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3D Image Segmentation using BBO

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Abstract—

This paper proposes a Biogeography Based optimization approach for automatically grouping the pixels of an image into different homogeneous regions. Biogeography is the study of the geographical distribution of biological organisms. BBO is basically an optimization techniques it does not involve reproduction or the generation of "children." From many years Image segmentation are done with many techniques like PSO, ACO etc. This paper elaborates BBO approach for image segmentation i.e. partitioning an image into multiple segments.

Keywords— ***Segmentation, Clustering, Region Growing, Biogeography*** *based optimization*

I. INTRODUCTION

"Segmentation" refers to the process of dividing a digital image into multiple segments such as a sets of pixels, also known as super pixels[1]. The main objective of segmentation is to simplify and/or change the representation of an image into meaningful image that is more appropriate and easier to analyze. Segmentation is basically a collection of methods that allowing spatially partitioning close parts of the image as objects. "Image segmentation" is an important aspect of digital image processing. Image segmentation may be defined as a process of assigning pixels to homogenous and disjoint regions which form a partition of the image that share certain visual characteristics. Image segmentation is used to locate and find objects and boundaries (lines, curves, etc.) in images[5]. It basically aims at dividing an image into subparts based on certain feature. Features could be based on certain boundaries, contour, color, intensity or texture pattern, geometric shape or any other pattern. It provides an easier way to analyze and represent an image[3]. The image segmentation process consists in grouping parts of an image into units that are homogeneous with respect to one or more characteristics as shown in fig 1. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. An example of image segmentation are given below:-
Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines neighbouring pixels of initial "seed points" and determines whether the pixel neighbours should be added to the region (Yu and Clausi, 2007).

Application of Image segmentation:-
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:
• Face Recognition
• Fingerprint Recognition
• Locating objects in satellite images
Since it deals with object detection, so it can also be used in applications involving object tracking such as traffic surveillance etc. Some of the practical applications of image segmentation are[3]:
• Medical imaging
• Locate tumors and other pathologies
• Measure tissue volumes
• Computer-guided surgery
• Diagnosis
• Treatment planning
• Study of anatomical structure
• Traffic control systems
• Brake light detection
• Machine vision
• Agricultural imaging – crop disease detection

II. BIOGRAPHY BASED OPTIMIZATION

Biogeography-Based Optimization, a type of evolutionary algorithm[2]. As its name implies, BBO is based on the mathematical study of biogeography. Biogeography is the study of the distribution of animals and plants over time and space. Its aim is to elucidate the reason of the changing distribution of all species in different environments over time. BBO is an evolutionary process that achieves information sharing by species migration[4]. It is modeled after the

immigration and emigration of species between habitats to achieve information sharing. BBO operates by migrating information between individuals, thus resulting in a modification of existing individuals. Individuals do not die at the end of a generation One characteristic of BBO is that the original population is not discarded after each generation. It is rather modified by migration[6]. 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[18]. 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[8]. 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)[17]. 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[9]. 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.

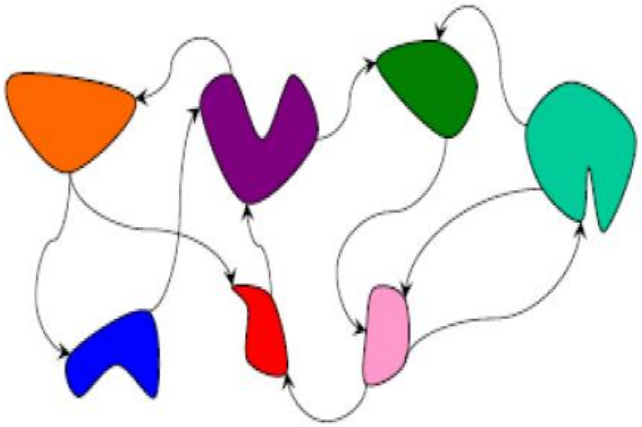

Fig. 1: Migration of spices[1]

BBO has demonstrated good performance on various unconstrained and constrained benchmark functions (Du et al., 2009; Ergezer et al., 2009; Ma and Simon, 2010). The species model of a single habitat is shown below in Fig. 2

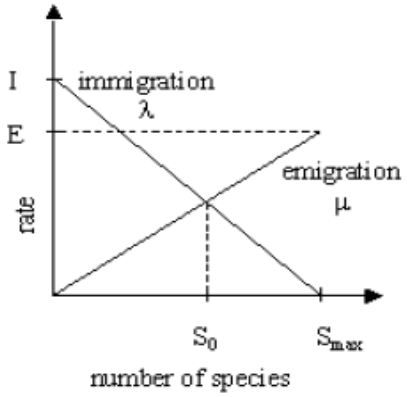

Fig2. Species model of a single habitat containing number of species[5]

Fig.2 illustrates a model of species abundance in a single habitat. The immigration rate λ and the emigration rate μ are functions of the number of species in the habitat. In immigration curve, maximum possible immigration rate I to the habitat occurs when there are zero species in the habitat[16]. As the number of species increases fewer species are able enter to the habitat and the immigration rate decreases[7]. The largest possible number of species in habitat Smax is at which point the immigration rate becomes zero. For emigration curve, if there are no species in the habitat then the emigration rate must be zero[10]. As the number of species increases more species are able to leave the habitat and the emigration rate increases. The maximum emigration E rate occurs when the habitat contains the largest number of species. The equilibrium number of species is So at which point the immigration and emigration rates are equal[8]. Each

individual has its own λ and μ and are functions of the number of species *K* in the habitat and is expressed by equation (1) and (2).

$\lambda = I\,(1-K/n)$…… (1)

$\mu = E/n$ …… (2)

Where k is the number of species of the k-th individual;
n is the maximum number of species.
E is Maximum emigration rate and
I is Maximum immigration rate.
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

III. METHODOLOGY

Image Segmentation is one of the important aspects of Digital image processing. Many techniques are used for image segmentation like clustering techniques where the features describing each pixel correspond to a pattern[11], and each image region (i.e. a segment) corresponds to a cluster (Lynch and Ghita, 2008). Therefore many clustering algorithms have widely been used to solve the segmentation problem (e.g., Kmeans, FCM, ISODATA and Snob)[12].Here we use new biogeographic technique for image segmentation (Taiwi, 2004). BBO is a population based optimization algorithm it does not involve reproduction or the generation of "children." As started select a seed using some set of predefined criteria. After selecting examine neighbour pixels of seed points and calculate MSE color distance between pixels (Auger and Hansen, 2005). If we use RGB image, then we calculate MSE color distance[14]. If we use LAB color space then we calculate CMC color distance between neighbouring pixels (Haisong and Hirohisa, 2005). According to the BBO approach make three islands HIS, MSI and LSI.HSI (highly suitability index) that contain pixels which have more similar properties[13]. Medium suitability index (MSI) basically contains pixels which have medially suitable. 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[15]. HSI have many species that emigrate to nearby habitats, simply by virtue of the large number of species that they host. HIS have a low species immigration rate because they are already nearly saturated with species. Therefore, HIS habitats are more static in their species distribution than LSI habitats. LSI has a high species immigration rate because of their sparse populations. Then we select threshold value (Fritz, Rinck and Dillmann, 2006). If our calculated distance less than threshold then it's migrate to other region, otherwise its make its own region.

IV. IMPLEMENTATION & RESULTS

For implementing BBO approach for image segmentation firstly we take RCB image, and then convert it into Lab image as shown below Fig 3. Then we segmented the objects in image and make different clusters. Those objects contain red objects are shown in fig below

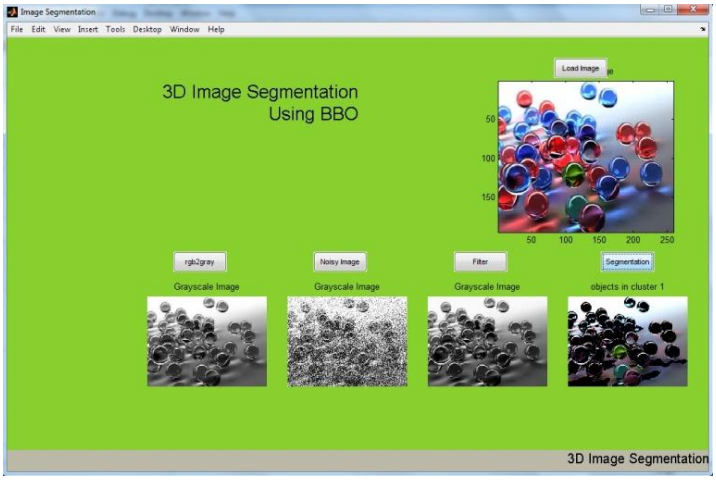

Fig. 3: Experimental results

V. 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 is uniquely a biogeography technique used for implemented image segmentation which provide more accurate segmented image as compared to other evolutionary algorithm. BBO is a population-based optimization algorithm and it does not involve reproduction or the generation of "children."

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