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A REVIEW ON VARIOUS IMAGE SEGMENTATION TECHNIQUES USING VARIOUS OPTIMIZATION TECHNIQUES

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ABSTRACT

In this paper we are defining about the image segmentation using help of PSO and BBO. BBO is basically an optimization techniques it does not involve reproduction or the generation of "children" whereas Particle swarm optimization is a stochastic global optimization algorithm that is based on swarm intelligence. Because of its excellent performance, particle swarm optimization is introduced into fuzzy entropy image segmentation to select the optimal fuzzy parameter combination and fuzzy threshold adaptively. This paper elaborates BBO and PSO approach for image segmentation i.e. partitioning an image into multiple segments.

Keywords: **PSO, BBO, image segmentation,**

I. INTRODUCTION

The meant of image segmentation is to cluster the pixels into relevant region and these regions may be surfaces, object or part of the image. There are many methods available to perform this segmentation. Clustering is a common step to get the segmentation. In the data space, clusters are regarded as regions of similar data points. This work discuss about semi supervised clustering for image segmentation using prior information. Image segmentation is done with 5 methods.

1) Pixel Based Segmentation
2) Region Based Segmentation
3) Edge Based Segmentation
4) Edge and Region Based Segmentation
5) Clustering Based Segmentation

Original Image Segmented Image

Image segmentation is mainly used to locate objects or object boundary, lines etc in an image so it can be used in applications which involve a particular kind of object recognition such as:

1) Face Recognition
2) Fingerprint Recognition
3) Locating objects in satellite images
4) Traffic control systems
5) Brake light detection
6) Machine vision
7) Agricultural imaging – crop disease detection.
8) Medical imaging
   - o Locate tumors and other pathologies
   - o Measure tissue volumes
   - o Computer-guided surgery
   - Treatment planning
   - Study of anatomical structure
   - Diagnosis

II. IMAGE SEGMENTATION TECHNIQUE

The Research on Image segmentation for many years has been a high degree of attention. Thousands of different segmentation techniques are present in the literature, but there is not a single method which can be considered good for different images, all methods are not equally good for a particular type of image [27]. Thus, algorithm development for one class of image may not always be applied to other class of images. Hence, there are many challenging issues like development of a unified approach to image segmentation which can be applied to all type of images, even the selection of an appropriate technique for a specific type of image is a difficult problem.

A. **Segmentation Based on Edge Detection:**

This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted [27] and linked to form closed object boundaries. The result is a binary image [27]. Based on theory there are two main edge based segmentation methods- gray histogram and gradient based method.

B. **Thresholding Method:**

Image segmentation by thresholding is a simple but powerful approach for segmenting images having light objects on dark

background [27]. Thresholding technique is based on imagespace regions i.e. on characteristics of image [27]. Thresholding operation convert a multilevel image into a binary image i.e., it choose a proper threshold T, to divide image pixels into several regions and separate objects from background. Any pixel (x, y) is considered as a part of object if its intensity is greater than or equal to threshold value i.e., $f(x, y) \geq T$, else pixel belong to background. As per the selection of thresholding value, two types of thresholding methods are in existence, global and local thresholding. When T is constant, the approach is called global thresholding otherwise it is

called local thresholding. Global thresholding methods can fail when the background illumination is uneven. In local thresholding, multiple thresholds are used to compensate for uneven illumination. Threshold selection is typically done interactively however, it is possible to derive automatic threshold selection algorithms.

C. Region Based Segmentation Methods:

Compared to edge detection method, segmentation algorithms

based on region are relatively simple and more immune to noise. Edge based methods partition an image based on rapid changes in intensity near edges whereas region based methods, partition an image into regions that are similar according to a set of predefined criteria.

D. Segmentation Methods Based on PDE (Partial Differential Equation):

Using a PDE based method & solving the PDE equation by a numerical scheme one can segment the image. Image segmentation based on PDEs is mainly carried out by active contour model or snakes. This method was first introduced by Kassetal in 1987. Kass developed this method to find familiar objects in presence of noise and other ambiguities. The central idea of snake is transforming a segmentation problem into a PDE framework. That is, the evolution of a given curve, surface or image is handled by PDEs and the solution of these PDEs is what we look forward to various methods for image segmentation are - snake, level set and Mumford-shah model.

E. Segmentation Based on Artificial Neural Network:

Neural Network based segmentation is totally different from conventional segmentation algorithms. In this, an image is firstly mapped into a Neural Network. Where every Neuron stands for a pixel, thus image segmentation problem is converted into energy minimization problem. The neural network was trained with training sample set in order to determine the connection and weights between nodes. Then the new images were segmented with trained neural network, for example, we can extract image edges by using dynamic equations which direct the state of every neuron towards minimum energy defined by neural network. Neural network segmentation includes two important steps feature extraction and image segmentation based on neural network. Feature extraction is very crucial as it determines input data of neural network, firstly some features are extracted from the images, such that they become suitable for segmentation and then they were the input of the neural network. All of the selected features compose of highly non-linear feature space of cluster boundary.

F. Segmentation Based on Clustering

Clustering is an unsupervised learning task, where one needs to identify a finite set of categories known as clusters to classify pixels. Clustering use no training stages rather train themselves using available data. Clustering is mainly used when classes are known in advance. A similarity criteria is defined between pixels, and then similar pixels are grouped together to form clusters. The grouping of pixels into clusters is based on the principle of maximizing the intra class similarity and maximizing the inter class similarity. The quality of a clustering result depends on both the similarity measure used by the method and its implementation. Clustering algorithms are classified as hard clustering, k- means clustering, fuzzy clustering, etc.

III. ACO(ANT COLONY OPTIMIZATION)

In ACO, a colony of simple agents, called artificial ants, search for good solutions at every generation. Every artificial ant of a generation builds up a solution step by step. These ants, once build a solution, will evaluate the

partial solution and deposit some amount of pheromone to mark their paths. The following ants of the next generation are attracted by the pheromone so that they will likely search in these areas nearby.

Algorithm for ACO[29].

Set all parameters and initialize the pheromone trails.

Loop (no. of iterations)

Sub-Loop (population size, popsize)

Build solutions based on the **state transition probability**

Continue until all ants have been generated

Evaluate all solutions during the iteration and select the best one

Apply the **pheromone update** rule

Continue until the **stopping criterion** is reached

For activity selection, the state transition probability shown below is used in the solution construction process.

$$p_{ij} = \begin{cases} \dfrac{(\tau_{ij})^{\alpha}}{\sum_{l \in \{1,2,..,UB_i - LB_i + 1\}} (\tau_{il})^{\alpha}} & j \in \{1,2,..,UB_i - LB_i + 1\} \\ 0 & otherwise \end{cases}$$

where i denotes the index of the threshold at multi-level (e.g. $i = 1$ for bi-level, $i = 2$ for tri-level, and $i = 3$ for four-level), j refers to the index for the gray level ranging from the lower bound and the upper bound of the ith threshold, and α denotes the parameter controlling the relative weight of pheromone. The pheromone trails, denoted by ij τ are constantly updated according to the pheromone updating rule.[29]

IV. PSO (PARTICLE SWARM OPTIMIZATION)

Particle swarm optimization (PSO) is a new evolutionary computing method that was developed by Kennedy and Eberhart in 1995 through the simulation of simplified social models of bird flocks. Due to its excellent performance, PSO has become one of the hotspots in evolutionary computing research and has been used in many applications such as function optimization, neural network training, and fuzzy control systems in recent years. The algorithm of PSO emulates from behavior of animals societies that don‟t have any leader in their group or swarm, such as bird flocking and fish schooling.[22] Typically, a flock of animals that have no leaders will find food by random, follow one of the members of the group that has the closest position with a food source (potential solution). The flocks achieve their best condition simultaneously through communication among members who already have a better situation. The process of PSO algorithm in finding optimal values follows the work of this animal society. Particle swarm optimization consists of a swarm of particles, where particle represent a potential solution. The algorithm of PSO is initialized with a particles obtained from SGF texture feature and then searches for optima by updating generations.

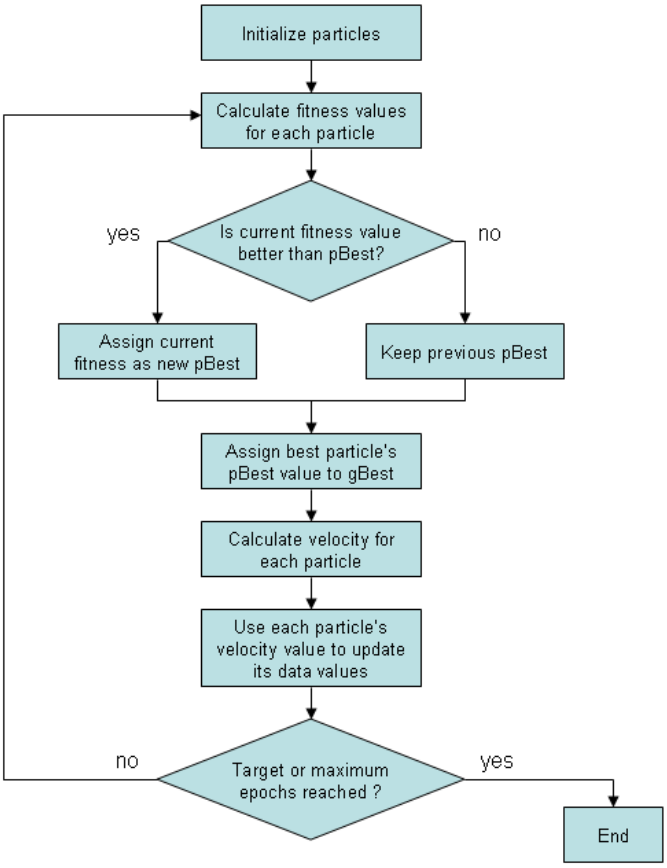

Fig2. Flow chart for PSO

Figure.2.Result of Segmentation
(a) Original image (b) optimal texture Portion

c) selected region d) segmented portion of the image c.

Fig 3. System Model

V. BBO(BIOGRAPHIC BASED OPTIMIZATION)

BBO is a population-based optimization algorithm it does not involve reproduction or the generation of "children." Mathematical equations that govern the distribution of organisms were first discovered and developed during the 1960s. Mathematical models of biogeography describe how species migrate from one island (habitat where they live) to another, how new species arise, and how species become extinct.

Biogeography basically based on two criteria-HIS and LSI. Geographical areas that are well suited and more compatible as residences for biological species are said to have a highly suitability index (HSI). Features that correlate with HSI include such factors as rainfall, diversity of vegetation, diversity of topographic features, land, area, and temperature (Simon, 2008). The variables that characterize habitability are called suitability index variables (SIVs). Habitats with a HSI tend to have a large number of species, while those with a low HSI have a small number of species. Habitats with a HSI have a low species immigration rate because they are already nearly saturated with species. HIS are more static than LSI. LSI have a high species immigration rate because of their sparse populations. LSI habitats are more dynamic in their species distribution than HIS habitats.

BBO consist of following basic steps:

1) Migration: The objective function value indicates the HSI for particular population member. Immigration and emigration rates are decided by the curves in figure 1. The nature of the curve is assumed to be same for immigration and emigration rate but with opposite slopes as both are linear in nature. Value of S represented by the solution depends upon its HSI.
2) Mutation: In nature a habitat's HSI can change suddenly due to random events. This phenomenon is known as SIV mutation and probabilities of species count are used for finding mutation rates. This probability mutates low HSI as well as high HSI solutions. Equation used for finding mutation rate is as follows.

$$M(S) = M_{max}\left(1 - \frac{P_s}{P_{max}}\right)$$

Where Mmax is a user defined parameter called mutation coefficient.

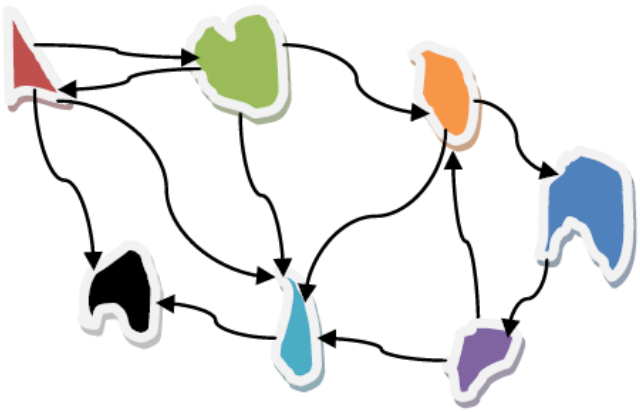

Fig4. Migration of spice(Simon,2008)[20]

Initialize Parameters:

P= population size

G= Maximum number of generation

Keep =Elitism parameter

Pmod =Island modification probability

Step1: Initialize P randomly and species count

probability of each Habitat

Step2: Evaluate the fitness for each individual in P

Step3: While The termination criteria is not met do
Step4: Save the best habitats in a temporary array
Step5: For each habitat, map the HSI to number of species S, λ and μ
Step6: Probabilistically choose the immigration island based on the immigration rates
Step7: Migrate randomly selected SIVs based on the selected island in Step6
Step8: Mutate the worst half of the population as Per mutation algorithm
Step9: Evaluate the fitness for each individual in P
Step10: Sort the population from best to worst
Step11: G=G+1
Step12: end while
Algorithm for BBO[28]

VI. CONCLUSION

Segmentation is a collection of methods allowing interpreting spatially close parts of the image as objects. From many decades, image segmentation is implemented using many techniques like PSO, GA, clustering techniques etc. BBO technique is typically used for detection of abnormal growth of tissues. Manual quantization of these tissues cannot be compared with the fast day today methods The PSO method can obtain the same optimal fuzzy parameter combination and fuzzy threshold as that of the exhaustive search while its search time is less than that of the exhaustive search when applied to different kinds of remote sensing images. Therefore, fuzzy entropy image segmentation based on PSO is an efficient segmentation method.

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