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SEGMENTATION FOR DIFFERENT IMAGE MODALITY

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Abstract:
In this paper, we presented comparative methods for image segmentation. There are several existing techniques, which used for image segmentation. These all techniques have their own importance. These all techniques can be approached from two basic approaches of segmentation i.e. region based or edge based approaches. Every technique can applied on different images to perform required segmentation. These all techniques also can classified into three categories The Segmentation of different modality images is an important step in forming realistic tissue models. Current segmentation approaches reviewed with an emphasis placed on revealing the advantages and disadvantages of these methods for medical imaging applications. To assist in classifying the relevant literature, there many methods for image segmentation image, we used a method witch based region segmentation. Segmentation of medical images is an important step in forming realistic tissue models. Segmentation of the image is an image processing operation, particularly in the medical field. Diagnostic imaging is an invaluable tool in medicine today. Magnetic resonance imaging (MRI), computed tomography (CT), digital mammography, and other imaging modalities provide an effective means for noninvasively mapping the anatomy of a subject. The segmentation of medical images is of paramount importance in the diagnosis and detection of various pathologies. We present in this paper a comparative study of segmentation methods by region such Fuzzy C-Means, K-Means, Meanshift and EM, where the results obtained are evaluated by three criteria: IntraInter_LN, Intra_LN, CritAtt, we used medical images base and x-ray image image Ultra Sound. The diversity of segmentation methods offers us several ways to segment the image. Always look for the EM method to get good results.
Key words: Image segmentation, modality of image, criteria for evaluation

Introduction:

Digital image processing is the use of computer algorithms to perform image processing on digital images. Image segmentation is an important and challenging process of image processing. Image segmentation technique is used to partition an image into meaningful parts having similar features and properties.

Image processing is an invaluable tool in domain different such as medicine, military etc... Magnetic resonance imaging (MRI), computed tomography (CT), digital mammography, and other imaging modalities provide an effective means for noninvasively mapping the anatomy of a subject. These technologies have greatly increased knowledge of normal and diseased

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anatomy for medical research and are a critical component in diagnosis and treatment planning. X-ray segmentation methods have received a considerable amount of attention recently. X-ray segmentation is challenging as X-ray images have a complex nature. .

In this paper, we used the approach in which an image is segmented into regions based on discontinuity. The edge detection based segmentation falls in this category in which edges formed due to intensity discontinuity y are detected and linked to form boundaries of regions

Several segmentation techniques have been developed and reported in the literature. The aim of segmentation of MRI Brain images is to Study anatomical structure, Identify region of interest: locate tumor, others abnormalities, measure tissue size (to follow the evolution of tumor) and help in treatment planning prior to radiation therapy (radiation dose calculation). However, the segmentation of MRI Brain images has remained a challenge in image segmentation. In addition, this is due to partial volume effects, motion (patient movement, blood circulation and respiration), the existence of image noise, the presence of smoothly varying intensity in-homogeneity, the fact that different anatomical structures may share the same tissue contrast and large amounts of data to be processed. For these and others many approaches have been studied, including Methods based edge [Kalavathi, 2013][Cheng, Chen, 2007][Karras and Mertzios, 2003], methods based region [Lisowski, et all, 2011], Methods based on thresholding [Tohka, et all, 2010][Sharma, et all, 2008], methods based artificial neural networks [Stella and Mackiewich, 2009], data fusion methods [Anami, and Unki, 2013], and hybrid Methods [Dempster, Laird, and Rubin, 1997].

This paper is organized as follows. In Section 2, common terminology and issues associated with the segmentation of different modality images are defined and discussed. In Section 3, we briefly describe methodologies used in common segmentation approaches. In Section 4, we review the ways in which segmentation methods have recently been applied in different imaging modalities. Finally, in Section 5, important issues relating to the future of medical image segmentation are discussed.

Materials and methods:

The simple approaches to segment an image based on the intensity levels and called as threshold-based approach. Threshold based techniques classifies the image into two classes and works on the postulate that pixels belonging to certain range of intensity values represents one class and the rest of the pixels in the image represents the other class. There are several existing techniques, which used for image segmentation. These all techniques have their own importance. These all techniques can be approached from two basic approaches of segmentation i.e. region based or edge based approaches.

Every technique can be applied on different images to perform required segmentation. These all techniques also can classified into three categories. The goal this works is present a comparative study for based image segmentation applied for different modality of image. Image segmentation is an important step perform in image analysis, image processing is a research theme located between computer science and signal processing. In this paper, we presented the results of the different tests on the different images databases. We use the MATLAB to program the segmentation methods by region that we studied on the medical images, then the analysis of the results. We have proposed three criteria to evaluate the results, this objective as well as subjective criteria allow us to make a decision on the change of image. In this works, I want to present the based image segmentation algorithms.

II.1 A. K-MEANS

This algorithm clusters the point nearest to the centroid. The centroid is the average of all the points in that cluster and has coordinate as the arithmetic mean over all points in the cluster, separately for each dimension.

K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other. Macqueen first proposed the iterative K-Means clustering algorithm. The algorithm aims at partitioning the data set, consisting of ℓ expression patterns {x1,..., xℓ} in an n dimensional space, into k disjoint clusters , such that the expression patterns in each cluster are more similar to each other than to the expression patterns in other clusters. There are two popular partitioned clustering strategies: square error and mixture modeling. The sum of the squared Euclidian distances between the samples in a cluster and the cluster center called within-cluster variation. K-Means are widely used in many applications such as data extraction and image segmentation. The K-Means method is an iterative algorithm that minimizes the sum of distances between each object and its cluster centroid.

Steps in K-Means algorithm:

1. Choose the number of clusters K.
2. Select at random K points, the centroids (not necessarily from your dataset).
3. Assign each data point to the closest centroid → that forms K clusters.
4. Compute and place the new centroid of each cluster.
5. Reassign each data point to the new closest centroid. If any reassignment. Took place, go to step 4, otherwise, the model is ready.

II.2 FUZZY C-MEANS (FCM)

In this algorithm, the test pixel allowed to be member of two or more clusters with different membership coefficient. FCM algorithm is iterative in nature, generate fuzzy partition matrix, and requires cluster center along with objective function. The FCM is an unsupervised fuzzy clustering algorithm. Excerpted from the algorithm of C-means, it introduces the concept of fuzzy set in the definition of classes; each point in the data set belongs to each cluster with a certain degree, and all clusters characterized by their center of gravity. The FCM clustering algorithm was first suggested by Dunn and latter improved by Bezdek. The FCM method proposes a fuzzy membership that assigns a degree of membership for each class by iteratively updating the cluster centers and the membership degrees for each data point. The cluster that has an associated pixel is one whose membership degree is highest. A novel approach called enhanced possibility Fuzzy C-Means clustering proposed for segmenting MR brain image into different tissue types on both normal and tumor affected pathological brain images. FCM methods has proposed for the segmentation of MR Images and for the

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segmentation of major tissues in litteratury and possible tumor on T1-weighted volumes. The FCM often used in medical image segmentation. Chen et al. have proposed an algorithm based on FCM for the correction of intensity in homogeneity and for segmentation of MRI images. Improved and enhanced FCM clustering algorithms by Tolias, Y. A. and Panas, S. M.(1998) and a Gaussian kernel-based fuzzy c-means algorithm with a spatial bias correction by M.-S. Yang and H.-S. Tsai(2008) have been used to accelerate the image segmentation process and to correct the intensity inhomogeneity during segmentation. FCM is the most effective algorithm for data clustering. FCM was proposed by Dunn and later on it was modified by Bezdek(1980). The standard FCM objective function for partitioning the data into C clusters is given as:

$$J_{\mathrm{FCM}} = (U, V) = \sum_{i=1}^{c} \sum_{k=1}^{N} \mu_{ik}^{p} \|x_k - v_i\|^2 , \quad (1)$$

II.3 Mean Shift Algorithm

Gradient-based methods of feature space analysis use gradients of the probability density function to find the maxima. Such methods are complex because, among other things, of the need for an estimate of the probability of density. The gradient-based methods first calculate the gradient and then the kernel is shifted by a specific length vector in the direction of a maximum increase of density.

The magnitude is the step size which has to be chosen appropriately. The task is how to choose a suitable step size because a small step size will slow down the convergence.

The mean shift algorithm solves the main problem of gradient methods. The main idea of the mean shift is to treat the points in D-dimensional feature space as an empirical probability density function where dense regions correspond to the local maxima of the underlying distribution. Gradient ascent is performed in the feature space on the local density estimation until convergence. After the procedure, stationary points correspond to the modes of the distribution, and the same stationary points are considered members of the same cluster.

The step size of the mean shift is adaptive and depends on the gradient of the density of probability. The gradient is not calculated, instead, a more efficient mean shift vector is calculated. The mean shift vector points in the same direction as the gradient in gradient-based methods.

In contrast to the well known K-means clustering approach, mean shift does not need assumptions on the number of clusters and the shape of the distribution, but its performance relies on the selection of scale parameters. Bandwidth is the only parameter to tune, so for the one-dimensional case this is a relatively simple procedure, but in a multidimensional case, it can be difficult. Mean shift might not work well in higher dimensions.

The mean shift procedure consists of two steps:

1. Construction of probability density in some feature space,
2. The mapping of each point to the maximum (mode) of the density, which is closest to it.

Each data point is shifted to the weighted average of the data set. The mean shift algorithm tries to find stationary points of an estimated Probability Density Function (PDF).

II. 4. Expectation-Maximization (EM) algorithm

K-means algorithm is simple. However, it is easy to get stuck in local optimal. The EM algorithm tends to get stuck less than K-means algorithm. The idea is to assign data points partially to different clusters instead of assigning to only one cluster. To do this partial assignment, we model each cluster using a probabilistic distribution.

So a data point associates with a cluster with certain probability and it belongs to the cluster with the highest probability in the final assignment.

We can use mixture of Gaussian distributions to model this. The mixture model is a weighted sum of K Gaussian distributions. The weights sum up to 1. Let the parameter of jth distribution be θj and its weight be wj , the probability of a data point xi given this model is

$$p(x_i|\Theta) = \sum_{j=1}^{K} w_j p_j(x_i|\theta_j),$$

where $\theta = (w1,\ldots,w_K, \theta_1,\ldots,\theta_k)$.

To do clustering, we want to determine the probability of the cluster Cyi for each data point xi given θ, that is, [illegible].

III. Results and discussions:

III.1 Information image IRM

The image below (Fig.1), presents a medical image MRI, a normal cranium, the size of this image 256 × 256 pixel (original, untreated), encoded on 8 bits. In this part, we applied the different methods of segmentation based on regions. In the figures and tables below, we applied four different segmentation methods and three evaluation criteria for the MRI image.

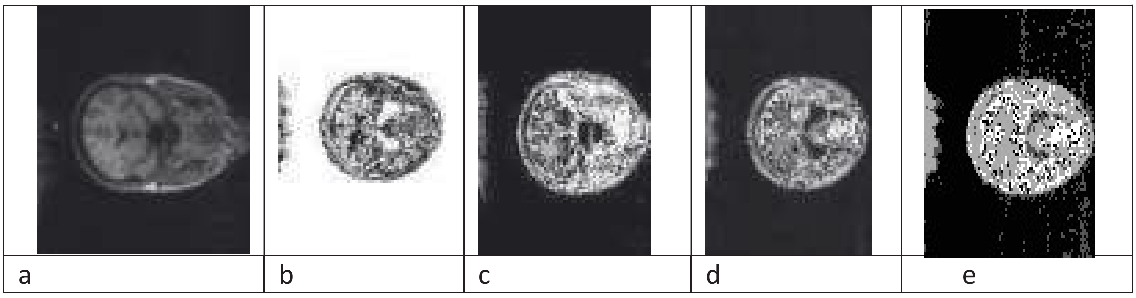

Fig 1 : IRM image segmentation results, a) original image, b) fuzzy C-medium method (FCM), c) k-means method, d) Mean Shifte method, e) Expectation Maximization (EM) method.

Table 1. Segmentation Evaluation Results in Fig.2 for an MRI Image

Criteria and Methods	FCM	KMeans	MeanShift	EM
IntraInter_LN	0.6013	0.6019	0.5836	0.5986
Intra_LN	0.0798	0.0803	0.0179	0.1224
CritAtt	0.1849	0.0255	0.0213	0.0018

III.2 Image information X-ray

In this part, we applied the different methods of segmentation based on regions. In the figures and tables below, we applied four different method of segmentation and three evaluation criteria for the x-ray image. The image below (Fig.2), presents a medical image X-ray, of a normal cranium, the size of this image 256 × 256 pixel, encoded on 8 bits. We found by the site: http: //www.aylward.org/notes/Open-access-medical-image-repositories in the Internet library.

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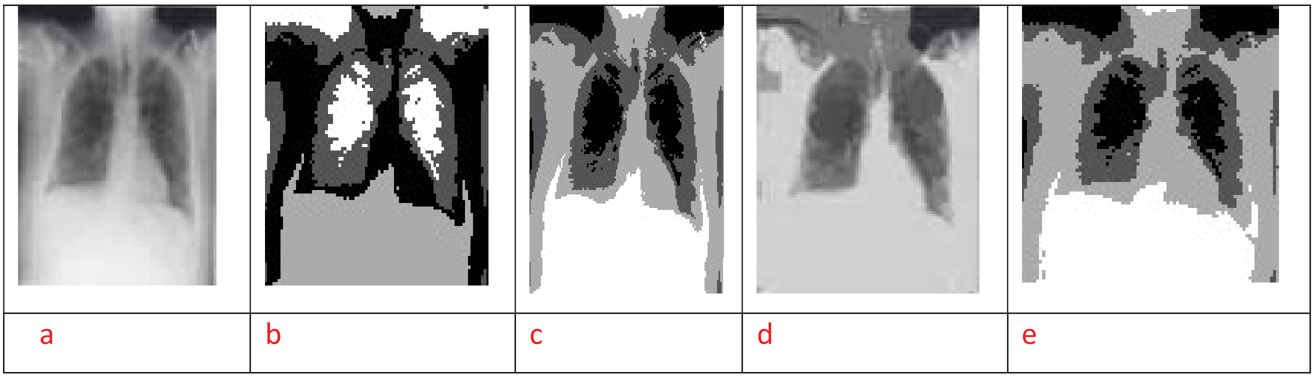

Fig.2: X-ray image segmentation results, a) original image, b) fuzzy C-Means method (FCM), c) k-means method, d) Mean Shift method, e) Expectation Maximization (EM) method

Table 2. Segmentation Evaluation Results in Fig.2 for an X-ray Image

Methods and criteria	FCM	K-means	Mean shift	EM
IntraInter_LN	0.5875	0.5865	0.5741	0.5896
Intra_LN	0.0805	0.0806	0.6648	0.0815
CritAtt	0.2087	0.2971	0 .2322	0.2261

III.3 Informations about Ultra Sound

In this part, we applied the different methods of segmentation based on regions. In the figures and tables below, we applied four different methodologies of segmentation and three evaluation criteria for the image Ultra Sound. The image below (Fig.3), presents a medical image Ultra Sound, a normal skull, the size of this 256 × 256 pixel image encoded on 8 bits. We found by the site: http: //www.splab.cz/en/download/databaze/ultrasound in the Internet library.

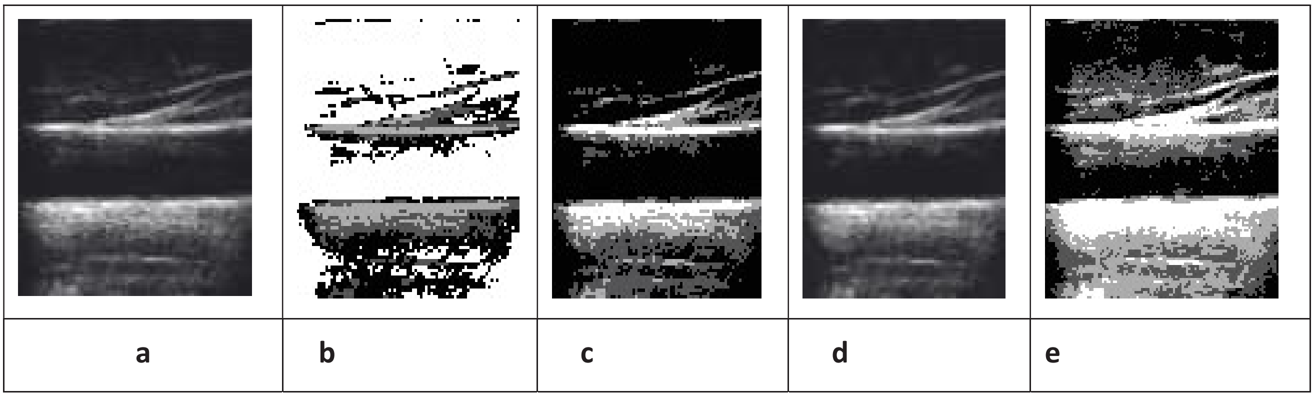

Fig.3 : Ultra sound image segmentation results, a) original image, b) fuzzy C-medium method (FCM), c) k-means method, d) Mean Shifte method, e) Expectation Maximization (EM) method.

Table 3. Segmentation Evaluation Results in Fig.3 for an Ultra Sound Image

Methods and criteria	FCM	K-means	Mean shift	EM
IntraInter_LN	0.5839	0.5845	0.5825	0.5561
Intra_LN	0.0868	0.0852	0.0580	0.1282
CritAtt	0.0502	0.0119	0.0032	0.0014

VI. Conclusion and discussion

We applied four methods of image segmentation by region (FCM, K-Means, Mean Shift, EM) are presented in the previous chapter to segment three sub-bases of images (MRI image, X-ray image, Ultra image Sound.) In addition, the values of the criteria (IntraInter_LN, Intra_LN, CritAtt) and a table is made for each result, this table presents the values of some evaluation criteria without truth in the field.

The segmentation process can be divided into various category based on the parameter selected for segmentation like pixel intensity, homogeneity, discontinuity, cluster data, topology etc. From the previous tables and figures, we noticed that: The results demonstrated that the K-Means segmentation method is the best compared to other magnetic resonance imaging (MRI) segmentation techniques.

The second image x-ray results demonstrated that the segmentation method (EM) is the best. The latest Ultra Sound image demonstrated results that the K-Means segmentation method is the best.

V. Conclusion

The purpose of our study is to compare a set of segmentation methods by region to segment medical images. The unsupervised criteria for evaluating segmentation that are used in this chapter are IntraInter_LN, Intra_LN, CritAtt. The application of these criteria is shown in the above tables that the best values of the criteria are varied. When a value is near to one reflects a very good segmentation result.

The results obtained show that the K-Means method is the best in both types of magnetic resonance images (MRI) and Ultra Sound. Moreover, the method (EM) is the best in the x-ray image.

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