CATEGORIZATION OF HYBRID ABC-FCM USING EFFICIENT APPROACH FOR MEDICAL IMAGE SEGMENTATION

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Abstract
One of the intriguing subcategories in the field of image processing is segmentation. As there are so many academics working on image processing segmentation, they are now focusing on Magnetic Resonance Imaging (MRI) segmentations, which is a difficult problem that still requires improvement against noisy data. A popular method for segmenting medical pictures is Fuzzy C Means (FCM), although it only considers the image's intensity and, as a result, yields insufficient results for images with a lot of noise. It is standard practice to design and combine many classifiers using the same fundamental classification learning model using classifiers like bagging and boosting. Boosting models on noiseless data are more robust than bagging. Improving weak learning models significantly reduces errors which only create classifications that are a little better than arbitrary guessing. Results demonstrate the increase in the classification of ac Fuzzy Bee Segmentation method.

Keywords: Image Segmentation, MRI, FCM, Classifier, Boosting

INTRODUCTION

Classification of the brain by using the Fuzzy C Mean (FCM) method, MRI has certain limitations. These are what they are: I It is clear that the FCM is effective when it comes to maintaining brain health; nevertheless, the effectiveness of the algorithm declines when it comes into contact with anomalies like edoema, tumors, and so on. (ii) Instead of using the enclosed pixels, FCM solely depends on the neighborhood traits. (iii) When the FCM pushes the cluster centre to select the relevant process, a substantial proportion of iterative processes seem to get tacked on to local optima. Appropriate optimization techniques are included to produce answers that are more precise. The Artificial Bee Colony (ABC) technique is based on its working inspiration from the natural behavior of the honeybees in search of the best food sources. There are a certain variety of insects that work on the basis of the swarm behavior, according to this pattern of behavior the simple tasks are accomplished by the individual insects, while the cooperative work accomplishment is established by their intelligent behavior. It is observed that according to the ABC algorithm three groups of bees in a colony of artificial bees is evident. It is the employed bees that would essential carry the details regarding their food sources, further it would also with hold information's regarding the distance and direction from the nest and the nectar amount of the source; certain details related to the new food sources would be precisely identified by the scout bees and onlooker bees that would wait in their respective hives for the food sources, these would essential locate the same through the information that is shared by employed bees. ABC thus defines two prime behaviors, namely – the recruitment of the concerned nectar source and abandonment of a related source [1].

ABC algorithm is utilized for the purpose of choosing a stochastic selection with reference to the available fitness values; this function is essentially carried forward by the onlooker bees that are found to suitably resemble the "roulette wheel selection" contained in the GA. Comparison of the ABC algorithm with that of the mutation process in the GA scheme reveals the similarity of the neighbor source's production mechanism. The other observed feature is that in the ABC algorithm there is no precise crossover unlike GA. The mutation process in ABC is essentially made use by the bees for sharing relevant information's between them. A food source contained in the ABC is viewed as a solution to the prevalent optimization problem; therefore it becomes mandatory to consider a set of food source positions at the initial stage of the procedure itself. The volume of solution thus derived reflects the volume of nectar contained in the food source; this further represents the quality of the derived solution which is essentially represented by that source that is searched by the bee. The first step would be to identify the nectar amount of the food source present at the initial positions; on the other hand the next step would be to compute the quality value of the obtained initial solutions.

Some of the noticeable advantages of the ABC algorithm over the other optimization techniques would comprise of the following – simplicity, robustness and flexibility; making use of a certain number of features in par with the other techniques; presence of simple hybridization strategies when compared with the other optimization algorithms; strategies of handling the devised objective cost with its relevant stochastic natures; simple incorporation with basic mathematical and logical operations[2] .Based on the dimensional synthesis mechanism, a hybridized optimization technique approach for the design purpose of the various linkages is incorporated here, which is found to integrate both the merits of the stochastic and the deterministic optimization. Real-valued Evolutionary Algorithm (EA) is suitably adopted as the basis for the considered stochastic optimization approach which is essentially utilized for the purpose of investigating the various design variable spaces widely while at the same time mechanisms for identifying the best linkages are thus initiated simultaneously [3].

Improvisations in the efficiency of the approach is done with the help of a local optimization technique that is suitably incorporated by the deterministic approach, this is done by minimizing the increased CPU time that is essentially required by the inbuilt EA techniques in these types of applications. This implementation process is essentially carried out in the EA in terms of two different stages. The first stage is termed as the Fitness evaluation stage where an effective new error estimator is utilized by the deterministic approach. The second stage is meant for refining the solution that is essentially required by the evolutionary part of the algorithm in the concerned deterministic approach. A specific process involving the evaluation procedure of the various individuals in each generation assists in overcoming the eliminations of the various well-adapted linkages that are unidentifiable by the other methods. This work involves in the study of the ABC-FCM technique.

OPTIMIZATION METHODS FOR MEDICAL IMAGE SEGMENATATION

The Optimization procedure is involved in the identification of a vector included in a function; it is this procedure that involves itself in the production of an optimal function. In the extreme value conditions these values that are preferably feasible are thus termed as the available and optimal solutions. Various optimization algorithms are incorporated for resolving the associated optimization. These optimization techniques are classified in to two different algorithms with reference to the nature of the algorithm; these are the deterministic and the stochastic type of algorithms. It is observed that these Deterministic type of algorithms make use of the gradients such as hill climbing which essentially incorporates the various rigorous moves and certain identical set of solutions that are suitably generated for the iterations that begin its functioning with the same initial starting point. [4]. On the contrary it is observed that various opposite solutions are generated without the involvement of gradients in the concerned stochastic algorithms, even if they possess identical initial values. If accuracy is of prime consideration then it can be viewed that even slightly varying final values can be found to converge to the same optimal solution. It is observed that the concerned stochastic algorithm is thus differentiated into two types, namely, the heuristic and the Meta heuristic types. The efficiency of the concerned Meta heuristic type of algorithm derives its inspiration from nature and is found to be even more powerful and eligible in resolving the nonlinear numerical global optimization issues. These Meta heuristic types of algorithms are found to establish a balance between the various available randomization techniques i.e. global and local search.

HYBRID OPTIMIZATION METHODS FOR MEDICAL IMAGE SEGMENATATION

The Meta heuristic algorithm is thus viewed as the most popular global optimization scheme that efficiently involves in reproducing the required social behavior or natural phenomena. The various noticeable optimization problems that are prevalent today can be solved using a number of Meta heuristic algorithms that are being used in numerous applications. Various complex issues can be suitably solved by these algorithms and the associated Computational efficiency can also be suitable enhanced by them. The structural optimization problems have been solved by the Meta heuristic approaches, these mechanisms have been proposed in the recent works by few authors. The authors have proposed a combinational work involving the CS algorithm and the levy flights for solving the above mentioned problem. Together with the above mentioned strategy, a new coupled eagle strategy was introduced for the purpose of solving the unconstrained and constrained global optimization issues, together with the incorporation of the efficient Differential Evolution (DE). Enhancement in the area of the global search mobility for robust global optimization was accomplished by a new technique called as the FA. The ultimate aim of the modern Meta heuristic algorithms is to expand the global search feature with respect to the following three major reasons: enhanced problem solving ability, complex problem solving features and obtaining robust algorithms [5].

PROPOSED METHODOLOGY FOR MEDICAL IMAGE SEGMENATATION

Initially the capacity of the global findings is adopted by the ABC-FCM algorithm for identifying the various optimal solutions that are suitably used as the initial clustering centres for the FCM process. In the next stage the algorithm thus suggested makes use of the FCM for the optimization of the initial clustering centres, followed by this the corresponding global optima is thus found to be captured [6]. The SN solutions of the ABC-FCM involve in the creation of a randomly distributed initial population, it is this algorithm that involves in the representation of the various sizes of the employed or onlooker bees. Hence it is found that these bees are involved in the representation of the various cluster centres. All solutions xi (i=1, 2..... SN) are thus represented as the D-dimensional vectors. Here, D is considered as the quantity of the various optimisation variables. Potential solutions are denoted by the issues that are meant to be optimized, here it is found that the quantity of the nectar suitably represents the various food sources and is thus found to be correlated to the fitness features of the concerned respective solutions.

This is computed through equation 1:

$$fit_i = \frac{1}{1+f_i} = \frac{1}{1+J_m(U,V)} \quad (1)$$

Where in $J_m(U,V)$ represents the objective function of the concerned FCM. The smaller the value of $Jm^{(U,V)}$ the greater is the individual fitness and thus involves in the production of better clusters. As far as the ABC-FCM is considered it is observed that when a location is not capable of being improvised then a relevant set of cycles are to be considered, at this point the corresponding food source is thus considered abandoned. If the abandoned source is represented as xi, then the concerned scout is to find a novel food source that is to be essentially substituted with xi. The operation is thus described by the following equation 2:

$$x_i^j = x_{\min}^j + rand[0,1](x_{\max}^j - x_{\min}^j) \quad (2)$$

ABC-FCM is considered as a robust search procedure where both the exploration and exploitation procedures are performed at the same time. The concept of Random searching by scouts is observed as the basis for the various global searches of the concerned algorithm and the neighbour production techniques are thus found to take place through the various employed and onlooker bees [7]. So, ABC-FCM can be deemed as an effective technology as it integrates the exploitation technique (local search) with that of the exploration technique (global search). The below described algorithm is found to clearly delineate the steps followed by the suggested ABC-FCM technique as shown in the figure 5.3: the values are set as SN represents the initial population and going by standards we have set to 15. The maximum iterations (MCN) was set at 500. C defines the number of clusters and we set it to 2. M is a real number set to 4 and epsilon is the error criterion set at 0.01

The segmentation process for ABC-FCM algorithm as shown in figure 1:

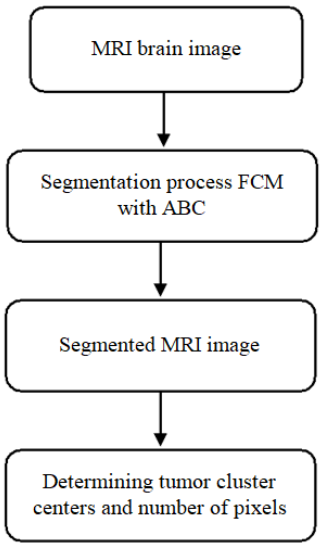

Figure 1 Segmentation Process for Hybrid ABC-FCM Algorithm

EXPERIMENTAL RESULTS

The FCM segmentation-bagging, FCM segmentation-boosting, fuzzy bee Segmentation-bagging and fuzzy bee segmentation-boosting classifiers are used. The classification accuracy, average precision and average recall as shown in tables 5.1 to 5.3 and figures 5.5 to 5.7.

Table 1 Classification Accuracy for Fuzzy Bee Segmentation

Techniques	Classification accuracy
FCM Segmentation- Boosting	91.74
FCM Segmentation - Bagging	92.96
Fuzzy Bee Segmentation - Boosting	94.58
Fuzzy Bee Segmentation Bagging	95.83

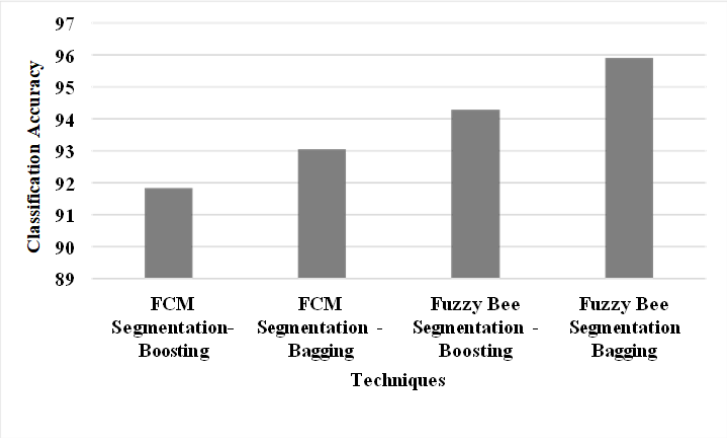

Figure 3. Classification Accuracy for Fuzzy Bee Segmentation

From the figure 5.5, it can be observed that the fuzzy bee segmentation bagging method increased classification accuracy by 4.42% for FCM segmentation-boosting, 3.02% for FCM segmentation-bagging & 1.82% fuzzy bee segmentation - boosting.

Table 2 Average Precision for Fuzzy Bee Segmentation

GTT	Average Precision
FCM Segmentation- Boosting	0.92584
FCM Segmentation - Bagging	0.92654
Fuzzy Bee Segmentation - Boosting	0.93417
Fuzzy Bee Segmentation Bagging	0.94905

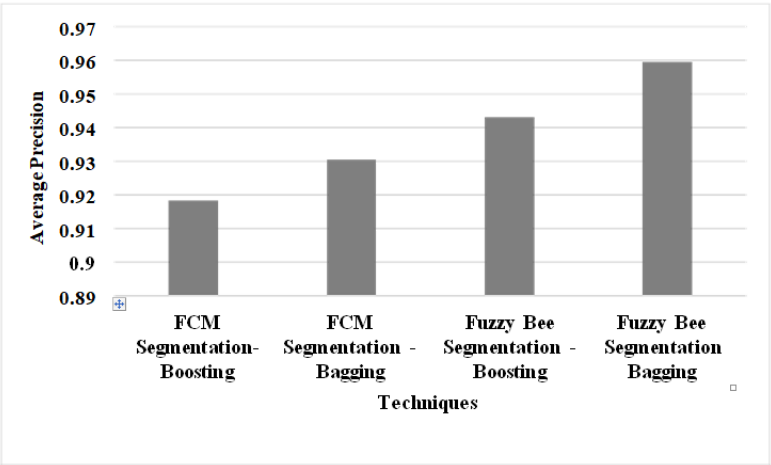

Figure 4 Average Precision for Fuzzy Bee Segmentation

From the figure 5.6, it can be observed that the fuzzy bee segmentation bagging method improved average precision by 4.42% for FCM segmentation-boosting, 3.05% for FCM segmentation - bagging & 1.81% for fuzzy bee segmentation - boosting.

Table 3 Average Recall for Fuzzy Bee Segmentation

Techniques	Average Recall
FCM Segmentation- Boosting	0.92018
FCM Segmentation - Bagging	0.92574
Fuzzy Bee Segmentation - Boosting	0.95937
Fuzzy Bee Segmentation Bagging	0.94985

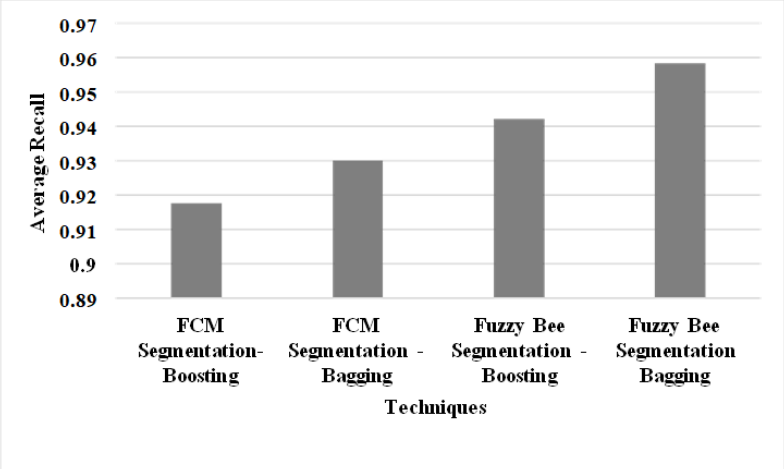

Figure 5 Average Recall for Fuzzy Bee Segmentation

From the figure 5.7, it can be observed that the fuzzy bee segmentation bagging method increased average recall by 4.42% for FCM segmentation- boosting, 3% for FCM segmentation - bagging & 1.81% for fuzzy bee segmentation - boosting.

CONCLUSION

Separating the structure of the relevant interest items from the background and other nearby objects is the primary goal of the picture segmentation procedure. The FCM algorithm, which is frequently used in the segmentation process of MR images, is one of the methods used to separate the brain's MR pictures. The performance of the FCM strategy is found to be simple and robust, but it does not guarantee safety in terms of its high accuracy feature and also involves itself in the production of noisy or abnormal images. It is observed that there is an inherent noise contained in the MRI images as a result of the various operator, equipment, and environment which might be turn out to be an obstruction in the accuracy feature of the concerned images. ABC has been introduced in this work before performing the FCM clustering algorithm strategy, in order to alleviate the sensitivity feature related to the noise factor. The algorithm thus introduced and studied in this work has been found to be efficient with respect to speed, performance and getting trapped in local minima points. From the results thus obtained, the ABC was found to offer improvised results when compared with that of the GA and the ACO techniques. Further it is observed that the optimal solutions are essentially obtained through the concerned ABC algorithm. Results show that the fuzzy bee segmentation bagging method improvises the classification accuracy by 4.42% for FCM segmentation-boosting, 3.05% for FCM segmentation-bagging & 1.81% fuzzy bee segmentation - boosting.

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