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Segmenting CT Lung Using Clustering Fast Fuzzy C-means

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Abstract: *Precise clustering of computerised tomography (CT) lung images presents the opportunity of early diagnosis for the different lung diseases such as the cancer or COVID 19. CT scan centres suffer from expert shortage, experiencing and high loads, particularly in developing countries. It prompted many researchers to make further improvements on the section is responsible for medical image processing. Reducing the work area in medical image by separating the parts of CT lung image was a major point which the radiologists targeted. The study focused on the segmentation methods, especially fast fuzzy c-means technique. In this work, fast fuzzy c-means automatically clusters the lung image from background. The promising results were obtained when the work is applied on the public CT lung image data.*

Keywords: clustering, medical images

1- Introduction

Similarly, the helpful features for homogenous regions segmenting efficiently included in clustering methods. The pixel properties of these regions usually similarity which reflect the homogeneity of region. The grey level of pixels is a measure for the absolute homogeneity [1], the parameter is summarised below:

$$R_1 \cup R_2 \cup R_3 \dots \cup R_i = I$$

Where R_1, R_2, R_3,… R_i represent regions the CT image I that consists of, furthermore,

$$R_1 \cap R_2 \cap R_3 \dots . \cap R_i = 0$$

For more details about the classification based the segmenting of region is gathered from three groups extracted from principles the region growing as demonstrated following:

1-1-Merging of Region

The selection of the initial seed pixels which are important to obtain the successful results in the segmentation. Iteratively, the merging for the neighbouring pixels continues by the merging criterion for the region growth. By merging criterion, each pixel belongs to a specific region to stop the process finally.

1-2-Separating of Region

The method works, the opposite of process the region merging, to repeatedly separate the data image and stops when the separation of a region is impossible.

1-3-Merging and Separating

The two processes (merging and separation) consist of various features. This method can organize the quad-quadrant tree of the data, splits individual segments within four quadrants until the original segment does not show non-uniform characteristics. The four neighbouring squares within the uniformity region merge in this method. The process continues in splitting and merging until there are no new results for both.

As one of the techniques that mentioned previously, the k-means clustering is a method based region segmentation in which grey levels of clusters' pixels are similar. The technique can push the cluster centre to take the appropriate position in the data among the rest clusters. A separated object by k-means keeps a wide range of the original image features with precise clustering.

The fuzzy clustering is one of the approaches that involved the conditions of clustering which implemented to the lung separation widely [1], [2] and [3]. The soft segmentation adopted the methods of fuzzy clustering which allows to cluster the overlapped region, where the various regions' pixel can have more than one memberships with numerous degrees belonging to the membership parameter. In hard segmentation, a value of maximum membership evaluates the pixel in the separated region that not allowed to be overlapped. Thus, the soft segmentation has precise details about the original image by a membership of pixel stays in the various regions.

The binary membership of pixel illustrated in the hard segmentation as in Equation.1:

$$m_{k.j} = \begin{cases} 1 & if\ j\ \in R_k \\ - & - \\ 0 & otherwise \end{cases} \qquad 1$$

Where *j* represents a *j^th^* pixel that belongs to the image (I), and the membership function of j^{th} pixel in region R_k represented *by* $m_{k,j}$.

In other words, the pixel, with a soft segmentation, owns many memberships in different regions, and the below conditions must performed membership function:

$0 \leq m_{k.j}$ 1 for all *k*, *j* and

$$\sum_{k=1}^{N} m_{k.j} = 1\ \forall j \qquad 2$$

Where N = whole the clustered regions within the image space (I). By the value of pixel j in R_k (k^{th} region) membership, one may evaluate and show the pixel belonging precisely to the region R_k: the most time the pixel, in particularly, the edge of regions, may possess a different membership related to various regions.

An optimal method has a principle of the soft segmentation is fuzzy clustering that is considered an unsupervised algorithm for segmenting of CT images as an example of this algorithm is the fuzzy c-means.

- **Fuzzy C-Means Clustering**

The main task of fuzzy c-means clusters image data to separate the image space into various regions that are called clusters. The region based on similar and close intensity values in the image. The intensity values usually overlap in the medical images, in specifically, of grey-scale within the various tissues, Fuzzy c-means technique is most suitable for medical image processing. And, the popular one is a k-mean method/ hard c-mean and is an iteration method to decrease the objective function J_{HCM} as illustrative below:

$$\mathrm{J_{HCM}(\mu.a)} = \sum_{i=1}^{m} \sum_{j=1}^{n} \mu_i(Y_j) \left\| Y_j - a \right\|^2 \qquad 3$$

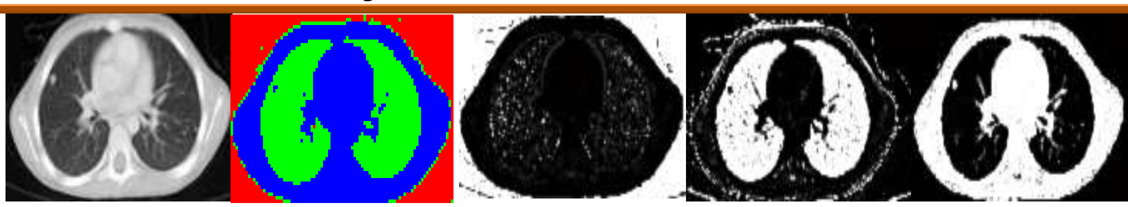
Here, $a1$,…, *am* usually represent m as cluster centres. The fuzzy development makes $\mu_i(y)$ to be a membership functions in fuzzy sets μ_i on Y involving values within interval [0, 1] such that $\sum_{i-1}^{m} \mu_i(y) = 1$ for all y in Y. In this case, $\{\mu_1 \ldots . \mu_m\}$ is a so-called fuzzy m-partition of Y. Hence, the objective function *JFCM* of the fuzzy c-mean (FCM) will be:

$$J_{FCM}(\mu.a) = \sum_{i=1}^{m} \sum_{j=1}^{n} \mu_i^m(Y_j) \qquad 4$$

Here, $\{\mu_1 \ldots . \mu_m\}$ is a fuzzy *m*-partition and *m* is a value greater than one to show the degree of fuzziness. The necessary conditions of the FCM clustering method are repeated to minimise J_{FCM} .

However, a modification of fuzzy c-means, which is original, implemented and improved to define as fast fuzzy c-means in the previous papers. The modified method shows strength against the outlier, also less noise sensitivity of original fuzzy c-means as well as the fast fuzzy c-means is the fastest in the segmentation processing. The local spatial and grey data accelerate the separation deals with the number of grey-levels which need to segmentation time is less than the time of the image size, therefore, the segmentation time is reduced when the image processing based on grey information and ignored the other levels of whole image size [4].

The fast fuzzy-c-means algorithm splits this image to separated segments as illustrated in Figure which shows the separated segments of CT lung image. L, L1 represent the CT lung image before and after implementing the fast fuzzy c-means while the images (L2-L4) covered each a segment by the pseudo colour reflecting how the pixels have relationship and belonging degrees of each region.



L L1 L2 L3 L4

Figure 1: Seperated regions of CT Lung Image: (L) Origin, (L1) Seperated Image by Pseudocolour, (L2–L4) Seperated regions

2- Conclusion

Fast fuzzy c-means has promised results in clustering the CT lung images.

The features for the method obtained after modification of fuzzy c-means method, contribute in successful the outcomes in terms of accuracy, speed and saving time. The view point of this techniques is its processing just involved the grey levels and ignored whole image size.

References

[1] Wang, Zhiling, Andrea Guerriero, and Marco De Sario. 1996. "Comparison of Several Approaches for the Segmentation of Texture Images." *Pattern Recognition Letters* 17 (5). Elsevier:509–21.

[2] Gevers, Theo, and A W N Smeulders. 1997. "Combining Region Splitting and Edge Detection through Guided Delaunay Image Subdivision." In *Computer Vision and Pattern Recognition, 1997. Proceedings., 1997 IEEE Computer Society Conference On*, 1021–26.

[3] Gevers, Theo, and A W N Smeulders. 1997. "Combining Region Splitting and Edge Detection through Guided Delaunay Image Subdivision." In *Computer Vision and Pattern Recognition, 1997. Proceedings., 1997 IEEE Computer Society Conference On*, 1021–26.

[4] Biniaz, Abbas, Ataollah Abbasi, and Mosa Shamsi. 2012. "Fast FCM Algorithm for Brain MR Image Segmentation." In *6th International Conference on Fuzzy Information and Engineering*, 1–8.