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Restoration of Gaussian Blur by Biogeography Based Optimization

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Abstract*—This paper introduces a new technique for restoration of Gaussian blurred image. We are not able to achieve the original image by using restoration technique. Restoration is way to interpret the image from blurred one. In this paper Biogeography based Optimization is applied to image. For the purpose of restoration image is segmented give desired restored output by finding the correlation between the neighbouring pixels in order to extract best solution based on fitness value using biogeography based optimization. Using Thresholding, we can find solution is based on threshold value which give binary representation of image or take multiple values above and below threshold value but by biogeographic based optimization best solution is extracted.

***Keywords*—Biogeography based Optimization , Thresholding ,Image Restoration, Image Segmentation, Level Set evolution.**

I. INTRODUCTION

Optimization is way to modify any design or decision as efficient as possible. There are many optimization techniques which have been used in order to extract best solution. Particle Swarm optimization (PSO), Ant Colony Optimization (ACO), Genetic algorithm (GA) are some of the examples of optimization technique. In this paper, we use biogeographic based optimization technique to restore Magnetic Resonance imaging (MRI) or computed tomography (CT) scanned images. Gaussian noise and Speckle noise are found in these images. Image restoration improves the quality or clarity of images for human viewing. Many filters like inverse filter, mean filter and median filter can also be used for restoration purpose. Removing noise, increasing contrast and revealing details are examples of restoration operations [2][4]. The field of image restoration is concerned with the reconstruction or estimation of the uncorrupted image from bias one. Let T(x,y) be original image and observed image is represented by I(x,y).

$$I(x, y) = b(x, y)*T(x, y) + n(x, y) \qquad (1)$$

Where b(x, y) is the spatial representation of the degradation function or Gaussian bias and the n(x, y) is noise added. Our main motive is to improve the quality of image by removing noise.

II. BIOGEOGRAPHY BASED OPTIMIZATION

Biogeography Based Optimization is method which is improved version of genetic algorithm. Genetic algorithm analyse genetic power of species or human. Type of species whose specimens are taken for genetic calculation is defined by Biogeography Based optimization (BBO).Biogeography Based optimization technique is motivated from the word biogeography. Biogeography is the study of plants and animals. The groups of birds or fishes are moving from one habitat to other depending on various factors like food resources, climatic conditions etc. This is basic idea behind the origin of Biogeography Based optimization technique .By using this technique the solution of any particular problem can be measured. Biogeography Based optimization technique is based on information sharing by species migration[6] .The sharing of features among the habitat is called migration. Migration results in the modification of existing individual. Migration is based on immigration and emigration of species. Immigration is entering of species in island and emigration is leaving of species from island. Migration is the process of copying the value of SIV from one solution to other based on HSI or fitness value. When the species are less compatible they migrate to other habitat. Habitats which are isolated from each other are considered to be as island or solution of problem[6][8]. The features of each habitat are represented by suitability index variable (SIV).SIV define either it belongs to High suitability index (HSI) or low suitability index (LSI). In BBO, each individual is considered as a habitat with a suitability index (SI). Habitats with suitability index (HSI) tend to have a large number of species, while those with a low suitability index (LSI) have a small number of species. Low suitability index(LSI) accept features from neighbour habitats with high HSI.

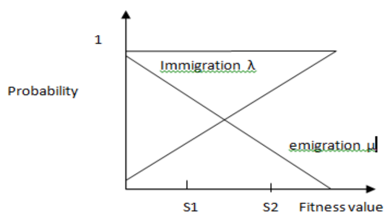

Fig. 1 Migration model

In Fig.1 S2 belongs to HSI as S2 have high fitness value as compared to S1. Emigration and immigration depend upon number of species in island .HSI have large number of species. So number of species entering in S2 island is low which lead to decrease in immigration rate and number of species leaving from S2 island is high which lead to increase in emigration rate .Each individual has its own λ and μ and is expressed by equations given below [8].

$$\lambda = 1 - \mu \quad (2)$$

$$\mu = \text{fitness} \quad (3)$$

$$\lambda = 1 - \text{fitness} \quad (4)$$

λ= the probability that the immigrating individual's solution feature is replaced.

μ = the probability that an emigrating individual's solution feature migrates to the immigrating individual

Mutation is used to increase the diversity of population to get good solution. It occur when there is drastic change in HSI. Both HSI and LSI participate in mutation and made new habitat is created by hybrid other habitat. Mutation is optional step in this algorithm[8].

III. BIOGEOGRAPHY BASED SEGMENTATION

Island is considered to be the solution of particular problem. The good solution is considered to have high HSI value and poor solution have low value. Let the size of habitat be N.

$$H=[SIV_1 ,SIV_2 ,SIV_3 ,\ldots\ldots SIV_M] \quad (5)$$

Where M is the number of feature to involve for optimal solution.

Segmentation is the process of dividing the image into set of pixels having homogeneous region.it is used to locate boundaries or objects. Close part of image is considered as object[2]. In Migration, pixels having similar intensity, color or characteristics are migrated and grouped together when biogeographic based optimization applied to image .The initial seed is selected randomly and find whether the pixels neighbour added or not. In BBO each solution learn from their neighbouring pixel. Solution changes through migration from other solution. HSI contain pixels that have similar properties and LSI contain the pixel having different properties. Select the threshold value and perform thresholding[2]. The simplest is based on a clip-level or a threshold value to turn a gray-scale image into a binary image. That binary image contains all the information about shape of object of interest. Thresholding is iterative process consists of following steps:

1) *Step-1* : An initial threshold (T) is chosen; this can be done randomly or according to any other method desired.
2) *Step-2* : The image is segmented into object and background pixels as described above, creating two sets:

$$G_1= \{f(m,n):f(m,n)>T\} \text{ (object pixels)} \quad (6)$$

$$G_2 = \{f(m,n):f(m,n)\leq T\} \text{ (background pixels)} \quad (7)$$

Where f(m,n) is the value of the pixel located in the m^{th} column, n^{th} row.

3) *Step-3* : An initial threshold (T) is chosen; this can be done randomly or according to any other method desired.
The average of each set is computed. M_1 is average of G_1 and M_2 average of G_2.
4) *Step-4 :* A new threshold is created that is the average of M_1 and M_2.

$$\text{New threshold } T = (M_1 + M_2)/2 \quad (8)$$

5) *Step-5* : Go back to step two, now using the new threshold computed in step four, keep repeating until the new threshold matches the one before it.

By using thresholding, pixels having similar properties or belongs to HSI are grouped together and pixels having different properties or LSI pixels belongs some other region. So after this migration process object pixels are isolated from background pixels.As we started we select a seed using some set of predefined criteria. After selecting examine neighbour pixels of seed points and calculate MSE color distance between pixels. According to the BBO approach make three islands HSI and LSI.HSI (highly suitability index) that contain pixels which have more similar properties. Low suitability index (LSI) that contain pixels which contain pixels that not so familiar. HSI tend to have a large number of species, while those LSI have a small number of species. Then we select threshold. If our calculated distance less than threshold then its migrate to other region, otherwise its make its own region.

A. Migration

Image population is considered to be total number of pixels. Population consists of population member or represented by number of pixels or species. Here island is considered as solution of problem or represented by group of similar pixels. Initialize the randomly generated SIV which characterize the population or species[5]. These SIV's represent solution of problem, group of similar pixels, Habitat H or Island. Each SIV is compared with fitness value (HSI). Replace the SIV on the basis of fitness value. After the predefined number of iterations, sort the SIV from best to worse.

B. Migration

Mutation is process of modifying the value of randomly selected SIV for better solution[7]. Mutation rate explore new SIV values and give better results.

IV. PROPOSED ALGORITHM

In order to restore image same biogeographic based segmentation technique is applied .Our basic aim is to remove the biasing from the image by using the segmentation detail and restore the image. By using local image information, image with intensity inhomogeneity can be segmented. Curve can be represented by diagram shown in Fig.2 In proposed algorithm intensity homogeneity can be segmented.

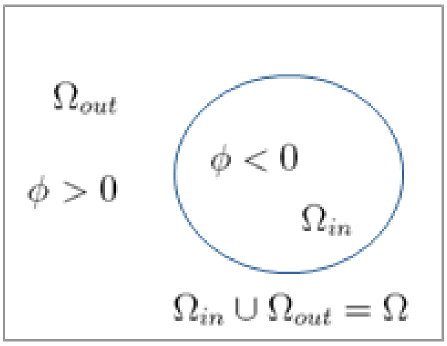

Fig. 2 Curve Evolution

The Heaviside function is the integral of the Dirac delta function . An alternative form of the unit step, as a function of a discrete variable *n*:

$$H[n] = \begin{cases} 0, & n < 0, \\ 1, & n \ge 0, \end{cases} \tag{9}$$

While integrating the Heaviside Distribution within the image domain.

$$|\Omega_{in}| = \int\int H_\alpha(\phi) d\Omega \tag{10}$$

Firstly apply the Gaussian filter to image in order to remove noise. Then apply biogeography based optimization for further restoration process. For all the pixels of object, if neighbourhoods included the heterogeneous pixel, the pixel was regarded as candidate boundary point[12]. Some pixels, such as noise points, might be included in the candidate boundary points. By using thresholding, pixels having similar properties are grouped together and pixels having different properties some other region. So after this migration process object pixels are isolated from background pixels. Here threshold value is considered as fitness value. Give threshold value according to desired results. In order to remove noise apply biogeography based optimization and find out the curvature with central difference scheme. According to Neumann boundary condition, directional directive normal to some boundary is zero. Find out the boundary points using Neumann condition. The intensity of image varies from 0 to 255.Find out average intensity. Compare the intensity of every pixel. If intensity of pixel is greater than average, it means it belongs to object. Using Heaviside function find out the object and background. Binary '1' represents pixels belongs to object and '0' represents background pixels Replace these pixel values of object pixels by using mutation in order to make their intensity high. Let *l* is a finite difference approximation of Laplace's differential operator applied to u and equal to the difference between an element of u and the average of its four neighbours, that is:

$$l = \frac{\nabla^2 u}{4} = \frac{1}{4}\left(\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2}\right) \tag{12}$$

Find out penalize term and make the intensity value of object pixels high. Take mu=255 which is considered as maximum intensity of grayscale image. By using curve separate object and background. Update the curve using penalize term.

Penalize term=mu*(*l* - central curvature) (13)

Remove noise by finding out image term ,length term and penalize term and update the curve. Repeat this procedure and update the value of curve. Now the object pixels have maximum intensity or we can say that image is restored.

Steps to be followed are given below:

1) *Step-1* : Read the noisy image.
   Step-2 : Apply Gaussian filter in order to remove some noise and make it suitable for segmentation.
2) *Step-3 :* Initialise the curve by defining function variable.
3) *Step-4 :* Based on sharing of species information between neighbouring pixels perform migration. Find out the boundary points using Neumann condition using neighbouring pixels.
4) *Step-5 :* Find out the curvature of curve using central difference scheme
5) *Step-6 :* Use Heaviside function differentiate between object pixels and background pixels. According to some fitness criteria or threshold value separate object pixels and background pixels. Extract the value of contour.
6) *Step-7 :* Replace the object pixels by the pixels of maximum intensity and remove noise from image by using mutation. Create hybrid region using mutation.
7) *Step-8 :* If the termination criterion is not met, go to step 3; otherwise, terminate

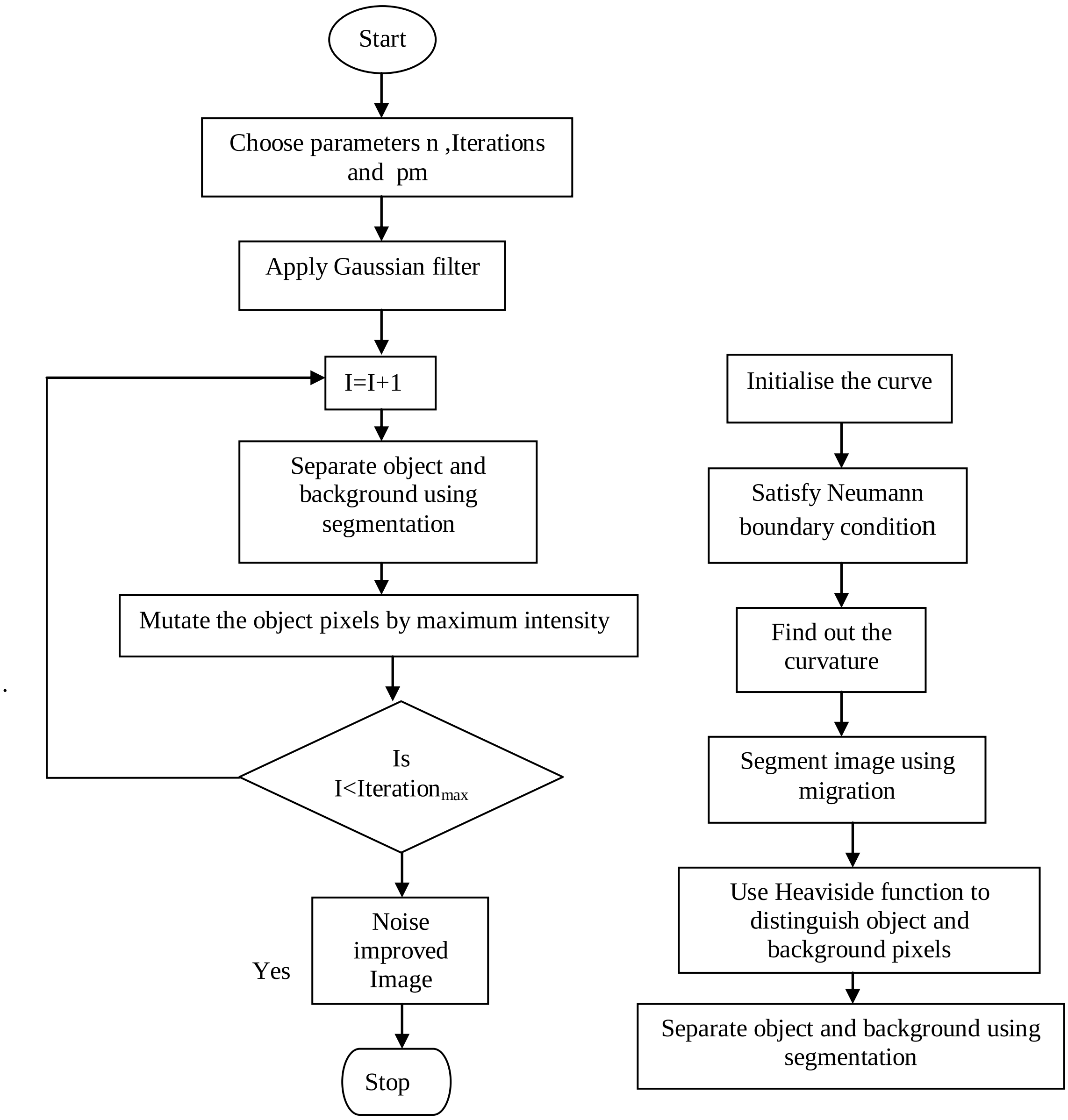

Fig. 3 Flowchart

V. Proposed Algorithm

Set value of mutation probability Pm for BBO and find out best fitness value. Let cardinality of search set n=4,population size N=4, number of peers=2.Set mutation probability Pm = 0.0001 and the readings of probability of BBO solution is shown in Table 1. The graph between cumulative percentage of population and generation number is shown inFig.4.

TABLE I

BBO Plot For MUTATION PROBABILITY=0.01%

Mutation Probability	**Population Vector**	**Probability BBO**
0.0001	0 0 0 4	0.94644
0.0001	0 0 4 0	0.042995
0.0001	0 0 1 3	0.003447
0.0001	No Optimal solutions	0.046229
0.0001	All Optimal solutions	0.94644

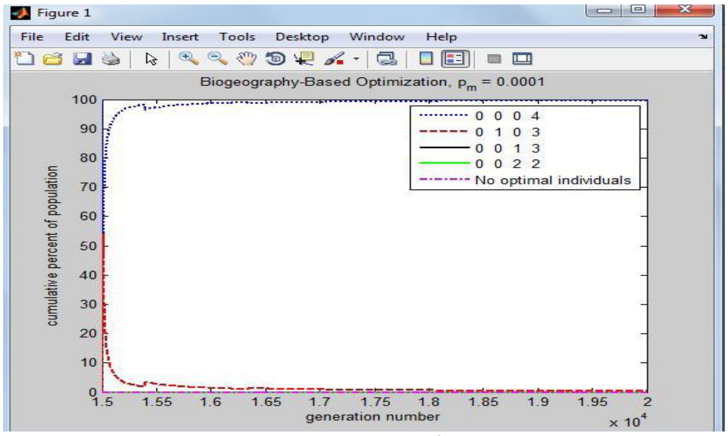

Fig. 4 Graph between cumulative percentage of population and generation number

The graph between cumulative percentage of population and generation number is shown in Fig.4. From the plot we can find the value at Pm = 0.0001. So set the mutation probability Pm =0.0001 for as it give the optimal solution with high probability of BBO solution is 0.94.So it is clear we get optimal solution at mutation probability Pm = 0.0001or 0.01%.Take grayscale image shown in Fig.5which show initial contour and after predefined iterations, the edges are outlined as shown in Fig.6.Our motive to remove this noise by applying based biogeography based segmentation. Applying Biogeography based Segmentation on Medical Image, retrieved and noise free image is shown in Fig.7.

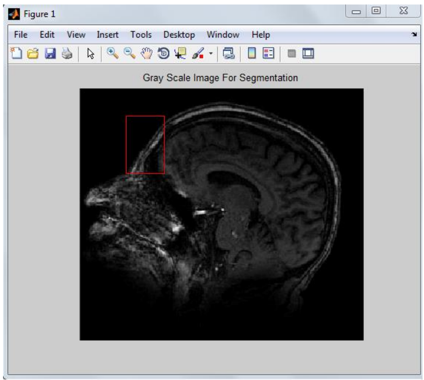

Fig. 5 Noisy Image

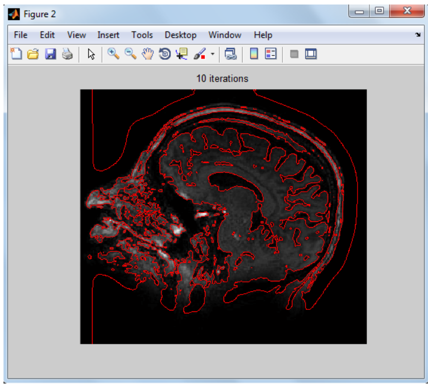

Fig. 6 Segmented image

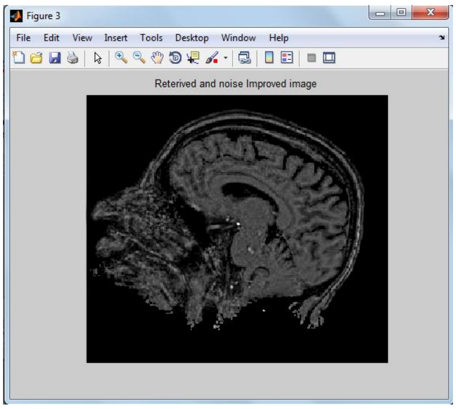

Fig. 7 Restored Image

VI. Conclusion

In order to deal with this long-lasting problem, various image processing techniques have been developed to restore an image. Some of those techniques are simple methods like Discrete Fourier transform, Discrete cosine transform methods. Image restoration processes consist of a collection of techniques. Various optimization techniques are Particle swarm optimization, Genetic algorithm and biogeography based optimization [7][8]. From these three techniques, Biogeography based optimization technique gives best result. Biogeography based optimization technique play an important role in enhancing the quality and contrast of natural images. In future we will improve the stability of program. We want to modify the code of function to let programs more stable. It's a chance to get a better adaptive method for image restoration even that we have an adaptive method already. BBO technique is used especially in the case of Restoration, Enhancement and Segmentation of image. This method can also be applied on Image Compression, Image Smoothing and Sharpening, Video Compression, Image Recognition, Image Steganography and Image Watermarking. Image is processed for visual interpretation, the viewer is ultimate judge of how this method work.

ACKNOWLEDGMENT

This thesis work is based on Biogeography based optimization technique to restore the image by using MATLAB. The main objective of this thesis is to study and implement biogeographic based segmentation technique for restoration of image and applies these techniques on blurred image for restoring the image[7] [8].The basic software required are Windows XP or Windows Server 2010,MATLAB version 7.10.0, Image Processing Toolbox.I would like to thank Prof. Tripatjot Singh Panag, Officer Incharge,PTU Regional Center, Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib for their kind support.I also owe my sincerest gratitude toward my guide Prof. Raju Sharma for his valuable advice and healthy criticism throughout my thesis which helped me immensely to complete my work successfully. I would like to thanks for the authors of all those books and papers which I have consulted during my thesis work as well as for preparing the report.

REFERENCES

[1] B. Bhanu, S. Lee, and J. Ming.,1995. *"Adaptive image segmentation using a genetic algorithm"*, IEEE Transactions on systems, man, and cybernetics, vol. 25, No. 12.

[2] D. Donoho., May 1995. *"De-Noising by Soft-Thresholding,"* IEEE Trans. Information Theory, vol. 41, pp 613-627.

[3] R.L.Lagendijk, J. Biemond and D.E. Boekee., *"Identification and Restoration of Noisy Blurred Images Using the Expectation Maximization Algorithm"*, IEEE Trans. on Acoustics, Speech and Signal Processing, vol. 38, pp.1180-1191.

[4] Y.L. You and M. Kaveh., 1996. *"A Regularization Approach to Joint Blur Identification and Image Restoration",* IEEE Trans. on Image Processing, vol. 5, pp. 416-428.

[5] Haiping Ma, Suhong Ni, and Man Sun.,2009. *"Equilibrium Species Counts and Migration Model Tradeoffs for Biogeography-Based Optimization"* IEEE Conference on Decision and Control Shanghai,P.R. China, December 16-18, 2009.

[6] D. Du, D. Simon, and M. Ergezer., 2009. *"Biogeography-Based Optimization Combined w ith Evolutionary Strategy and Immigration Refusal"*, IEEE International Conference on Systems, Man, and Cybernetics, available online at http://embeddedlab.csuohio.edu/BBO.

[7] D. Du, D. Simon, and M. Ergezer., 2009. *"Population Distributions in Biogeography-Based Optimization with Elitism"*, IEEE International Conference on Systems, Man, available online at http://embeddedlab.csuohio.edu/BBO.

[8] Simon, D.,2008. "*Biogeography-Based Optimization,"* IEEETransactions on Evolutionary Computation, Vol. 12, No. 6, pp. 702 –713.

[9] T. Davis and J. Principe. , 1993. "A Markov chain framework for thesimple genetic algorithm" ,*Evolutionary Computation*, vol. 1, pp. 269-288.

[10] Surbhi Gupta, Krishma Bhuchar, Parvinder S. Sandhu,2011. *"Implementing color image segmentation using Biogeography Based Optimization"*2011International Conference on Software and Computer Applications IPCSIT vol.9 IACSIT Press, Singapore.

[11] Deepak Jha, Sachin Jain, Manish Kumar and Mandeep Dalal.,2012. *"Estimation of convolution Mask for MRI restoration using genetic algorithm"*International Journal of Research Review in Engineering Science and Technology,Volume1,Issue 1,June 2012.

[12] T.Saikumar,S.Amit,Y.Dinesh,2010. *"Improved Kernel Fuzzy Adaptive Threshold algorithm on level set method for Image Segmentation"*International Journal of Video & Image Processing and Network Security,Volume10,Issue 1,December 2010.

