ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(8): 284-287
www.allresearchjournal.com
Received: 11-06-2016
Accepted: 12-07-2016

SP Priyadharshini
Head, Dept. of PG Computer Science, AJK College of Arts & Science, Navakkarai, Coimbatore, Tamil Nadu, India

S John Grasias
Head, Dept. of Computer Applications AJK College of Arts & Science, Navakkarai, Coimbatore, Tamil Nadu, India

Correspondence
SP Priyadharshini
Head, Dept. of PG Computer Science, AJK College of Arts & Science, Navakkarai, Coimbatore, Tamil Nadu, India

Image segmentation with optimization techniques

SP Priyadharshini and S John Grasias

Abstract
Image segmentation is an essential technique and plays vital role in image analysis system and computer vision. Image segmentation is to partitions an input image into its constituent parts and extracting useful information from complex images. Ant colony optimization (ACO) is a cooperative search algorithm inspired by the behaviour of real ants. In order to achieve an approving performance of ACO is global optimization algorithm to solve image segmentation problems. Consequently, the image segmentation can be performed more effectively by finding disease in medical images by using conventional optimization algorithms. The proposed method has been successfully applied to detect the tumour from brain images by using image segmentation techniques. Experimental results show that the proposed segmentation methods produce satisfactory outcome.

Keywords: Segmentation, optimization techniques, consequently, satisfactory outcome

1. Introduction
All in computer vision, Segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Further, Image segmentation is typically used to locate objects and boundaries in images.

Image Enhancement is one of the most important steps in image processing and analysis to improve the interpretability of the information present in images for human viewers. Filter techniques are mainly used for smoothness and sharpening of images and extracting the useful information for the analysis for image processing.

2. Image Enhancement
Image Enhancement is one of the important aspects of image processing to advance the interpretability of the present in images. The objective of image enhancement is to improve the quality of image as perceived by human beings through enhancement algorithms. It can be performed both in the spatial domain as well as in time domain. In spatial domain method median filter is used which works on pixel values of the images.

3. Median Filter
An image containing salt-and-pepper noise is called Gaussian noise which will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by analog-to-digital converter errors, bit errors in transmission. Images are usually degraded by various noises in the signal transmission, coding and decoding processing. The results of image processing such as image segmentation, feature extraction and image recognition will to a great extent depend on the noise removal results. So de-noising an image is of great importance in image processing.

Recently, a rapid advance in mathematics gave impetus to the research and development of digital image processing. Locate the noised pixel according to the firing state and then remove it using proper algorithms such as Median filter. This avoids false operation on non noise pixels. Therefore, the algorithm can not only remove noise, but also can keep the details of the image well. In median filtering, a pixel is replaced by the median of the pixels contained in a window around by pixels.

$$y_i(N) = \sum_{n=0}^{m-1} w_n(N) b_n(N)$$

Where W is a suitably chosen window around the pixel. The algorithm for median filtering requires arranging the pixel values in the window in increasing or decreasing order and picking the middle value. Generally, the window is chosen to be square with an odd square size. Median filtering is popular in removing salt n paper noise and works by replacing the pixel value with the median value in the neighborhood of that pixel. Median filters are statistical non-linear filters that are often described in the spatial domain. A median filter smoothens the image by utilizing the median of the neighborhood. Median filter performs the following tasks to find each pixel value in the processed image:

- All pixels in the neighborhood of the pixel in the original image which are identified by the mask are stored in the ascending (or) descending order.
- The median of the stored value is computed and is chosen as the pixel value for the processed image.

4. Image Segmentation

Image segmentation is the process of partitioning a Digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

4.1 Particle Swarm Optimization

Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart andDr. Kennedy in 1995, inspired by social behavior of birds. The system is initialized with a population of random solutions and searches for optima by updating generations. The potential solutions, called particles, fly through the problem space by following the current optimum particles. The advantages of PSO are that PSO is easy to implement and there are few parameters to adjust. PSO has been successfully applied in many areas: function optimization, artificial neural network training, fuzzy system control, and other areas where GA can be applied.

For each particle
Initialize particle
For each particle
Calculate fitness value
If the fitness value is better than the best fitness value (pbest)
Set current value as new pbest
End
Choose the particle with the best fitness value of all the particles as gbest
For each particle
Calculate particle velocity
Update particle position
End
Continue while maximum iterations or minimum error criteria is not attained.

PSO has a fitness evaluation function to compute each position's fitness value. The position with the highest fitness value in the entire run is called the global best solution PBest. Each particle tracks its highest fitness value. The location of this value is called the personal best solution Pi. The algorithm involves casting a population of particles over the search space and remembering the best solution encountered. For each iteration, all particles adjust its velocity vector based on its momentum, and the effect of both its best solution and the global best solution of its neighbors.

4.2 Ant Colony Optimization

Ant colony optimization (ACO) is a nature-inspired optimization algorithm motivated by the natural phenomenon that ants deposit pheromone on the ground in order to mark some favourable path that should be followed by other members of the colony. The first ACO algorithm, called the ant system, was proposed by Dorigo *et al*..

ACO has been widely applied in various problems. In this thesis, ACO is introduced to undertake the image segmentation problem, where the aim is to extract the edge information presented in the image, since it is crucial to understand the image's content. The proposed approach exploits a number of ants, which move on the image driven by the local variation of the image's intensity values, to establish a pheromone matrix, which represents the edge information at each pixel location of the image. Ant colony optimization is applied for the image processing which are on the basis continuous optimization. This paper proposes an ant colony optimization (ACO) based algorithm for continuous optimization problems on images like image edge detection, image compression, image segmentation, structural damage monitoring etc in image processing.

4.3 Algorithm for ACO

Initialization of Pheromone, K, maximum iteration, ρ,
For each ant
Movement of k_{th} ant from pixel i to pixel j according to the probability equation for K number of steps
First update of the pheromone matrix locally (local pheromone update)
Find out binary mask
Second update of the pheromone matrix globally
End for.

5. Experimental results and discussions

The proposed algorithm has been implemented using MATLAB. The performance of various image segmentation approaches are analyzed and discussed. The measurement of image segmentation is difficult to measure. There is no common algorithm for the image segmentation.

The quality of image segmentation is measured by some statistical parameters such as Rand Index (RI), Global Consistency Error (GCE), Boundary Displacement Error (BDE), and Variations of Information (VOI) are used to evaluate the performance.

Now a day's cancer is one of the diseases that jolts people the nearly everyone. Brain cancer may be considered among the most difficult cancers to treat, as it involves the organ which is not only in control of the body, but is also responsible for the self-definition of the person. Recently, swarm intelligence (SI) has been applied in several fields including optimization. One of SI methods performing well in solving optimization problems is particle swarm optimization (PSO) and Ant Colony Optimization (ACO). The optimization algorithm is easy to implement and has been successfully applied to solve a wide range of optimization problems in many fields such as image processing fields including image segmentation. Image segmentation is a low-level image processing task aiming at partitioning an image into homogeneous regions.

The statistical measurements could be used to measure the quality of the image segmentation. The rand index (RI), global consistency error (GCE), boundary displacement error (BDE), and variations of information (VOI) are used to evaluate the performance. The detailed description with formulae of RI, GCE, BDE, VOI parameters are explained in detail as follows.

Table 1: Statistical Parameters of Image Segmentations

Images	Rand Index (RI)		Global Consistency Error (GCE)		Variations of Information (VI)		Boundary Displacement Error (BDE)	
	PSO	ACO	PSO	ACO	PSO	ACO	PSO	ACO
1	0.8673	0.8932	0.2213	0.2134	0.6349	0.6201	0.4569	0.4248
2	0.8083	0.9345	0.4402	0.1102	0.2449	0.2112	0.2921	0.2355
3	0.7710	0.9852	0.3401	0.1278	0.3375	0.2621	0.3745	0.3628
4	0.9706	1	0.4504	0	0.2368	0	0.4896	0.4542
5	0.8145	0.8825	0.5365	0.4568	0.5145	0.4497	0.4416	0.4161
6	0.8275	0.7658	0.5312	0.3265	0.5698	0.4223	0.5093	0.4854
7	0.9545	09645	0.4569	0.1568	0.4945	0.4521	0.2345	0.1986
8	0.9648	1	0.6058	0	0.5030	0.4245	0.5369	0.5042
9	0.8744	1	0.0469	0	0.6836	0.5512	0.5223	0
10	0.7166	0.9645	0.0884	0.2650	0.7045	0.2205	0.3715	0.2586
11	0.9570	0.9856	0.0659	0.0356	0.5779	0.4577	0.6503	0.5698
12	0.7458	1	0.0035	0.3581	0.4456	0.4289	0.4623	0
13	0.6285	0.7589	0.0365	0	0.5986	0.2258	0.7685	0
14	0.5478	0.8569	0.0158	0.0345	0.2689	0.2568	0.3986	0.2586
15	0.8845	0.9658	0.0178	0.0896	0.3109	0.1120	0.5841	0.0123
16	0.8512	1	0.0451	0	0.5881	0.5582	0.3103	0.0896
17	0.9478	0.9658	0.0158	0	0.6458	0	0.7158	0
18	0.8562	0.9645	0.4580	0.0256	0.8546	0.8456	0.8456	0.2653
19	0.9545	09645	0.4569	0.1568	0.4945	0.4521	0.2345	0.1986
20	0.9648	1	0.6058	0	0.5030	0.4245	0.5369	0.5042

Table 1 is point up the performance of PSO and ACO are evaluate by using statistical parameter such as Rand Index, Global Consistency Error, Variation of Information, and Boundary Displacement Error over 20 images. The highlighted values in the table are better value of an image for methods of image segmentation

Table 2: is illustred the average performance of ACO and PSO. The rand index value of ACO issuperiorcompare to PSO. whereas, all other parameter of ACO such as GCE, BDE, VI are improved.

Rand Index		Global Consistency Error		Boundary Displacement Error		Variation of Information	
PSO	ACO	PSO	ACO	PSO	ACO	PSO	ACO
0.8453	0.9426	0.2719	0.1178	0.4868	0.2619	0.5108	0.3687

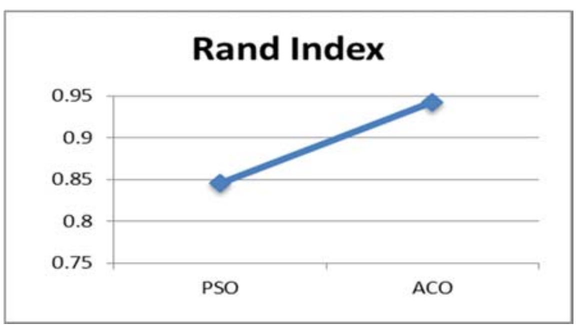

Fig 1: Performance analysis of Rand Index

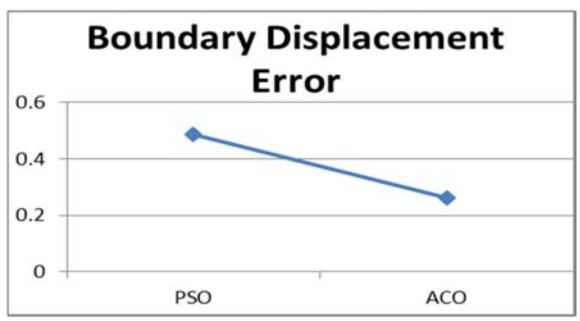

Fig 3: Performance analysis of Boundary Displacement Error

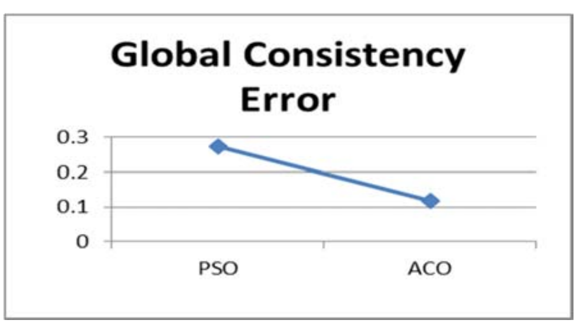

Fig 2: Performance analysis of Global Consistency Error

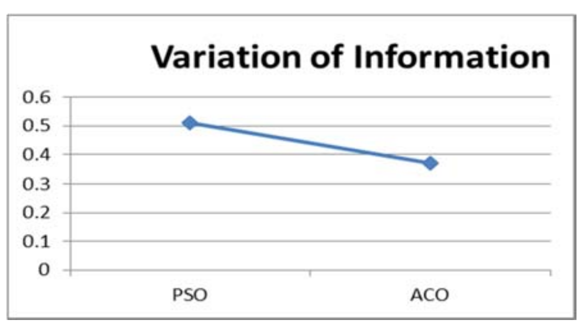

Fig 4: Performance analysis of Variation of Error

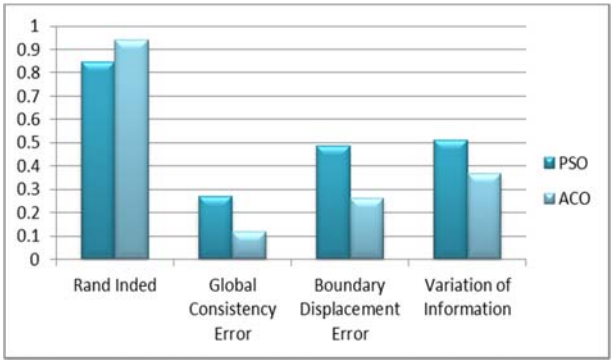

Fig 5: average performance analysis chart reveals that the Rand Index of Ant Colony Optimization

Fig1. has highlighted the performance of ACO and PSO its rand index value, Fig. 2 Is illustrate the performance of ACO and PSO its global consistency error, Fig. 3 is demonstrate the average performance analysis of ACO and PSO its boundary displacement error and Fig.4 is express to the average performance of ACO and PSO its variation of error.

Average performance analysis chart reveals that the Rand Index of Ant Colony Optimization algorithm is higher than Particle Swarm Optimization and also the global consistency error, variation of information, and boundary displacement error of ACO are lower than PSO. It was observed that the proposed method Ant Colony Optimization performs better compare to Particle Swarm Optimization approach.

5. Conclusions

The Brain tumour is one of the most common killer diseases for human being. At present researchers are developing a best optimization algorithm to detect presence of brain tumor based on image segmentation technique. Yet there is no such best optimization algorithm available. So there is a great scope for developing such an algorithm. To do this task in this research work, two optimization algorithms have been proposed to detect presence of brain tumor based on image segmentation technique. The physical dimension of the tumor which is of highest importance to the physicians could also be calculated using the proposed techniques. Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) have been proposed and used for finding the disease of tumor in brain image. The quality of image segmentation is measured by some statistical parameters such as Rand Index (RI), Global Consistency Error (GCE), Boundary Displacement Error (BDE), and Variations of Information (VOI). The proposed methods are successfully applied to detect the tumor from brain images by using image segmentation techniques. Experimental results show that the proposed segmentation methods produce satisfactory outcome. The computational results showed that the proposed ACO based image segmentation technique gives the better quality result than PSO with reference to 20 brain images. RI, GCE, BDE, VI values of ACO is better than those of PSO. So ACO performs better than PSO for this problem. The experiments demonstrate the potential of proposed algorithms. The major advantages of the proposed algorithms are low computational time and complexity.

6. References

1. Alamelumangai N, Dr. Devi Shree J. PSO Aided Neuro Fuzzy Inference System for Ultrasound Image Segmentation, International Journal of Computer Applications (0975 – 8887). 2010; 7(14).
2. Pushpavalli R, Sivaradje G. Switching Median Filter for Image Enhancement, International Journal of Scientific & Engineering Research. 2012; 3(2). ISSN 2229-5518.
3. Yao Wang. Image Filtering: Noise Removal, Sharpening, Deblurring, Polytechnic University, Brooklyn, NY11201. 2006.
4. Chaohong Wu, Zhixin Shi, Venu Govindaraju. Fingerprint Image Enhancement Method Using Directional Median Filter, 2004.
5. Computer Vision CITS4240, School of Computer Science & Software Engineering, the University of Western Australia 2012. Australia 2012.