International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 24 (2017) pp. 13990-13994

Estimation of Boundary Regions for Images using Contour Based Model

K.Srinivasan
Assistant Professor, Department of Computer Science Engineering,
Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya (SCSVMV University),
Enathur, Kanchipuram
Orcid: 0000-0003-3150-2276

Dr. N.R. Anantha Narayanan
Associate Professor, Department of Computer Science Engineering,
Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya (SCSVMV University),
Enathur, Kanchipuram-631 561, India.

Dr.S.K.Srivatsa,
Professor (Retired),
Anna University, Chennai, India.

Abstract

Contour Based Model is widely used in the image segmentation. Segmentation divided into two broad categories a. edge based b. region based Contour models improves the gradient flow. Edge construction is made from images with region based segmentation. Experiments made on images using the active based contour model for measuring Boundary region of the images.

Keywords: Contour, Snake, Hough transform, Bezier curve, Segmentation, Elasticity, Entropy, Stability Curve**.**

INTRODUCTION

For analyzing an image it is to be partitioned into multiple segments it makes easier to analyze. It is used to locate boundaries (lines, curves etc) in an image. The resultant of image segmentation it contains collection of an image or set of contours extracted from the image. Image Segmentation is divided into two parts 1. Edge Based 2. Region Based. Edge based represents a large group based on edges. In the Region based is to partition an image into regions and taking only boundary based region in the grayscale images. It determines the regions directly. Region growing methods gives a good segmentation results than edge based. For the feature extraction of boundaries contour based approaches are used. Active based contour approach is widely used in the image segmentation. Popular active based contour approach is snake model. Snake was introduced by kass, witkin and Terzopoulos *et al[1]*. Snake is an energy minimization influenced by constraint and image forces towards object contours and internal forces.

OBJECTIVE OF THE STUDY

To find the boundary region through Image segmentation

Calculate the boundary region through energy minimization.

To find the stability of the region for restoring images

Literature review

Kass,Witkin and Terzopoulos[1] in his work "Snake Active Contour Model" discussed about the active contour method by calculating its variations on the background of curve evolution. Tony F.Chan [2] *et al* made his work on active contour model using Mumford-shah functional for segmentation instead of using edge and region based. Jiuyu Sun[3] *et al* used VFCCV Snake model for the region based method. Tanunchai Boonnuk,Thanwa Sripramong[4] *et al* used the active contour model for the texture segmentation with edge and the traditional active contour model was compared. Alireza Nejati[5] *et al* developed active contour for segmenting and tracking cells in phase contrast microscopy images. Jonas De Vylder and Wilfried Philips[6] *et al* studied about active contour model converges when the initialization of external energy is far from the object of interest. Yu Jing[7] *et al* made their work in detection of oil slick they defined their energy function modal combining a region scalable fitting concept and global minimization active contour.

METHODS

Segmentation

Taking a image it is divided into four segments.

Figure 1: (a) brokened image (b) segmented image

Contours are edges having the line segments it may be curved or straight that separates one region from other. An edge detection technique can be used for segmentation.. The edge detection is done through using the gradient operator. Magnitude of the gradient can be calculated by

$$G = \sqrt{\delta f/ \delta x + \delta f/ \delta y}\ldots \qquad \text{eqn (1)}$$

taking the pixel values as

I(i,j)	I(i,j+1)
I(i+1,j)	I(i+1,j+1)

Consider a temple oriented image for calculating gradient value

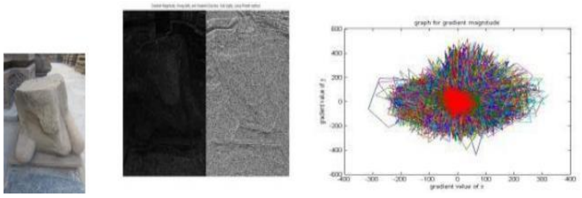

Figure 2: (a) broken image (b) gradient image (c) graph for gradient image

Boundary region

Boundary detection problem is that of locating discrete contours in a digital image has correspond to sudden changes of physical properties of the three dimensional scene. The image has been extracted according to their physical origins.

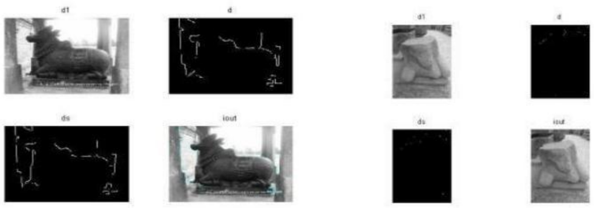

Figure 3: (a) (b) indicates boundary region of above image

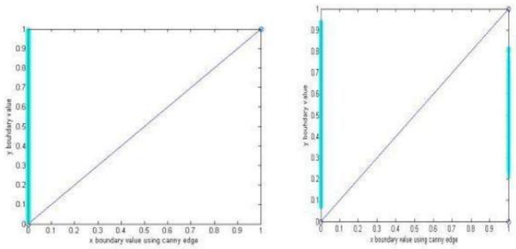

Figure 4: From the above graph shows that straight line it indicates that the image are bounded . Fig (a) graph indicates the thick line in the y axis shows that the boundary of image and Fig(b) indicates both side of the boundary image.

Contour model

Contour model are divided into two forms 1. Active 2.parametric. Active contour method called as snake methods. Active contour methods have closed boundaries in the resulting segmentation. Active contour consist of curve in the boundary region. So it is called as energy functional minimization problem. Snake model has a parametric curve to minimize the energy functional Consider a parametric curve

$$C(p) = [x(p),y(p)]^T \ldots\ldots \quad .\text{eqn (2)}$$

were $p \in [0,1]$ the energy minimization or the parametric curve is

$$J(c) = \varepsilon_{internal}(c) + \varepsilon_{external}(c)\ldots. \qquad \text{eqn (3)}$$

εinternal is internal energy of the curve high level shape of the curve is controlled by this internal energy.

εexternal is external energy of the curve which consider often used edges and low level features.

To detect the shape of the curve we have used the Hough transform. The purpose of using this transform is to find imperfect instances of objects within a certain class of shapes in the parameter space

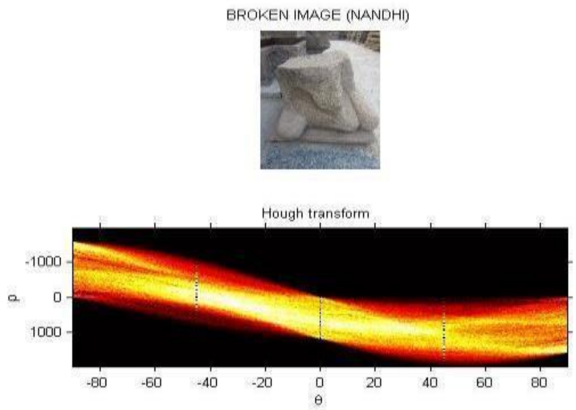

Figure 5: a) original image taken b) Hough transform

For further process we have used snake model for determining energy minimization. Hough transform works on voting methods and it detects points vote on possible model parameters. Hough transform is based on rigid model shape. In the case of deformable contour it is a prior on shape it can

be iteratively adjusted. By voting it can detect multiple instances it requires one optimization pass to fit a curve in a single contour.

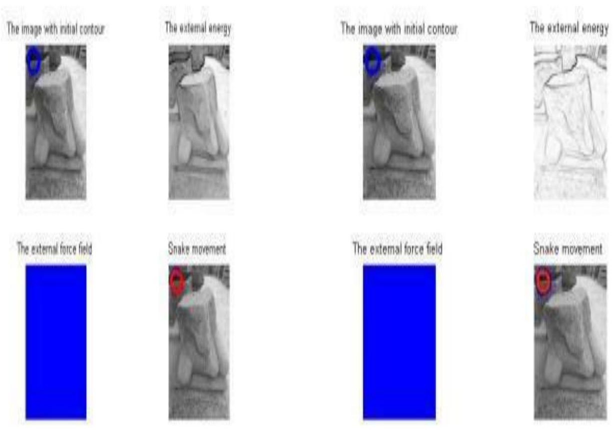

Figure 6: a) Snake model 1 b) snake model 2

In the snake model 1 indicates the initial contour with external energy and snake movement. Snake model2 indicates with the external energy boundary region extracted and final snake movement

Equation of the line is Y =(m*x+c)….eqn(4)

Parametric form of equation is

$$\rho = x * \cos\theta + y * \sin\theta \quad \text{…..eqn (5)}$$

Where ρ is the perpendicular distance from origin to the line and θ is the angle formed by this perpendicular line and horizontal axis measured in counter-clockwise.

Table 1: Values of rho and theta from Hough transform

Values	Rho (ρ)	Theta (θ)
Set1	-0.0220 - -0.0030	-90.000 - -78.0000
Set2	-0.0029 - 0.0000	-77.000 - -66.0000
Set3	0.0005 - 0.0050	-65.000 - -53.0000
Set4	0.0050 - 0.0105	-52.5 - 0.0000
Set5	0.0120 - 0.0360	0.0000 - 89.5000

The above table indicates that theta value varies from ρ value it indicates that θ is used to rotate an image and ρ value for distance calculation. Snake consists of higher level process initializing any shaped contour close to the object boundary to be detected. Using the algorithm snake starts deforming trying to minimize its energy functional at every step. It shrinks-wrap around the object boundary and stops when it attains spatial local minima where contour perfectly wraps around region of interest. Elastic energy is the potential energy stored in the configuration as work is performed to distort its volume or shape.

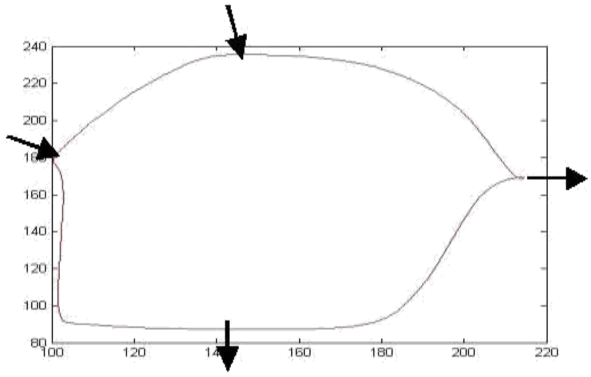

Figure 7: Curve From Snake Model

b0, b1, b2, b3 indicated by arrow mark are chosen for curve interpolation. There are many insignificant edge points due noise are not taken. Coarse to fine approach allows the snake to take strong points and to avoid weaker points Thus the four control points are taken arbitrarily for evaluating Bezier curve interpolation parametric equation for the above curve is

$$C(t) = (1- t)^3 b0 + 3(1- t)^2 t\, b1 + 3(1- t)t^2 b2 + t\, b3 \quad \text{. ..eqn (6)}$$

Table 2: Control Points Of Bezier Curve

i	0	1	2	3
xp	1	2	3	0
yp	0.3	0.8	1.10	1.30

xp ,yp are the augmented matrix and gauss Jordan method

Table 3: Cubic curve Bezier interpolation

i	b0	b1	b2	b3
Cubic curve	1.0000	3.0452	4.2000	0.1405

To calculate the elastic energy of the snake model we have find the gradient value of an image . Gradient method is used to erode an image using the simple structuring elements.

Table 4: Gradient Value of the Eroded Image Energy Function

Magnitude				Direction			
151	90	123	-172	-22	60	84	87
-114	-147	148	106	35	109	120	62
-142	-143	-145	-113	24	159	165	-5.1

Contour v(s) is a sum of energy in the continuous spatial domain. It can be categorized as 1. Internal Energy 2. External Energy 3. Constraint Energy Mathematical model

$$E_{snake} = E_{internal} + E_{external} + E_{constraint} \quad \text{. eqn (7)}$$

$$E_{snake} = \int_s 1/2 \left(\alpha(s)|v_s|^2 + \beta(s)|v_{ss}|^2\right) + E_{Image}(v_s))ds \quad \text{..eqn (8)}$$

Finding a curve for which E has a stationary value and variational calculus and by using Euler and Lagrange equation for attaining energy snake a minima. Elastic energy causes the control points connected by springs in tension.. Hence energy is proportional to the distance of separation between adjacent control points. Potential energy of a spring stretched by a distance d having a spring constant α is given $\frac{1}{2}\alpha x^2$. Entire contour is given as

$$E_{elastic} = \alpha/2 \sum_{i=1}^{n} = \int \alpha |v_s|^2 \, ds. \quad \text{… eqn (9)}$$

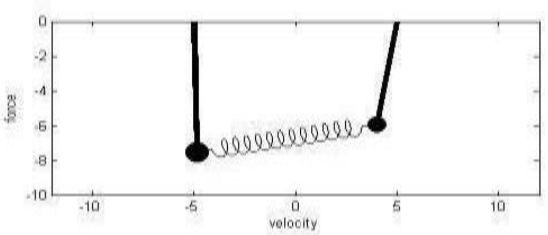

Figure 8: Elasticity Curve

Table: 5 Energy created using Euler Lagrange equation

Set1	Set2	Set3	Set4
2.1457	1.4388	0.8683	-0.4281
1.9565	1.2834	0.7465	-0.3368
1.7754	1.1366	0.6326	-0.2525
1.6028	0.9982	0.5266	-0.1748

Energy created using the Euler- Lagrange equation above tables infers that the values are converging from maxima to minima. Force is created along with the velocity, tension is created and spring elongate. thus a curve is formed.

The snake model curve was studied for placing a structure above the curve. Above Four set of values are taken as parameter for finding stability value. To check the values are within the range Probability Density Function calculated it shows the steady state of curve values and the values are within the range. Entropy values are calculated to get average amount of random values and to specify un certainty in the image values

Table 6: Probability Density Function

Set 1	Set 2	Set3	Set4
0.0223	0.0213	0.0203	0.0196
0.0175	0.0169	0.0159	0.0152

Table 7: Entropy values for four boundary points

Set 1	Set 2	Set3	Set4
7.2818	7.5039	7.7921	6.9990

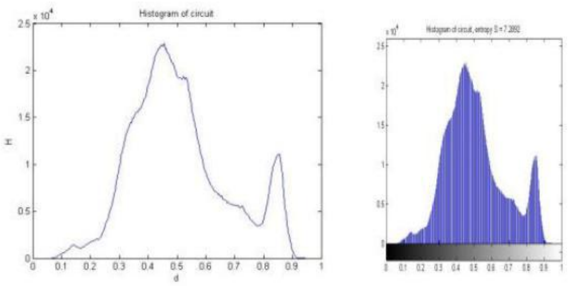

Figure 9: Curve for Probability Density Function and Entropy

The above graph shows the probability density function of a random variable taken from the curve it was determined that in the table 6 the pdf values are very much closer to the curve values.

To avoid the uncertainty entropy value was calculated The curve in the Fig 9 (b) it shows that the entropy value is closely related to PDF.

To test the stability and vibration of the elliptical curve Mathieu equation a linear second order partial differential equation has been used.

The canonical form of the equation is

$$Y''(x) + [a-2q\cos 2x]y(x) = 0 \quad \text{.... eqn .} \qquad (9)$$

where a and q are constants

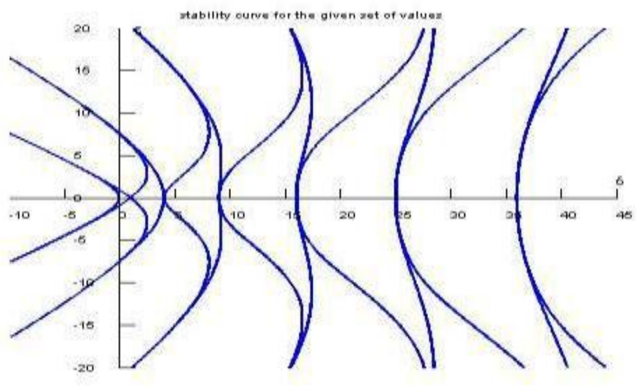

Figure 10: Stability curve using Mathieu Equation

The above curve shows well known stability curves white color inside the curve shows ‘a’ and ‘q’ with stable periodic solutions and the color curve indicates that unstable solutions. From this we infer that we can keep any type of structure within the boundary.

CONCLUSION

We Emphasize this method is reliable for calculating boundary region of broken images. Hence many images which are unknown information can adopt this method for boundary calculation. We can place images according to the base curve and this method will be suitable one

FUTURE WORK

In Future this method we can be implement in archeology survey of India they can use our work for calculation of unknown and broken images.

REFERENCES

[1] Kass, M., Witkin, A., Terzopoulos, D.” Snakes active contour models.” International Journal of Computer Vision 1” (1988) 321–331.

[2] Tony F. Chan, Luminita A. Vese “Active Contours Without Edges,”IEEE Transactions on Image Processing, vol. 10, no. 2, 2001.

[3] Jiuyu Sun,Nilanjan Ray, Hong Zhang, ” VFCCV Snake:A Novel Active Contour Model Combining Edge and Regional Information”,IEEE Transaction on Image Processing.,Vol.14,2014.

[4] Tanunchai Boonnuk,Thanwa Sripramong, Sanun Srisuk, “Texture Segmentation using Active Contour Model Incorporated with Edge Flow on MRI Images”,IEEE Transaction on Image Processing vol II,2014.

[5] Alireza Nejati,Charles P.Unsworth Euan S.Graham “Improving active contour methods for tracking Endothelial cells by the removal of low-confidence Edge segements”34th Annual International Conference of IEEE,” 2012

[6] Jonas De Vylder Wilfried Philips, “A Computation Efficient External Energy for Active Contour Segmentation Using Edge Propagation”IEEE 17th International Conference on Image Processing 2010

[7] Yu Jing, Jubai An and Zhaoxia Liu,” A Novel Edge Detection Algorithm based on Global Minimization Active Contour Model for Oil Slick Infrared Aerial Images”, IEEE International Conference on Computer Vision,2009.

[8] Othmane El meslouhi Mustapha Kardouchi Hakim Allali Toufiq Gadi,”Semi-Automatic Cervical Cancer Segmentation Using Active Contours Without Edges”, Fifth International Conference On Signal Image Technology and Internet based System”,2009

[9] Ghassami Hamarneh and Tomas Gustavsson, “ Statistically Constrained Snake Deformations” IEEE,2000.

[10] Yue Fu, A. Tanju Erdem, and A. Murat Tekalp,” Tracking Visible Boundary of Objects Using Occlusion Adaptive Motion Snake “IEEE Transaction on Image Processing,2010.

[11] Christopher Grandy “ The Principle of Maximum Entropy and difference between uncertainity” Springer page no.39-47.,”kluwer Academic Publishers”,1991.

[12] D.Frenkel and R.Portugal, ”Algebraic methods To Compute MFs”, J.Phys A.Math Gen 2001,

[13] S.R.Rengarajan and J.E. Lewis, ”Mathieu functions Of Integral order and arguments”,IEEE Trans, Microwave Theory and Techniques Vol.MIT-28,1980,page 276-277