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Segmentation Techniques Comparison in Medical Image Processing

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Abstract
In day-to-day life, new technologies are come to fore in the field of Image processing, especially in the world of segmentation. We present soft computing approaches namely like K-Means, Fuzzy C-Means and Penalized Fuzzy C-Mean Clustering etc., mentioning its merits as well as the demerits. Some of the techniques are suitable for noisy images. PFCM solves the noise sensitivity defect of FCM, overcomes the coincident clusters problem of PCM, whereas K-Mean is the simplest technique for segmentation.

Keywords
Medical Image segmentation, Thresholding, PFCM, FCM, K Mean

I. Introduction

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to examine. Segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour, intensity or texture.

II. Classification

Segmentation can be classified as follows:

- Threshold
- K-Mean
- FCM
- PFCM

The classification is specified in Fig 1

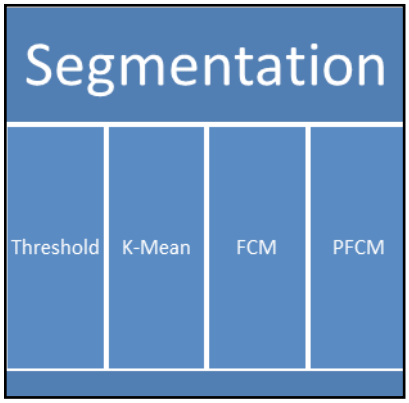

Fig. 1. Various Types of segmentation

A. Threshold

Thresholding is the easiest way of segmentation. It is done through that threshold values which are obtained from the histogram of those edges of the original image [24]. The threshold values are obtained from the edge detected image. So, if the edge detections are accurate then the threshold too. Segmentation through thresholding has fewer computations compared to other techniques. [23] Segmentation is based on "his ton". For a particular segment there may be set of pixels which is termed as "his ton". Roughness measure is followed by a thresholding method for image segmentation. [18] Segmentation is done through adaptive thresholding. The gray level points where the gradient is high, is then added to thresholding surface for segmentation [10] The drawback of this segmentation technique is that it is not suitable for complex images.

b. K-Mean

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters fixed a priori. [11]This algorithm aims at minimizing an objective function, in this case a squared error function. [7]. The algorithm is composed of the following steps:

- Place K points into the space represented by the objects that are being clustered. These points represent initial group centroid.
- Assign each object to the group that has the closest centroid.
- When all objects have been assigned, recalculate the positions of the K centroid. Repeat Steps 2 and 3 until the centroid no longer move.
- This produces a separation of the objects into groups from which the metric to be minimized can be calculated. [8]

Merits & Demerits

The computational results showed that the K means image segmentation has less accuracy but it provide poor result. The k means algorithm takes minimum numbers of iterations compare to C means. The KCM consume more time.

C. FCM

Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method (developed by Dunn in 1973 and improved by Bezdek in 1981) is frequently used in pattern recognition. It is based on minimization

of the following objective function:

$$J_m = \sum_{i=1}^{n} \sum_{j=1}^{c} u_{ij}^{m} \| x_i - cj \|^2$$

where m is any real number greater than 1, uij is the degree of membership of xi in the cluster j, xi is the ith of dimensional measured data, cj is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center.

Merits:

FCM yields successful results for robust and effective image segmentation of noisy images. Gives best result for overlapped data set and comparatively better then k-means algorithm. Unlike k-means where data point must exclusively belong to one cluster center here data point is assigned membership to each cluster center as a result of which data point may belong to more then one cluster center.

Demerits

1) Apriori specification of the number of clusters.
2) With lower value we get the better result but at the expense of more number of iteration.

D. PFCM

A novel fuzzy clustering method, called penalized FCM (PFCM) algorithm is presented for image segmentation. The penalty term takes the spatial dependence of the objects into consideration, which is inspired by the neighborhood EM (NEM) algorithm [19] and is modified according to the criterion of FCM. The PFCM algorithm is then proposed by minimizing this new objective function according to the zero gradient condition, which can handle both the feature space information and spatial information during segmentation.PFCM model and algorithm that generated both membership and typicality values when clustering unlabeled data. PFCM solves the noise sensitivity defect of FCM, overcomes the coincident clusters problem of PCM and eliminates the row sum constraints of FPCM.

Merits and demerits:

PFCM algorithm helps in identifying hidden pattern and providing enhanced understanding of the functional genomics in a better way.

III. Conclusions

This paper defines the segmentation technique in various fields like in medical images detect Cancer, to brain MRI, to count blood cells, in Horticulture for pest detection and many more. With the help of various clustering methods, segmentation became very effective. Cluster based segmentation can give effective result so further study can be conducted regarding improving clustering technique in segmentation. Issues in image segmentation are image quality and number of errors. We have to improve these errors

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