

Abstract

More research and work has been done on Fuzzy C Means (FCM) Clustering scheme to enhance more effectiveness of this method. In this Article we have purposed a scheme of FCM to get enhanced performance. It is more considerable than hard segmentation methods because it could retain much more details. This work mainly focuses on clusters. This algorithm implemented on different images of different size and format and recorded. PSNR, MSE, RMSE, BER, SSIM are major focus here for computing performance.

Keywords: Fuzzy Traditional Fuzzy segmentation, FCM, Clusters, Iterations, Parameters.

Introduction

Fuzzy C-Means also call ISODATA is data clustering method. In this method each data points belonging to a cluster to a degree described by membership value [1]. FCM is used in many applications such as classification, segmentation, recognition etc. unlike K-means clustering method. Its performance is based on initial cluster centers and also suffers from noise and outliers. FCM algorithm allocates pixels to fuzzy clusters without labeling. Unlike the hard clustering methods otherwise also called as k-means clustering which force pixels to belong entirely to one class where FCM allows pixels to belong to numerous clusters with changeable degrees of membership. Because of the additional flexibility, FCM called as Soft clustering method [2].

Fuzzy C – Means formulation and procedure

The FCM method [3] try to divide a finite ‘n’ no. of elements that is $X = \{x_1, \dots, x_n\}$ into a group of C fuzzy clusters with respect to some specified condition. For a finite group of data, this method returns a list of C cluster centers that is $C = \{c_1, \dots, c_c\}$ and a partition matrix

$$W = w_{i,j} \in [0,1], i = 1, \dots, n, j = 1$$

Where each element $w_{i,j}$ notify the quantity to which element x_i belongs to cluster c_j .

This method is basically belongs to iterative procedure is given below:

1. Initialize the membership matrix W with random values between 0 and 1.
2. Calculates C fuzzy cluster center c_i , $i = 1, \dots, c$, with following equation:

$$c_1 = \frac{\sum_{j=1}^n u_{ij}^m X_j}{\sum_{j=1}^n u_{ij}^m}$$

3. Compute the cost with following equation. Stop if either it is lower than specified threshold value or its improvement over previous iteration:

$$J(U, C, \dots, C) = \sum_{i=1}^c J_i = \sum_{i=1}^c \sum_j u_{ij}^m d_{ij}^2$$

4. Compute a new W with given equation. And Go to step 2:

$$u_{ij} = \frac{1}{\sum_{k=1}^c \left(\frac{d_{ij}}{d_{kj}}\right)^{2/(m-1)}}$$

Literature survey

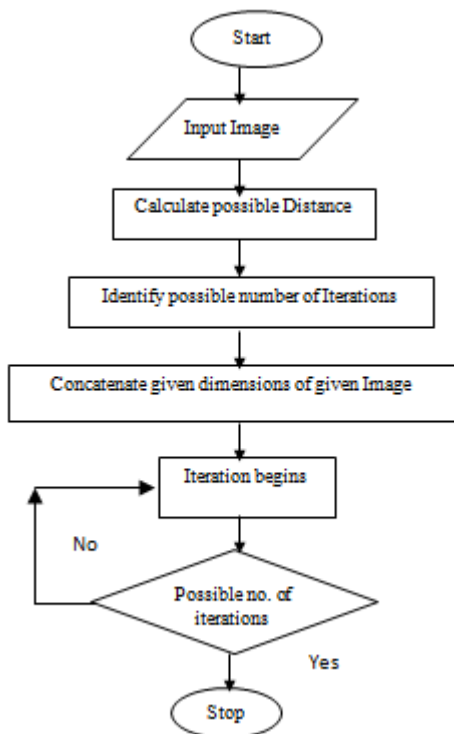
More research and work has been done on Fuzzy C Means (FCM) Clustering scheme to enhance more effectiveness. Survey on such methods given below.

In MRI images, grey and white matter can be measured with sensitivity and specificity giving accurate and stable result [4]. FCM introduced to overcome the crisp definition of similarity and clusters by assigning weights to features according to their clustering [5]. In paper [6], two data clustering methods, Hierarchical Cluster Analysis and Fuzzy C-Means clustering, are used to classify sets of oral cancer cell data without a pre-processing procedure. FCM was found to achieve extensively better. Fuzzy clustering methods proved to be best in segmentation to reduce over segmentation to get better PSNR, MSE and other parameters [7]. One innovative method contains spatial relations by assuming that geometric model of segmented image is Gibbs Random Field. Fuzzy C-Means clustering method includes the energy function which is the sum of potentials of GRF to get accurate and faster results [8]. To overcome the noise sensitivity of traditional fuzzy c-means, modifications done on standard FCM algorithm with a penalty term

which takes into account the control of the neighboring pixels over central pixels[9]. Improved level set method purposed in which, watershed transform is used to pre-segmentation, to get the first partition of it. A few valuable information about primitive regions and boundaries can be attained. The Improved fuzzy c-means used to create a first contour curve which overcomes leaking at the boundary throughout the curve propagation [10]. Fuzzy k-means clustering and fuzzy c-means clustering was used for brain tumor detection and for exact location identification [11]. FCM approach also used over meteorological data, gives better results than Fuzzy K-means method over data mining platform WEKA [12].

Evaluating method

Figure 1: Method to be used

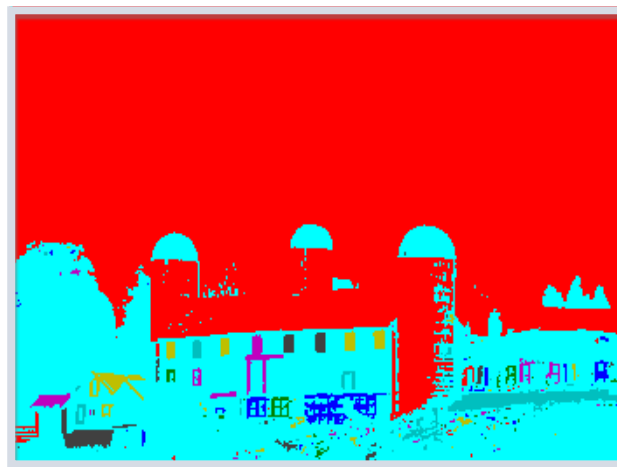


iteratively during segmentation. In FCM, all the areas of image are segmented correctly and visible.

Figure 2: Fuzzy Segmented Image



Figure 3: Fuzzy C - Means (FCM)



In table 1, some parameters are to be evaluated for analysis in segmentation such as PSNR, MSE, RMSE, BER, and SSIM. All these parameters are showing the resultant values must to higher for PSNR and SSIM, Lower for MSE, RMSE, BER.

Evaluating performance

In this part of performance analysis, 5 images are to be included for evaluating results are: “Bird”, “Building”, “Car”, “Horses” and “Pens”. Following results on “Building” image are showing segmentation with Traditional Fuzzy in figure 2 and FCM in figure 3. From figure 3 and figure 4, it is evident that performance of FCM is better instead of Traditional Fuzzy. In FCM, Clusters are generated

Table 1: Parametric Evaluation

Parameters	Bird	Building	Car	Horses	Peus
PSNR	52.1723	51.3466	42.7164	41.3608	42.8922
SSIM	49.7424	48.0644	35.0619	47.9074	33.6715
MSE	0.0115	0.0057	0.0489	0.0034	0.0054
RMSE	6.3042	6.9328	5.9213	6.9215	5.8027
BER	0.0311	0.0319	0.0306	0.0319	0.0304

Conclusion

FCM is more considerable than hard segmentation methods because it could retain much more details from Image. This algorithm implemented on different images of different size and format and recorded. PSNR, MSE, RMSE, BER, SSIM are major focus here for computing performance. FCM is better instead of Traditional Fuzzy is evident from Evaluating performance. In FCM, all the areas of image are segmented correctly and visible. In future, Fuzzy C – Means can be compared with Otsu's segmentation is also one of strong method of segmentation.

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