ISSN: 2321-7782 (Online)
Volume 2, Issue 8, August 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Efficient tumor segmentation in medical images using artificial bee colony optimization algorithm and fuzzy c-means clustering

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Abstract: ***Fuzzy c-means (FCM) is a useful clustering technique. A conventional FCM algorithm does not fully utilize the spatial information in the image. In this paper the bee colony optimization algorithm uses a segmentation process is almost similar to ant colony search process, but bee colony optimization has some advantage in comparison with ant colony optimization. In recent years, artificial bee colony optimization algorithm has been successfully applied to hard combinational optimization problems included travelling salesman problem, job shop scheduling etc., however, it has not been used to image segmentation as yet. The system also uses Improved Fuzzy C-Means (FCM) clustering algorithm which has advantages over the previous, which has already been used to segmentation of MR images of brain tumor segmentation experiments show that an excellent accuracy of this algorithm for abnormal brains with edema, tumor, etc, is not efficient. IFCM algorithm only takes care to pixel intensity and does not consider their location or neighbourhood properties or any other features in the images. As a result, noisy images influence effectiveness of this algorithm. Fortunately, Medical images always contain a significant amount of noise caused by operator, equipment, and the environment, which lead to serious inaccuracies in the segmentation. It is caused any changes in pixels intensity such as noise, significantly affects the clustering results with better accuracy is achieved.***

Keywords: Improved Fuzzy C-Means clustering, Brain Tumor Detection and Segmentation, MRI, Artificial Bee Colony Optimization.

I. INTRODUCTION

A brain tumor, or tumor, is an intracranial solid neoplasm, a tumor (defined as an abnormal growth of cells) within the brain or the central spinal canal.

Brain tumors include all tumors inside the cranium or in the central spinal canal. They are division, usually in the brain itself, but also in lymphatic tissue, in blood vessels, in the cranial nerves, in the brain envelopes (meninges), skull, pituitary gland, or pineal gland, Within the brain itself, the involved cells may be neurons or glial cells (which include astrocytes, oligodendrocytes, and spread from cancers primarily located in other organs (metastatic tumors) [1].

Any brain tumor is inherently serious and life-threatening because of its invasive and infiltrative character in the limited in the limited space of the intracranial cavity. However, brain tumor (ever malignant ones) are not invariably fatal, especially lipomas which are inherently benign. Brain tumors or intracranial neoplasms can be cancerous (malignant) or non-cancerous (benign); however, the definitions of malignant or benign neoplasms differs from those commonly used in other types of cancerous or non-cancerous neoplasms in the body. Its threat level depends on the combination of factors like the type of tumor, its location, its size and its state of development. Because the brain is well protected by the skull, the early detection of a brain tumor occurs only when diagnostic tools are directed at the intracranial cavity. Usually detection occurs in advanced stage when the presence of the tumor has caused unexplained symptoms [3].

Primary (true) brain tumors are commonly located in the posterior cranial fossa in children and in the posterior cranial fossa in children and in the anterior two-thirds of the cerebral hemispheres in adults, although they can affect any part of the brain [12].

II. Proposed System

A new heuristic model in bee colony intelligence, sophisticated relationships of bees and various foraging possibilities make ABC algorithm go a long way before it becomes mature. For example, ABC algorithms still weak in mathematics. As for image segmentation discussed in this study, little evidence in theory may be referred to and some control parameters have to be specified by experiences. We would like to point out that, like all global thresholding techniques, the proposed method using a single threshold merely partitions the entire image into two kinds of regions, objects and backgrounds, which is suitable for simple MRI Brain image as far as MRI Based Brain Tumor image segmentation is concerned, the global threshold estimation can be regarded as a search procedure which search for a proper integer in a continuous integer interval. Hence, it is feasible to apply ABC algorithm to find the optimal threshold. Due to the special imaging mechanism, MRI Based Brain Tumor image contains serious spackle noise, so it is required that the segmentation algorithm is robust to noise pollution, the improved two-dimensional grey entropy may suppress the influence of speckle noise on segmentation results. Thus, to serve as the fitness function of ABC algorithm. Here, each bee in ABC algorithm is two-dimensional, standing for a pair of gray number (s, t). The population size, i.e. the number of bees, is the number of possible thresholds searched in parallel. The position of a food source represents a possible threshold, and the nectar amount of a food source corresponds to the quality of a segmented image evaluates. The basic procedure of MRI Based Brain Tumor image segmentation based on ABC algorithm [21].

III. Process and Discussion

A. Image Pre-processing:

Pre processing methods use a small neighbourhood of a pixel in an input image to get a new brightness values in the output image. Such pre-processing operations are also called filtration [8]. Local pre-processing methods can be divided into the two groups according to the goal of the processing.

Smoothing suppresses noise or other small fluctions in the image, equivalent to the suppression of high frequencies in the frequency domain. Unfortunately, smoothing also blurs all sharp edges that bear important information about the image. Gradient operators are based on local derivatives are bigger at locations of the image where the image function undergoes rapid changes [5]. The aim of gradient operators is to indicate such locations in the image. Gradient operators suppress low frequencies in the frequency domain (i.e. they act as high-pass filters). Noise is after high frequency in nature; unfortunately, if a gradient operator is applied to an image the noise level increases simultaneously [22]. Clearly, smoothing and gradient operators have conflicting aims. Some pre-processing algorithms solve this problem and permit smoothing and edge enhancement simultaneously.

B. Feature Extraction:

As a kind of social insects, honey bees live in a colonies and exhibit many features [12]. These features include bee foraging, bee dance, queen bee, take selection, collective decision making, nest site selection, mating, pheromone laying and navigation systems, which can be used as models for intelligent applications [15]. Actually, a lot of researchers have been inspired to develop algorithms by the behaviours of bee. A survey of the algorithms based on the intelligence in bee swarms and their applications has been presented. As mentioned, the ABC algorithm proposed by Karaboga and Basturk is one of the most popular algorithms.

C. Artificial Bee Colony Optimization:

ABC and its applications are used in real time problems. In 2010 it is based on a structural optimization [2]. In 2011, MRI image classification and face pose estimation [4].

The main steps can be described as follows:

1) Decompose the original image with a three-level DWT. Then low-frequency coefficients at the third level reflecting the approximation information are reconstructed as an approximation image, while high-frequency parts at the third level possessing information on edge and texture are reconstructed as a gradient image.
2) Employ a low-pass filter (a circular averaging filter) to deal with the approximation image and obtain a filtered image.
3) Normalize the gradient image I and the filtered image G to [0, 255] by the formulas (3) and (4). After that, construct a 256 × 256 filtered-gradient co-occurrence matrix C to get the improved two-dimensional grey entropy.
4) Treat the two-dimensional grey entropy as the fitness function of ABC algorithm, and set the control parameters in ABC algorithm, including the population size, the limit times for abandonment, the maximum number of iterations, etc.
5) By the cooperation and information-sharing of multiple cycles of employed bees, onlookers and scouts, the best bee gradually approaches to the optimal threshold, and at the same time the grey numbers (s, t) are whitened.
6) Segment the filtered image I with the optimal threshold s and get the final segmented image.

As mentioned above, the fitness function is a key component of ABC algorithm, which evaluates the foraging quality of the colony,

i.e. the accuracy of possible solutions. Besides, some control parameters, such as the number of employ bees or onlooker bees, the limit times for abandonment, the maximum number of iterations or stop conditions, need to be assigned. They would have a direct influence on the speed and stability of convergence [14] [15].

D. Fuzzy C-Means clustering:

Forms of knowledge representation suitable for notions that cannot be defind precisely [11]. Fuzzy logic represented into four ways slowest, slow, and fast, fastest. Fuzzy logic provides a more efficient and resourceful way to solve control system [15]. Fuzzy c-means provides an alternative way to represent linguistic and subjective attributes of real world computing. It is able to be applied to control systems and other applications in order to improve the efficiency and simplicity of the design process.

E. Segmentation:

In Computer vision, image segmentation is the process of partitioning a digital image into multiple segments. The image segmentation simply change the represented the image into something that is more meaningful and easier to analyze [26] [27]. Image segmentation is typically used to locate objects and boundaries in images.

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level to turn a gray scale image into a binary image [4] [5]. In this case, distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel color, intensity, texture, and location, or a weighted combination of these factors.

IV. CONCLUSION

In this paper we applied data mining process artificial bee colony optimization. The multi-fractal feature extraction and unsupervised clustering techniques using to defining the brain tumors. The image segmentation using to finding the nearest

tumor cells. This result may produce accurate vale and without noise pollution using bee colony optimization and fuzzy c means clustering techniques.

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