

Enhance Brain Images using Adaptively Regularized KFCM Approaches on Image Segmentation: A Survey

Yogesh Kumar Gupta*, Nirupama Tiwari, Vivek Jain

Department of Computer Science and Engineering, ShriRam College of Engineering & Management,
Gwalior, Madhya Pradesh, India

Abstract

The purpose of image segmentation is to apply logic and convert the explication of an image into some aspect that is easy for examine. This paper concerns on study of various image segmentation (IS) techniques and analysis. The merits and demerits are also described in this paper. Then there is discussion about various underpinning concerns in IS and find the gap between them that require to be connected so as to refine the IS performance and effectiveness.

Keywords: Image segmentation, FCM, MRF, KFCM, thresholdbased, edge based, region based many other techniques

***Author for Correspondence** E-mail: yogeshkumargupta257@gmail.com, girishniru@gmail.com

INTRODUCTION

To repossess required information from the given image, digital image processing (DIP) is used in such a manner that it does not affect other features of the picture. Images are the important medium of conveying information, and by understanding images, the retrieved in sequence can be used for many tasks. A digital image (DI) is formed by countable quantity of pixels. DIP is an integrative operation and it contains various types of mechanisms like segmentation, compression, image representation and transformation [1].

It has been a range of active research for the past two decades resulting in different IS techniques that have been future. Depending on the trouble area, there are various classes of pictures that would be processed and analyzed like mild intensity (grayscale), color, range (intensity), thermal (infrared), sonar, X-ray (radiographic), nuclear magnetic character images and lots of extra. IS described as the procedure of dividing a DI into multiple segments means group of pixels, pixels in a realm are similar according to some homogeneity criteria such as color, intensity or texture, in order to locate and identify objects and coverage arena in an image. IS is carried out for filtering of noisy pictures and medical applications like locating tumors etc., face

recognition (FR), finger print recognition (FPR), and so on [2].

IMAGE SEGMENTATION (IS)

The separation of a picture into fixed areas that cover it's far known as IS (Figure 1). It varies from filtering of noisy pictures, scientific applications; discovering objects in satellite pictures, FR and many others [3].

EXISTING METHODS

Fuzzy C-Means

Fuzzy c-method (FCM) is a clustering method wherein a dataset is ready into n clusters with every statistics factor within the dataset belongs to each cluster to the correct degree. This approach is advanced to those which constitute the connection between the input pattern information and clusters more certainly. FCM is a popular soft clustering method; its effectiveness is largely limited to spherical clusters. Downy c-means is one of the most assuring fuzzy clustering techniques [4].

Markov Random Field (MRF)

The inferences issue underlying picture and scene structure to resolve problems such as picture reconstruction, IS, 3D vision, and object labeling. It feasts the MRF each as a tool for modeling picture statistics, coupled

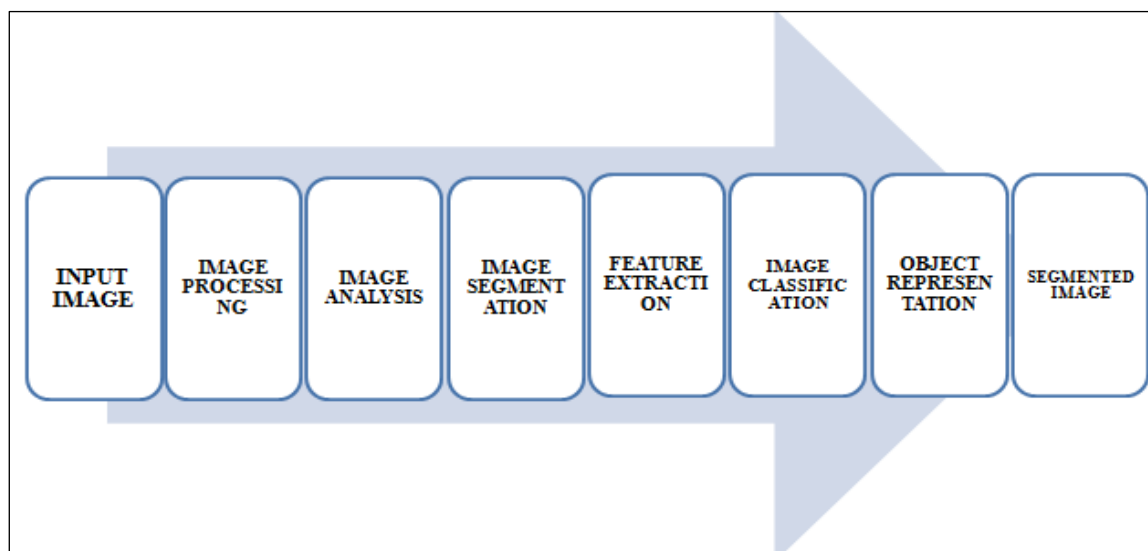


Fig. 1: Image Segmentation.

with a hard and speedy of these days' superior algorithms, as a way of making inferences approximately pictures. The unifying ideas in using MRFs for visible are the subsequent:

- Pictures are divided into an meeting of nodes that could correspond to agglomerations of pixels or pixels.
- Hidden variables associated with the nodes are introduced into a model designed to "explain" the values (colors) of all the pixels.
- A joint probabilistic model is built over the pixel values and the hidden variables.
- The direct statistical dependencies among hidden variables are expressed with the aid of honestly grouping hidden variables; these businesses are frequently paired depicted as edges in a graph.

Adaptively Regularized Kernel-Based Fuzzy C-Means Clustering

FCM cannot always work well. The kernel method is cast-off to generate the non-linear version of FCM. It also develops a kernel-based fuzzy C-means clustering algorithm (KFCM). The core concept of KFCM is to first graph the input data into a feature space with higher facet via a non-linear transform and then perform FCM in that excellence space. Thus, the original complex and nonlinearly separate data structure in input space may become simple and linearly separable in the feature space after the nonlinear update. So, we desire to be able to get better performance. This method adaptively takes the number of

clusters with some criteria and is very advantageous property. Denoising the input image before it is segmented out by KFCM. The original image is partitioned into sub-images with fuzzy boundaries through KFCM. At the end of image segmentation level, set method is initiated and an edge indicator function extracts of boundaries for further processing [5].

- Step 1: fix $c, t_{\max}, m > 1$ and $\varepsilon > 0$ for some positive Constants;
- Step 2: initialize the membership u_{ik}^0 ;
- Step 3: For $t=1, 2, \dots, t_{\max}$, do:
 - (a) Update all prototypes v_1^t ;
 - (b) Update all membership u_{ik}^t ,
 - (c) compute E^t If $E^t < \varepsilon$,
- Stop; else $t=t+1$,

MOTIVATION

Motivation of the project is as follows:

- To investigate the fuzzy clustering techniques in brain tumor image database.
- To test the effectiveness of the clusters produced from fuzzy method based on their ability to separate actives/inactives compounds and their intermolecular similarity of their centroids.
- To test the different fuzziness indices and their effect on the clusters produced.
- To analyze and compare the result from the fuzzy clustering method with Ward's method.
- To combine the fuzzy clustering method and Ward's method to improve the results of both methods.

LITERATURE REVIEW

Duan *et al.*'s convolutional neural network (CNN) is better for studying characteristics from unprocessed data without manual intervention, especially the structural characteristics [6]. CWNN gives result of segmentation with two types of approaches i.e., a super pixel approach and a MRF approach to generate the final segmentation plan. In order to implement smooth nature on the local arena, the super pixel approach is cast-off. On the contrary, the MRF approach is cast-off to uphold the edges and the description of the SAR image. By applying the super pixel and MRF strategy, two segmentation maps will be generated. The first segmentation map is achieved by assembling the segmentation map of CWNN and the super pixel advance and the second segmentation map is achieved by application of MRF approach on the authentic SAR image.

CWNN is effective for the segmentation tasks because the effectiveness of CWNN is proved by several experiments on texture images. The speculation on the actual SAR images represents that the approach achieves the area along labeling consistency and uphold the edges and details at the same time.

In the paper by Sammouda *et al.*, two image segmentation methods: K-means algorithm and FCM algorithms are discussed and compared [7]. K-means algorithm and FCM algorithms are used to compare the extricated cancer clusters. The K-mean is much precise approach than FCM in extricating the proper shape of tumors.

Naik *et al.* did partitioning of the image into distinct objects [8]. It has wide range of applications in many areas like object identification, face tracking, satellite, remote sensing and most importantly, medical applications. A novel IS with help of iterative partitioning mean shift clustering algorithm that out-turns the drawbacks of conventional clustering algorithms and provides good segmented pictures.

According to Mahajan *et al.*, the FCM membership function can handle the overlapped clusters efficiently with predefined

amount of clusters, but this algorithm is not capable of clustering non-linearly separable data, also, choosing of initial cluster centre is a difficult task which results in poor image segmentation [9]. To conquer this drawback, we proposed serialized fuzzy c-means (KFCM) clustering. Plane into superior dimension feature space and these kernel functions are used to find non-Euclidean distance between feature points without defining transfer function, and then perform FCM in feature space. Here we use two different kernel functions for IS and compare their outputs.

Abdel-Maksoud *et al.* presented the advantages of the K-means clustering for IS with respect to minimal calculating time [10]. In addition to it, there is possibility to attain the advantages of the FCM with respect to accuracy. The performance of the proposed IS move toward was evaluated by comparing it with some state of the art segmentation algorithms in the event of accuracy, processing time, and performance. The accuracy has been evaluated by comparing the outcomes with the floor truth of each processed image. The experimental results clarified the potency of proposed approach to manage an increased number of segmentation problems via improving the segmentation quality and accuracy in minimal execution time.

According to Gharipour *et al.*, in the process of segmentation, two stages are included, in first stage, there is processing of local and global spatial information of the accustomed cell image and a final segmentation stage which is based on the idea of conventional fuzzy clustering [11].

According to Tripathy *et al.*, this approach was not as susceptible to noise when it is compared to the conventional FCM algorithm and derives better results [12]. Intuitionist refers back to the degree of hesitation that rises as a problem of loss of info. Proposed method is comparatively less hampered by noise and performs better than existing algorithms.

Balla-Arabé *et al.* presented an electricity functional based totally on the FCM objective characteristic which incorporates the bias area

that counts for the intensity in homogeneity of the authentic international picture [13]. Using the rise descent method, we achieve the respective level group equation. The mechanism is fast, robust against noise, independent of the position of the original contour, effective in the presence of intensity inhomogeneity and can detect objects with or without edges.

According to Bora *et al.*, image segmentation is highly adaptive concept of research and choice of large number of researchers [14]. Segmentation of a picture is famous because of its importance in the area of image processing (IP) and visual application. The prime task of the researchers working in the field is to develop a method for efficient and better IS. High-quality of IS can be obtained by application of clustering strategy. The advantage of using approaches of clustering in image segmentation is that this has a wide area and can be employed in other areas of engineering too. In this paper, the author has developed a new technique for image segmentation keeping clustering as a base. Sobel filter is then used for filtering and the results are obtained using Marker Watershed algorithm. The performance parameters that are taken into are mean square error and PSNR.

According to Khan *et al.*, image segmentation (IS) is crucial portion of image processing [15]. The author says that the steps of IS are necessary when it comes to area of IP. The task of image segmentation (IS) is dividing the image into information of regions so that image could be analyzed easily. The numbers of objects in the image are also recognized easily when segmentation of image is done. To ease the process of evaluating and analyzing images various IS techniques have been developed till date. In this paper, the author has reviewed the techniques that have been developed till date for IS and has also developed a new technique for IS using the recent technology.

PROBLEM STATEMENT

This study on fuzzy clustering in compound selection is experimented based on their intermolecular dissimilarity of their centroids and their ability to separate active/inactive structures. The different values of fuzziness

index and the number of clusters are also experimented to see the effect of these different values to the clusters produced by fuzzy clustering. The combination of fuzzy c-means and Ward's clustering method is analyzed to evaluate the effectiveness and efficiency of both methods.

PROPOSED METHODOLOGY

According to using adaptive weight which can adaptively change the weight value in different conditions. The experiment results show that our method adequately considers about the characteristics of poor anti-noise performance caused by spatial information, and our method has better performance than other methods in the aspect of edge information processing.

However, the problem of IS speed is still an important problem in image processing. Therefore, how to improve the segmentation speed of different algorithms is an indispensable topic. In this paper, we applied adaptively regularized KFCM for improving the image result.

EXPECTED OUTCOME

Future research in the segmentation of brain tumor medical images will strive towards humanizing the accuracy, precision and computational speeds of segmentation techniques, along with eliminating the quantity of manual interface. Efficiency of computation will be significantly important in real time processing applications. The proposed algorithm can be compared with other FCM clustering algorithms so that the efficiency of the algorithm can be measured.

Applications

Satellite imagery, wire picture standards conversion, medical, pictures ,videophone, person reputation and IS are some of its applications [16].

IMAGE SEGMENTATION TECHNIQUES

Lots of image segmentation (IS) strategies were developed by using researchers and scientists, a number of the most important and broadly used IS techniques are shown in Figure 2. Latest research work on IS techniques highlighted in Figure 2 is discussed and evaluated below.

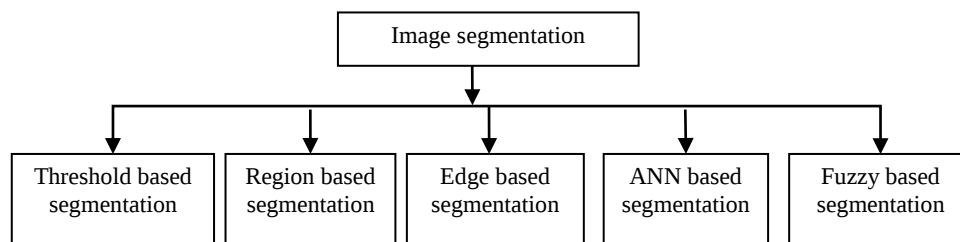


Fig. 2: Various Image Segmentation Techniques.

Threshold Based

Thresholding is a popular technique for IS. By thresholding, image segmentation is a simple and powerful strategy for dividing images on dark environment. There are two forms of thresholding techniques. They are classified as global and local thresholding. If threshold T is consistent, then its miles are known as global thresholding; in any other case its miles are referred to as neighborhood thresholding. When the historical past illumination is choppy, global thresholding strategies can fail. Multiple thresholds are used to balance uneven illumination, in neighborhood thresholding. There are sure risks of thresholding approach. Only lessons are generated, and it cannot be applied to multichannel pictures. Thresholding does not bear in mind the spatial traits of an image, so it is touchy to noise. This corrupts the histogram of the image, making severance extra hard.

Threshold Selection

Segmentation using thresholding approach is the selection of selecting threshold fee T . Automatically decided on threshold value for every picture by using the machine without human intervention is called a computerized threshold scheme. In automatic threshold selection method, the value of T can be taken on the basis of histogram, cluster, variance etc.

Histogram Based Threshold Selection

This mechanism is depending on the achievement of the estimating the brink price that separates the two; homogenous place of the item and background of an image. Histogram primarily based thresholding is implemented to reap all possible uniform regions within the picture. Let P_1 and P_2 be the gray value of the peaks of the histogram. The entry rate T is given by Eq. (1):

$$T = (P_1 + P_2) / 2 \quad (1)$$

EMT Technique

Edge maximization method (EMT) is used whilst there are several identical locations in representation or where there is an exchange on illumination between the object and its background. In this part of the object may be assemble with the background or part of the background may as an object. That is with why any of the automated threshold choice techniques, overall performance turns into much higher in pictures with massive homogenous and nicely separated regions.

Region Based Segmentation Methods

Region-based segmentation strategies are based at the reality that a pixel cannot be considered part of an item or not based totally handiest on its gray value. They include measures of connectivity among pixels in order to make a decision whether these pixels belong to the same region (or object) or not. Mathematically, region-based segmentation methods can be described as a systematic way to partition an image I into n regions, $R_1, R_2, \dots, R_n$, such that the following properties hold:

$$\begin{aligned}
 &U_{i=1}^n R_i = I. \\
 &R_i \text{ is a connected region, } i = 1, 2, \dots, n. \\
 &R_i \cap R_j = \emptyset \text{ for all } i \text{ and } j, i \neq j. \\
 &p(R_i) = TRUE \text{ for } i = 1, 2, \dots, n. \\
 &p(R_i \cap R_j) = \\
 &= FALSE \text{ for any adjacent regions } R_i \text{ and } R_j.
 \end{aligned}$$

Here, $P(R_i)$ is a logical predicate defined over the points in set R_i , and Φ is the empty set. The first belongings states that the segmentation will be complete, that is, each pixel in the image will be labelled as belonging to one of the n regions. The aim of region detection is to provide the possibility to characterize the detected object by parameter analysis (shape, position, size...). We examine neighbouring pixels and detect whether the

neighbour pixel should be added or not. Region based segmentation technique attempts to group the pixels with similar characteristics (such as approximate Gray level equality) into regions. There are two approaches in region-based methods:

Region Growing

In this, there is grouping of pixels in entire icon into sub areas or large areas depending on predefined criterion. Region developing can be processed in four steps:

- (i) Mark the group of seed pixels in real picture.
- (ii) Take a clustering general like gray level intensity or shade and set a stopping rule.
- (iii) Enlarge the areas by using connecting to each seed to the neighboring pixels with the motive of have glad the cluster homes just like seed pixels.
- (iv) End location increasing when no better pixels met the measure for addition in that area.

Region Splitting and Merging

One can divide an image into a set of precipitate unconnected regions and then merge the regions in an attempt toward satisfying the conditions of reasonable IS. Splitting and merging of regions is usually implemented with quad tree concept.

Edge Based

ED techniques are generally used for locating discontinuities in gray level pictures.

There are a lot of techniques for area detection, however most of them can be grouped into classes, seek based and 0-crossing based totally. The seek-primarily based methods locate edges by using first computing a degree of edge energy, normally a 1st-order derived expression. The 0-crossing based techniques search for 0 crossings in a

2nd-order spinoff expression computed from the picture (Figure 3) with a view to locate edges.

Edge-based segmentations (EBS) are based on edges in a picture by area detecting operators, those edges mark image places of discontinuities in gray level, color, texture, and lots of others. Segmentation methods based on discontinuity find for surprising modifications in the depth fee. These strategies are known as edge or boundary primarily based strategies.

1st order Derivative

- 1) **Prewitt Operator:** It is far a discrete differentiation operator, computing an approximation of the slope of the picture intensity feature. The Prewitt operative is based totally on convolving the picture with a small, separable, and integer valued filter, out in horizontal and vertical recommendations and is therefore fairly much less expensive in phrases of computations.
- 2) **Sobel Worker:** It is a discrete differentiation operative computing an approximation of the gradient of the picture depth function. At each issue in the picture, the end result of the Sobel operator is both the corresponding gradient vector and the norm of this vector. The Sobel operator is based totally on convolving the picture with a small, separable, and numeral valued clear out in horizontal and vertical path and is consequently distinctly cheaper in phrases of computations.
- 3) **Canny operator:** The Canny aspect detector is an area detection operator with the aim of using a multi-level set of rules to discover big kind of edges in pictures. It turned into developed with the aid of John F. Canny in 1986.



Fig. 3: Edge Based Segmentation.

2nd Order Derivative

- 1) *Laplacian Operator*: There must exist a point where there is a zero crossing. To facilitate position is the edge's location. Edge detectors that are based on this idea are called Laplacian edge detectors.
- 2) *Zero-Crossings*: In the field of DIP, outstanding emphasis is placed on operators which search for out edges within a picture. They are known as 'Edge Detection' or 'Gradient filters'. A gradient pass through a filter is a filter out which seeks out regions of rapid alternate in pixel cost. These factors typically mark a facet or a boundary. A Laplace filter (LF) is a filter which fits on this circle of relatives, though it units about the mission in a different way. It seeks out factors in the signal stream wherein the DS of a picture passes via a pre-set '0' value, and marks this out as a capability edge point. Because the sign has crossed through the factor of 0, it is referred to as a 0-crossing.

Segmentation Based On Clustering

Clustering uses no training stages rather train themselves using presented data. Clustering is usually used when classes are known in prior [17]. A similarity mapping is defined between pixels, and then similar pixels are grouped together to become a cluster. The combination and groups of pixels into clusters is based on the principle of increasing the intra-class comparison and increasing the inter-class similarity.

The level of a clustering end result relies upon on both, the similarity degree used by the technique and its operational method. Clustering algorithms are characterized as: (i) hard clustering, (ii) k-means clustering, and (iii) fuzzy clustering, etc.

K-Mean Clustering

K-Means set of rules is an unmonitored clustering algorithm that classifies the participation information factors into a couple of training, based totally on their inherent distance from each other. In K-means algorithm, data vectors are grouped into predefined number of clusters. At the start, the centroids of the predefined clusters are

initialized arbitrarily. The dimensions of the centroids are identical as the measurement of the information vectors. This method is repeated till no enormous modifications end result for every cluster suggest or for a few fixed quantity of iterations.

Downy C-Means Clustering

Fuzzy clustering approach can be taken into consideration to be advanced to those of their difficult counterparts on account that they could constitute the connection concerning the enter sample records and clusters greater clearly. FCM is a famous soft clustering technique; its effectiveness is, largely restricted round clusters. FCM is one of the most promising fuzzy clustering methods. In most cases, it is stretchers than the corresponding difficult-clustering algorithm.

ANN Based Image Segmentation

Most segmentation methods are based only on color information of pixels in the image. Humans use much more understanding than this, whilst doing IS, but enforcing these facts would value enormous computation time and might require a big domain-knowledge database, that is currently not accessible. Neural network (NN) segmentation is predicated on processing small regions of a picture, the use of an ANN or a fixed of NN.

After such processing, the decision-making mechanism marks the areas of an image therefore to the category general via the NN. Pulse-coupled NN are neural fashions proposed by means of modeling a cat's visual cortex and evolved for excessive performance biometric IP. The Eckhorn model furnished an easy and effective device for studying the visual cortex of small mammals, and turned into soon recognized as having substantial software capability in illustration processing.

In 1994, the Eckhorn model became adapted to be an IP algorithm by Johnson, who termed this set of rules Pulse-Coupled NN. Some of the mostly used NN for IS are: Hopfield, BPNN, FFNN, MLFF, MLP, SOM, and PCNN. Segmentation of image using NN is performed in two steps, i.e., pixel arrangement and edge detection [17].

Table 1: Comparison Between Segmentation Techniques [18].

Segmentation Technique	Method Description	Advantages	Disadvantages
Thresholding Method	Depends on the histogram of a picture.	A simple approach in which there is no requirement of prior knowledge of image. It is a first step to segmentation method.	It does not work well if too many edges are present or not fit for flat valleys.
Edge Detection Approach	Based on discontinuity of pixels or pixels having different intensities.	Easy detection of the edges.	This method is less immune to noise and does not work if the edges are not defined perfectly.
Region Based Method	Grouping of pixels having similar properties form the region.	Work well when the region homogeneity criteria are easily defined and more immune to noise.	This technique consists of dual segmentation which takes time and memory.
Clustering Method	Grouping the pixels having similar properties and defines the cluster values according to their visible intensities.	Easy detection and implementation.	Needs to define the value of cluster i.e. K.
Artificial Neural Network	It uses the neural network consisting of nodes.	Uses training data to solve complex problems and easily detects errors.	Training process consumes more time and it requires over training.

CONCLUSION

This paper gives an evaluation of various image segmentation techniques. And the composition of segmentation methodologies proposed for DI giving out is explained briefly. Various techniques are mentioned in this paper which are applied in very advance mission of identification of object or region image.

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