# A SURVEY OF SWARM BASED BIO-INSPIRED OPTIMIZATION ALGORITHMS FOR BRAIN TUMOR SEGMENTATION

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***Abstract*—Nature is obviously a great and enormous source of inspiration for solving hard and complex problems in computer science since it exhibits extremely diverse, dynamic, robust, complex and fascinating phenomenon. It always finds the optimal solution to solve its problem maintaining perfect balance among its components. This is the thrust behind bio inspired computing. Nature inspired algorithms are metaheuristics that mimics the nature for solving optimization problems opening a new era in computation. This paper presents a broad overview of biologically inspired optimization algorithms and their applications in the segmentation of brain tumors.**

***Keywords :* Bio-inspired Optimization Algorithms, Segmentation, Brain Tumor, Swarm Intelligence.**

## I. INTRODUCTION

Brain is the portion of central nervous system that is located within the skull. It is soft spongy mass of tissues that is protected by bones of skull and three thin membranes called meninges. A brain tumor is an abnormal growth of tissue in the brain. Unlike other tumors, brain tumors spread by local extension and rarely metastasize (spread) outside the brain. Brain Tumors can be either benign (non cancerous) or malignant (cancerous*)*. Each year over 190,000 people in the United States and 10,000 people in Canada are diagnosed with various types of brain tumor. Brain tumors are the second leading cause of cancer based deaths among children in the age group between 0 and 19 years. And also they are the second leading cause of cancer based deaths in young men up to age 39 years and the fifth leading cause of cancer based deaths among young women between ages 20 and 39 years. There are over 120 different types of brain tumors including malignant and benign, making effective treatment highly complicated. In India, totally 80,271 people are affected by various types of brain tumor. The first step to minimize the death rate of brain tumor is to develop an effective diagnosing method. The computer aided diagnoses is to use computer to process the medical images to extract the useful information so that the doctor can make a diagnoses decision easier and quicker. The process of segmenting tumors in MRI images as opposed to natural scenes is particularly challenging [6 The tumors vary greatly in size and position, have a variety of shape and appearance properties, have intensities overlapping with normal brain tissue, and often an expanding tumor can deflect and deform nearby structures in the brain giving an abnormal geometry also for healthy tissue [5]. But it is very difficult to locate the problems in medical images if it contains noise or the image is not in a proper format due to irregular structure of human body. Applying image processing technologies plays a pivotal role in processing and analyzing the images and also in forming the images.

## II.ANT COLONY OPTIMIZATION

Ant Colony Optimization (ACO) metaheuristic; a recent population-based approach, is inspired by the observation of real ants colony and based upon their collective foraging behavior. Real ants are capable of finding the shortest path from a food source to the nest without using visual cues. Ants are moving on a straight line that connects a food source to their nest is a pheromone trail. Pheromone is a volatile chemical substance lay down by ants while walking, and each ant probabilistically prefers to follow a direction rich in pheromone. This elementary behavior of real ants can be used to obtain optimum value from a population. In ACO, solutions of the problem are constructed within a stochastic iterative process, by adding solution components to partial solutions. Each individual ant constructs a part of the solution using an artificial pheromone, which reflects its experience accumulated while solving the problem, and heuristic information dependent on the problem [3,4]. Ant Colony Optimization for brain tumor detection is as follows:

1. Read the MRI image or the ROI image and stored in a two dimensional matrix.

 

2. Pixels with same gray value are labeled with same number.
3. For each kernel in the image, calculate the posterior energy U (x) value.
4. The posterior energy values of all the kernels are stored in a separate matrix.
5. Ant Colony System is used to minimize the posterior energy function.
6. Initialize the values of number of iterations (N), number of ants (K), initial pheromone value (T0),a constant value for pheromone update (ρ).[here,we are using N=20,K=10, T0=0.001 and ρ =0.9]
7. Create a solution matrix (S) to store the labels of all the pixels, posterior energy values of all the pixels, initial pheromone values for all the ants at each pixels, and a flag column to mention whether the pixels is selected by the ant or not.
8. Store the labels and the energy function values in S.
9. Initialize the pheromone values, T0=0.001.
10. Initialize all the flag values for all the ants with 0,it means that pixels is not selected yet,if it is set to 1 means selected.
11. Select a random pixel for each ant, which is not selected previously.
12. Update the pheromone values for the selected pixels by all the ants.
13. Using GA, select the minimum value from the set, assign as local minimum (Lmin).
14. Compare this local minimum (Lmin) with the global minimum (Gmin),if Lmin is less than Gmin,assign Gmin = Lmin.
15. Select the ant,whose solution is equal to local minimum, to update its pheromone globally.
16. Perform the steps (13) to (15) till all the image pixels have been selected and perform the steps (7) to (16) for M times.
17. The Gmin has the optimum label which minimizes the posterior energy function.
18. Store the pixels has the optimum label in a separate image that is the segmented image.

## III.BACTERIA FORAGING OPTIMIZATION ALGORITHM

Bacteria Foraging Optimization Algorithm (BFOA) was proposed by Passino [8]. This algorithm is based on the application of group foraging strategies of a swarm of E.coli bacteria in multi-optimal function optimization. Bacteria search for nutrients in a manner to maximize energy obtained per unit time Foraging is the method for locating, handling and ingesting food. During foraging activity of the real bacteria, movement is achieved by a set of tensile flagella. Flagella help an E.coli bacterium to tumble or swim, which are two basic operations performed by a bacterium at the time of foraging [1,2]. Prime steps in Bacteria Foraging Optimization Algorithm are given below:

1. Chemotaxis: This process simulates the movement of an E.coli cell through swimming and tumbling via flagella. An E.coli bacterium can move in two different ways. It can swim for a some period of time in the same direction or it may tumble.
2. Swarming: Swarming is termed as a group behavior of E.coli bacteria in which the cells arrange themselves in a form of a ring by moving up the nutrient gradient. The cells when stimulated by a high level of succinate, release an attractant aspertate, which helps them to aggregate into groups and thus move as concentric patterns of swarms with high bacterial density
3. Reproduction: The health of Bacteria can be calculated using the objective function. If the objective function yields a high value such bacteria are the least healthy bacteria and finally they die. The bacteria which yield lower value are the healthier ones which split into two separate bacteria, which are then placed in the same location. This is how the swarm size is constant.
4. Elimination and Dispersal: Gradual or sudden changes in the local environment like rise of temperature, where a bacterium population lives may kill or disperse a group of bacteria that are currently in a region with a high concentration of nutrient gradients.

## IV.FISH SWARM ALGORITHM

The fish swarm algorithm (FSA) is a new population-based/swarm intelligent evolutionary computation technique proposed by Li et al. [7] in 2002 which is inspired by the natural schooling behavior of fish.FSA presents a strong ability to avoid local minimums in order to achieve global optimization. A fish is represented by its D-dimensional position Xi = (x1, x2, . . ., xk, . . ., xD), and food satisfaction for the fish is represented as FSi. The relationship between two fish is denoted by their Euclidean distance dij = ‖Xi −Xj‖. FSA imitates three typical behaviors, defined as searching for food, ―swarming in response to a threat, and following to increase the chance of achieving a successful result. **Searching** is a random search adopted by fish in search of food, with a tendency towards food concentration. The objective is to minimize FS (food satisfaction). **Swarming:** aims in satisfying food intake needs, entertaining swarm members and attracting new swarm members. A fish located at Xi has neighbors within its visual. Xc identifies the center position of those neighbors and is used to describe the attributes of the entire neighboring swarm. If the swarm center has greater concentration of food than is available at the fish‘s current position Xi (i.e., FSc < FSi), and if the swarm (Xc) is not overly crowded (ns/n < δ), the fish will move from Xi to next Xi+1, toward Xc . **Following** behavior implies when a fish locates food, neighboring individuals follow. Within a fish's visual, certain fish will be perceived as finding a greater amount of food than others, and this fish will naturally try to follow the best one(Xmin) in order to increase satisfaction(i.e., gain relatively more food[FSmin < FSi] and less crowding[nf/n < δ]). nf represents number of fish within the visual of Xmin. Three major **parameters** involved in FSA include visual distance (visual), maximum step length (step), and a crowd factor. FSA effectiveness seems primarily influenced by the former two (visual and step).

## V.CONCLUSION

Bio inspired algorithms are going to be a new revolution in computer science. The scope of this area is really vast since as compared to nature, computer science problems are only a subset, opening a new era in next generation computing, modeling and algorithm engineering. This paper provides an overview of a range of Bio inspired algorithmss drawn from an evolutionary metaphor or natural phenomena including the ant colony, bee colony, fish swarming, etc. Generally speaking, almost all of the algorithms perform with heuristic population-based search procedures that incorporate random variation and selection. Biologically inspired computing still has much room to grow since this research community is quite young. There still remain significantly challenging tasks for the research community to address for the realization of many existing and most of the emerging areas in technology. In particular, there are great opportunities in exploring a new approach/algorithm.

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