Segmentation of Images using Fuzzy CMeans with Spatial and Intensity Constraint Membership Linking

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ABSTRACT

To segment images the suitable and well-organized clustering method is fuzzy C-means (FCM). Nevertheless, FCM is lagging due to non-robustness and leading to inaccuracy for noise images. This paper proposed a revised FCM scheme in order to segment the noise and is termed as FCM_SICM. For instance, to obtain the local spatial and the intensity of image the filtering technique; fast bilateral filter is acquired. Later, the absolute variance of image among the bilateral filtered and actual image is employed and the joint of the variance image and itself obligeunoriginal FCM including the intensity and local spatial evidence correspondingly. As a final point the membership is associated with the previous iteration by making the additive of all the functional membership grades computed at each and every cluster in the formula of squared logarithmic methodin the expressed objective function as denominator. Experimental validation proves that the proposed technique attains greater segmentation operation in terms of its performance.

I. INTRODUCTION

Image segmentation stood as a significant procedure that gives the outcome of partitioning into various sets of digital image to pixel format for simplifying the investigations of desired image relying on particular comparisons amongst pixels comprising luminance, intensity, color, configuration, texture, etc. There exists various methodologies to solve for the image segmentation says in the literature. It is observed that image segmentation is a challenging task [1-4] now a days in order to create an effective design for the result of robust and accurate process of image processing. To not just train the sample images that has been chosen from the reference FCM serves [6,7] as the basic and feasible kind of unsupervised system. Basically there is separation for objects as well as patterns into various groupings such that the individual object or pattern in the same group similar behavioural characteristics instead with the different groupings [8,9]. Even though the clustering based FCM method is operative and effective for segmenting the images without noise and its error occurring in the process, there exists few constraints for which not including the local and optimal relationship among pixels. As the result of it is less efficient for imaging noise and artifacts making it insensitive [5]. From past decades, the researches have been established various FCM techniques to minimize the noise insensitiveness from the traditional FCM techniques. According to histogram outcomes clustering, the information of locally oriented data has been prior measured clustering such that the estimation speed is rapid yet it doesn’t give spatial valued information in the process of clustering histogram. Based on the probability density function the prior operating’s are done that considers the unknown fields of Markov randomness that are said to be the better tools and functions for solving the uncertainty under certain assumptions made. Next, to work with the methodology dealing with the kernel are deliberated to arrange with non-linear filters and classification difficulties. Though, there are certain developments and limitations for a extent in the segmentation process of image. As a final point the membership...
is associated with the previous iteration by making the additive of all the functional membership grades computed at each and every cluster in the formula of squared logarithmic method in the expressed objective function as denominator with no reflection of iterations. Generally the clustering varies with the people.

The important peak value numbers in the image segmentation is basically well thought-out terms of referral value under the automated case of clusters as the number preference [10]. As respective to the imaging noise, contrary the histogram represented the bars that are intentionally equalized for the peak value and made it hard to critically identify the noise in the pixel format. Therefore, numerous amount of noise pixels said to be the outliers are further exist in the work as well to consider the noisy image [11-14]. Furthermore, the amount of clusters cannot be determined at a single batch or prior based on the clustering performance measuring with the actual possible terms in the aspect of noise occurrence. In essence, there exists cluster based validity scheme indexes upon comprising the summing of cluster oriented distances squared error, CH index, RMSE, silhouette index, and KL index [15,16,17] all together with the common approach of the series structure of cluster that has been automated under selection of proper number of clustered valued system. Probability density function the prior operating’s are done that considers the unknown fields of Markov randomness that are said to be the better tools and functions for solving the uncertainty under certain assumptions made. Next, to work with the methodology dealing with the kernel are deliberated to arrange to make the summing or additive of clusters under the indexing value is obtained small within the speed of indexed number with decreasing secondary index that varied over the point of elbow. When the index valued for the indexes reach a certain maximum level then the clustered numbers presented under such statistical basis acquired from the gap of determining the clusters. Such statistical gap based system is developed to regulates clustered numbers. Among the observed and reference data, the variation in summing clusters over the distances is computed by the proposed method which further sampled by the logarithmic procedures of Monte Carlo simulation. The gap statistics is capable of choosing the suitable number of clustered values whenever the observed termed data is nearer to uniform distribution. However, it can be chosen with the help of automated approaches for selecting the required cluster based validated indexes. This paper proposed a revised FCM scheme in order to segment the noise and is termed as FCM_SICM. For instance, to obtain the local spatial and the intensity of image the filtering technique; fast bilateral filter is acquired. Later, the absolute variance of image among the bilateral filtered and actual image is employed and the joint of the variance image and itself oblige unoriginal FCM including the intensity and local spatial evidence correspondingly. As a final point the membership is associated with the previous iteration by making the additive of all the functional membership grades computed at each and every cluster in the formula of squared logarithmic method in the expressed objective function as denominator. Evidently, there exist three characteristics for FCM-SICM to achieve the actual occurrence of segmented image: Spatial and intensity constrained at the original FCM specified under varying conditions of pixels, reducing the steps of iteration by interlinking the memberships, quality of segmentation with the noisy images achieved the better mixed relation rather with the state-of-art techniques.

II. Proposed Algorithm FCM-SICM

The traditional FCM verified is insensitive to the noise occurrence and thereby it is very difficult to process the image segmentation under noisy condition. Hence it is suggested to propose or develop a new FCM that integrates intensity and local spatial evidence and reducing the steps of iteration by interlinking the memberships, quality of segmentation with the noisy images.

The proposed technique has the objective function as follows,

$$J = \sum_{i=1}^{K} \frac{\sum_{j=1}^{N} \alpha_i(u_{ij}^{(a)})^{m} (y_j - c_{ij}^{(a)})^2 + \sum_{j=1}^{N} \beta_i(u_{ij}^{(a)})^{m} (y_j - c_{ij}^{(a)})^2}{\ln(\sum_{w=1}^{N} u_{iw}^{(a-1)} + 1)}$$

(1)

It is very crucial and key task to think through how to randomly choose the parameters such as $\alpha$ and $\beta$ under such cases of heavy and less noise. There is a trade-off between noise levels and parameters values selection. If noise is heavy, then it is important to chose the values of $\alpha$ having less value and $\beta$ having greater value. Under such operation, the image segmentation has greater affect on the bilateral filter wherein the actual image had the preserved value to a convinced range. In training, dissimilar $\alpha$ and $\beta$ are required fore applying onto the segmentation process of images and $\alpha$, $\beta$ are static values for all pixels i.e. trade-off occurrence among pixels in desired image and bilateral filtered image were both identical. Thus, loss in flexibility obtained in the proposed methods for the parametric values.
These are stated as,

\[ \beta = |y_j - \bar{y}_j| \]
\[ \alpha = \frac{1}{|y_j - \bar{y}_j|} \]  \hspace{1cm} (2)

The objective function is finally given as,

\[ J = \sum_{i=1}^{K} \left( \frac{1}{\beta_i} \left( y_j - c_j \right)^2 + \frac{1}{\alpha_i} \left( \bar{y}_j - c_j \right)^2 \right) \]  \hspace{1cm} (3)

3. Results:

For testing the methods at the real time condition, variety of noises has been included to entire test images for the simulations for validating the proposed technique.

Figure 1: (a) Original image (b) added mixed noise to original image (c) Segmented image (d) objective function.
Figure 2: (a) Original image (b) added mixed noise to original image (c) Segmented image (d) objective function.
Figure 3: (a) Original image (b) added mixed noise to original image (c) Segmented image (d) objective function.

Figure 4: (a) Original image (b) added mixed noise to original image (c) Segmented image (d) objective function.

III. Conclusion

The key concern in the process of image segmentation using FCM is that the localised information is not employed. For the instance to acquire the better results under noise segmentation, and enhanced FCM technique has been provided with adaptive intensity and spatial constraint and membership connecting with FCM_SICM is offered. For instance, to obtain the local spatial and the intensity of image the filtering technique that is applied for the complexity in time to achieve the objective function on through O(n4) to O(n3); fast bilateral filter is acquired. Later, the absolute variance of image among the bilateral filtered and actual image is employed and the joint of the variance image and itself oblige unoriginal FCM including the intensity and local spatial evidence correspondingly. To minimize the noise, it is essential to improve the affect by a constant value of modification.
image and the variance image itself as constrictions lessen the quantity of iteration stages computed under the assumptions and conditions. Experimental implementation is performed employing FCM-SICM over the conditioned of varied noises. Also, the proposed FCM_SICM-based system is operative in managing the segmentation problem under noisy image.

REFERENCES