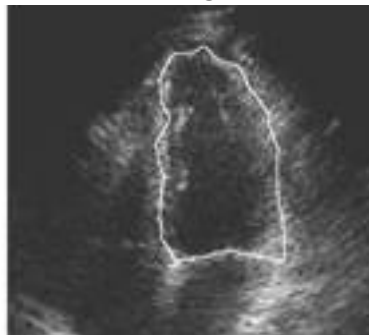


Results for different preprocessing stage implementations:

without image fusion



with image fusion



COMPARISON BETWEEN PROPOSED APPROACH AND METHODS FROM THE LITERATURE

	image axis	# of images	CI, μ	ES(%), $\mu \pm \sigma$
Proposed method	LA	8	0.917	10.79 \pm 2.95
Lilly <i>et al.</i> [5]	LA	25	-	11.35 \pm 4.22
Sequential radial search [4]	LA	7	-	18.51 \pm 5.06
de Andrade <i>et al.</i> [3]	LA	20	-	9.62 \pm 7.9
Optic flow [1]	SA	10	-	9.47 \pm 2.02
Small sliding window [1]	SA	10	-	12.44 \pm 2.41
Klinger <i>et al.</i> [2]	canine SA	-	0.93	-

Quantitative comparison using the same image database (5 long-axis images)

	CI, μ	ES(%), $\mu \pm \sigma$
Proposed method	0,949	10.79 \pm 2.95
Optic flow [1]	0,95	9.47 \pm 2.02
Silva <i>et.al</i> [11]	0,897	17.88 \pm 3.40

- A set of 8 long-axis (LA) images from 9 different patients, classified as of high quality by a specialist, were used to evaluate the performance of the proposed algorithm
- the optic flow algorithm [1] is computationally-intensive (approximately 20 minutes), whereas the proposed method's computational time is approximately 2 minutes.

Results



original image



corresponding composite image

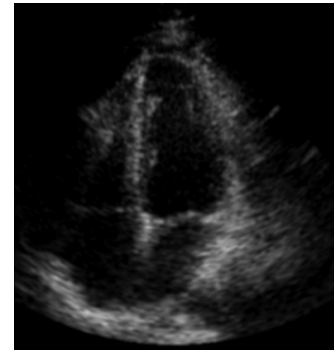
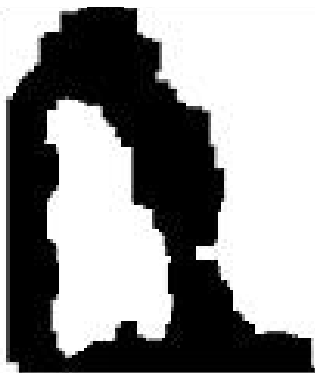
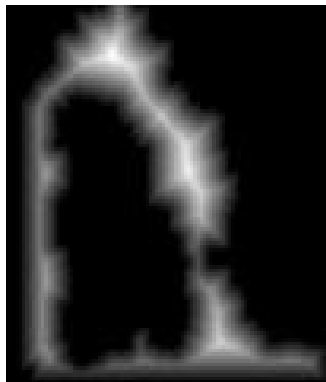


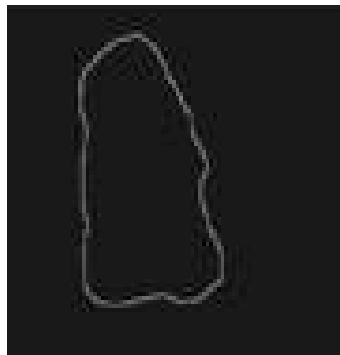
image smoothed by Gaussian filter



Otsu thresholding



Euclidean distance transform



watershed segmentation



superposition onto original image

Superpositon of the manually-segmented contour (dotted line) onto the automatically-segmented contour

