PECTORAL MUSCLE SEGMENTATION ON DIGITAL MAMMOGRAMS BY NON LINEAR DIFFUSION FILTERING

Authors

H.MIRZAALIAN, M.R. AHMADZADEH, S. SADRI

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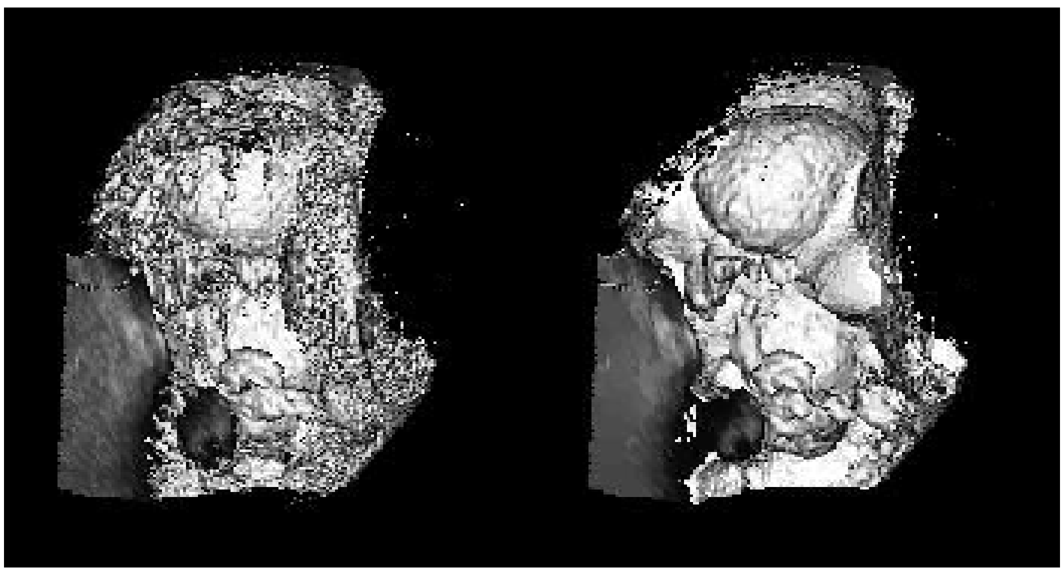
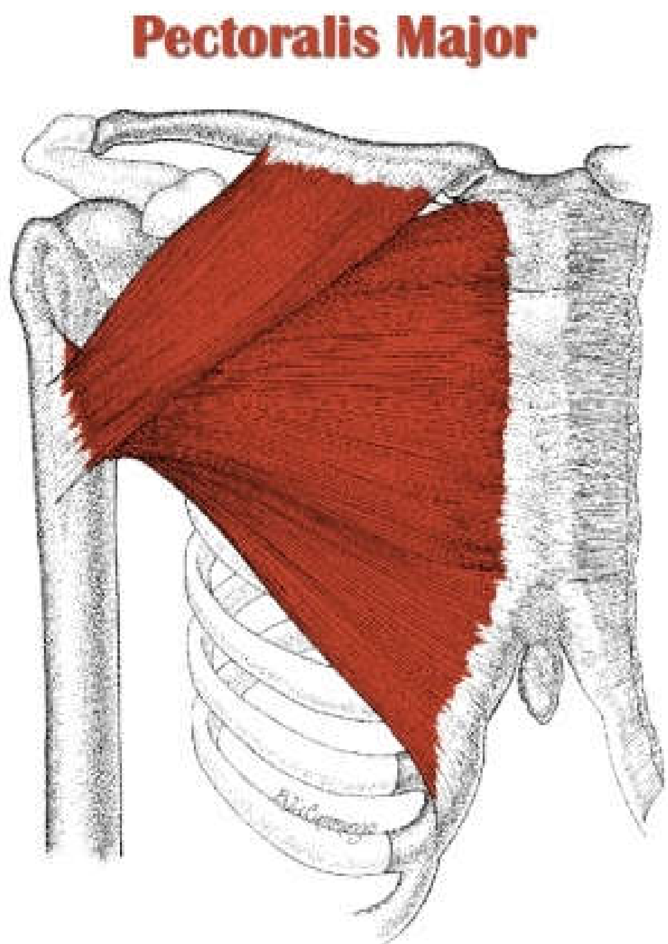


PRESENTED BY:
Abhijeet Singh
1301CH01
Aman Prakash Singh
1301EE02

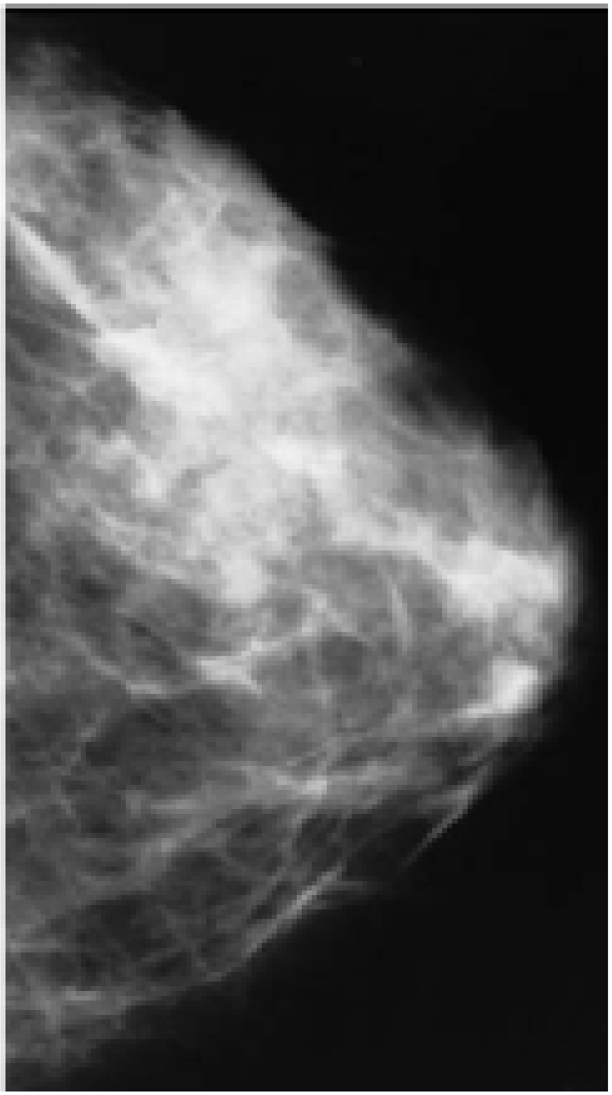
MAMMOGRAMS AND PECTORAL MUSCLES



- X ray picture of breast
- It is used to check for breast cancer in women who have no signs or symptoms of the disease
- **Pectoral Muscle** is the largest Muscle in the human chest region

The author used MLO (Medio Lateral Oblique) views of the mammograms

WHY PECTORAL MUSCLE SEGMENTATION



- The pectoral muscle represents a predominant density region in the most Medio-Lateral Oblique (MLO) views of mammograms
- It can affect the results of the image processing of the digital mammograms
- Existence of the pectoral muscle in the image data being processed may bias the detection procedures

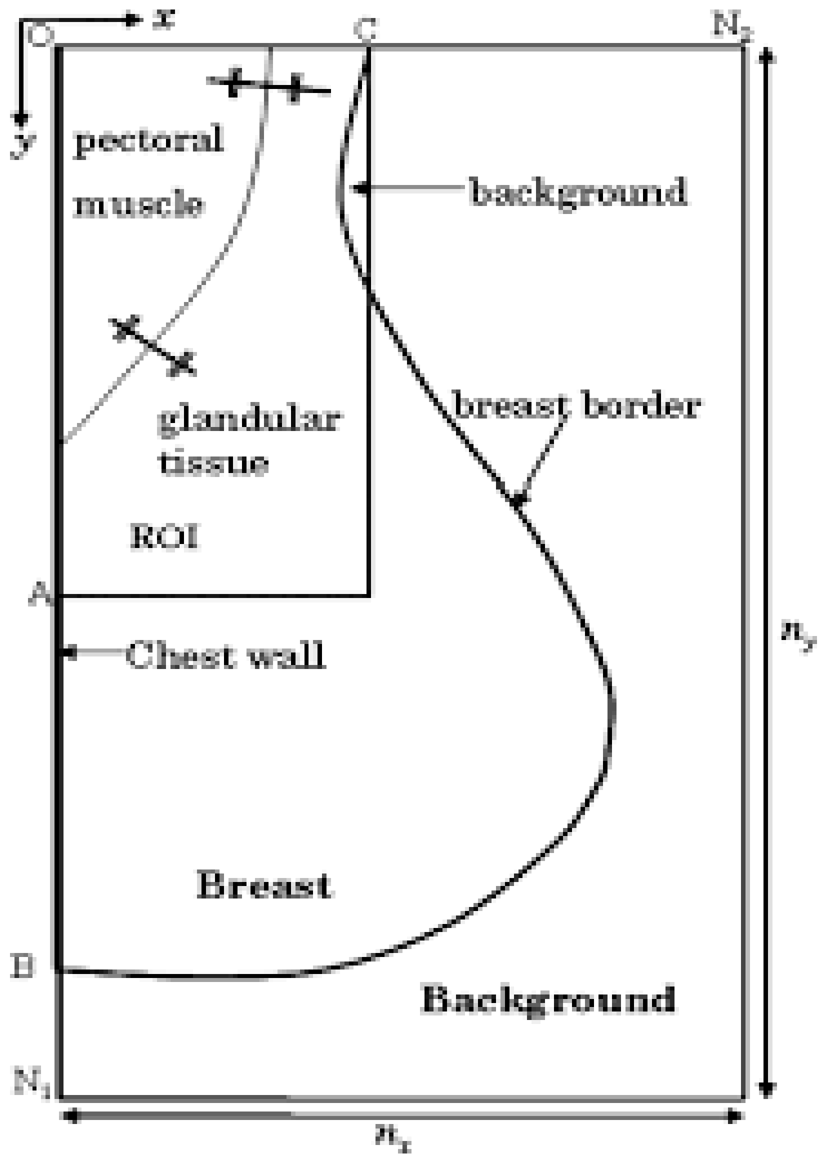
Non Linear Diffusion filters

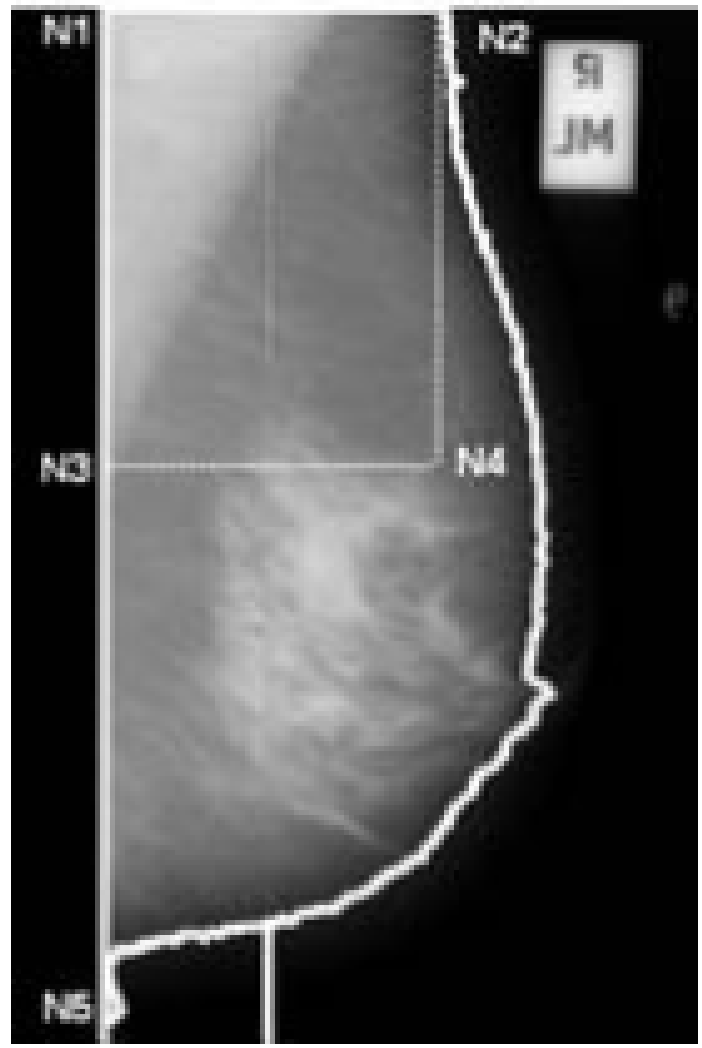
- De-noising by low-pass filtering not only reduces the noise but also blurs import edges

- On the contrary nonlinear diffusion is smoother which is an edge preserving
- The Diffusion function used by the author in this paper is

$$D(x,t) = 1 - \exp\left(-\frac{C_m}{\left(\frac{\nabla U(x,t)}{\lambda}\right)^m}\right)$$

Areas of Focus in Segmentation





Mathematics of Non Linear Diffusion Filters

$$\frac{\partial U(x,t)}{\partial t} = \nabla.(D(x,t)\nabla U(x,t))$$

To implement it computer program , discritizing the LHS and RHS

$$D(x,t) = F(\frac{1}{\Delta x}\left[U(x+\frac{\Delta x}{2},t) - U(x-\frac{\Delta x}{2},t)\right]$$

$$\nabla.(D(x,t)\nabla U(x,t)) = \frac{\partial}{\partial x}(D(x,t)\ \frac{\partial}{\partial x}\ U(x,t))$$

$$= \frac{\partial}{\partial x}\left\{D(x,t).\frac{1}{\Delta x}\left[U(x+\frac{\Delta x}{2},t) - U(x-\frac{\Delta x}{2},t)\right]\right\}$$

$$= \frac{1}{(\Delta x)^2}\left\{D(x+\frac{\Delta x}{2},t)[U(x+\Delta x,t) - U(x,t)]\right.$$

$$\left. - D(x-\frac{\Delta x}{2},t)[U(x,t)U(x-\Delta x,t)]\right\}$$

$$\frac{\partial U(x,t)}{\partial t} = \frac{U(x,t+\Delta t) - U(x,t)}{\Delta t}$$

Mathematics of Non Linear Diffusion Filters

If we define $\nabla U1$ and $\nabla U2$ such that:

$$\nabla U_1(x) \underline{\underline{\Delta}}\ U(x+\Delta x,t)-U(x,t)$$
$$=U(x-\ h_1,t)-U(x,t)$$

$$\nabla U_2(x) \underline{\underline{\Delta}}\ U(x-\Delta x,t)-U(x,t)$$
$$=U(x-\ h_2,t)-U(x,t)$$

$$D_1(x) \underset{=}{\Delta} D(x+\frac{\Delta x}{2},t)=F(\frac{1}{\Delta x}\nabla U_1(x))$$

$$D_2(x) \underset{=}{\Delta} -D(x-\frac{\Delta x}{2},t)=F(\frac{1}{\Delta x}\nabla U_2(x))$$

$$U(x,t+\Delta t)=U(x,t)+\frac{\Delta t}{(\Delta x)^2}\times$$
$$\left[D_1(x)\nabla U_1(x)+D_2(x)\nabla U_2(x)\right]$$

$$U(x,t+\Delta t)=U(x,t)+$$
$$\Delta T'\sum_{d=1}^{\Gamma} D_d(x,t)\nabla U_d(x,t)$$

IMPLEMENTATION

U=ROI;
t=0 ;
y(t)=U;
Iteration=30;

Convolve y(t)with Gaussian Filter with sigma=1
y(t)=conv2(y(t).gauss);

Calculate gradient of y(t)
g=gradient (y(t));

Diffusion function
d(g)=1-exp(-Cm/(g/k)^m),
The constant Cm is calculated to make the
flux(g*d(g)))ascending for g<k and descending for g>=k

dy/dt=div(d(g),g);
Y(t+1)=y(t)+200*dy/dt
t=t+1

t<Iteration

Thresholding
Image
With
T=0.6

Final contour

RESULTS AND CONCLUSIONS

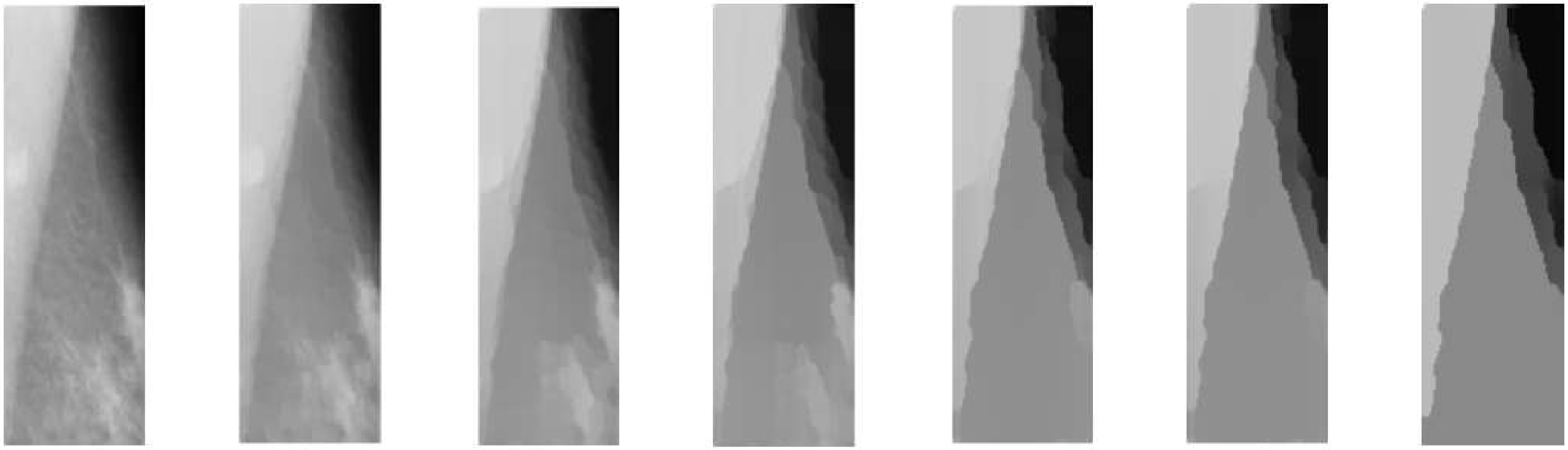


TABLE 1. RESULTS FROM HDM

Method \ Error	Mean	Variance
Hough-Transform	27.1545	8.7909
Gabor -Filter	19.1185	7.8123
Nonlinear Diffusion	14.7585	7.7737

TABLE 2. RESULTS FROM MAEDM

Method \ Error	Mean	Variance
Hough-Transform	8.5035	3.4005
Gabor -Filter	4.981	1.9189
Nonlinear Diffusion	2.5525	1.6343

THANK YOU