IMAGE SEGMENTATION USING FUZZY C-MEANS CLUSTERING ALGORITHM AND ITS TYPES OF TECHNIQUES

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Abstract

Fuzzy C-Mean (FCM) is an unsupervised clustering algorithm based on fuzzy set theory that allows an element to belong to more than one cluster. Where fuzzy means “unclear” or “not defined” and c denotes “clustering”. In FCM the number of cluster are randomly selected. FCM is the advanced version of K-means clustering algorithm and doing more work than K-means. K-Means just needs to do a distance calculation, whereas fuzzy c means needs to do a full inverse-distance weighting. This, plus the overhead needed for computing and managing, explains why FCM is quite slower than K-Means. This paper exposed to C-Means clustering algorithm and its techniques.

Keywords: Image Segmentation, Fuzzy C-Means , Clustering, Ant Colony.

1. Introduction

Image segmentation is an image analysis process that aims at partitioning an image into several regions according to a homogeneity criterion. Image segmentation is a very complex task, which benefits from computer assistance, and yet no general algorithm exists. It has been a research field in computer science for more than 40 years now, and the early hope to find general algorithms that would achieve perfect segmentations independently from the type of input data has been replaced by the active development of a wide range of very specialized techniques. Most of the existing segmentation algorithms are highly specific to a certain type of data, and some research is pursued to develop generic frameworks integrating these techniques. Segmentation can be a fully automatic process, but it achieves its best results with semi-automatic algorithms, i.e. algorithms that are guided by a human operator. This concept of semi-automatic process naturally involves an environment in which the human operator will interact with the algorithms and the data in order to produce optimal segmentations. The simplest example of the need of a human intervention during the task of segmentation results from the specificity of the existing algorithms. Depending on the type of input data, the operator will have to carefully pick the best adapted algorithm, which most of the

time cannot be done in an automatic way. The subjective point of view of the human is required.

Image segmentation is very important and challenging problem and a necessary role in image analysis as well as in high-level image interpretation and understanding such as robot vision, object recognition, and medical imaging. The goal of image segmentation is to partition an image into a set of disjoint regions with uniform and homogeneous attributes such as intensity, color, tone or texture, etc. Many different segmentation techniques have been developed till now. A clustering based method for image segmentation will be considered. Classification can be of two types i.e. supervised and unsupervised. Unsupervised classification is known as clustering. In supervised classification we need some prior information about the classification. But in unsupervised classification no prior information about the classification is needed i.e. It automatically generates the clusters. Clustering is a process by which we can group together the objects such that the objects belongs to the same cluster will have same property but objects belongs to different cluster will have different property. There are mainly two types of clustering namely partitioning and hierarchical. At present other technique has been developed. Many of them are hybrid in nature. Nevertheless, based on the basic architecture clustering can be classified as density-based, grid based, model-based, sample-based etc.

2. Literature Survey

S. Murugavalli et.al implements a neuro-fuzzy segmentation procedure of the MRI data to identify different tissues like WM, GM, CSF and tumor. To identify brain tumor a neuro fuzzy based segmentation was implemented. In terms of weight vector, the execution time and detected tumor pixels they considered the performance of the biomedical image. Then compare the results with existing method, this attains a higher value of identify tumor pixels than any other segmentation system. With additional input features this also obtains the weight vector value for the neuro fuzzy i.e. (6×6). The number of tumor cells and the execution time will also be analyzed for weight vector value with the different distance classifier methods. This also analyzes the change of growth rate of the tumor of the same patient. A Fuzzy kohonen neural network for medical image segmentation is used to analyses the tumor by extraction of the features (area, entropy, means and standard deviation). **H.S. Prasantha et.al** discussed various image segmentation algorithms. They evaluate the outputs and check which type of segmentation technique is better for a specific format. Precision and stability are the two key factors which allows for the use of a segmentation algorithm in a larger object discovery system. **Ajala Funmilola A. et.al** elucidate numerous methods employed for biomedical image segmentation such as Clustering, Thresholding, Classification, Deformable Model, Region Growing, Markov Random Model etc. Their work is mainly focused on clustering methods, in particular k-means and fuzzy cmeans clustering

algorithms. They combine these algorithms together to form another method called fuzzy k-c-means clustering algorithm, which results better in terms of time utilization. The algorithms have been proposed and tested with MRI images of human brain. Results have been examine and recorded. **A Basavaraj S. Anami et al** introduced combined method segmentation based methodology is proposed in this paper for automated brain MRI image segmentation. In this initial segmentation is done with by modified FCM which forms the first stage and the segmented result of first stage are used in second stage which comprises the level set based segmentation. **Kaihua Zhang et al** introduced a sliding window is used to transform the intensity domain to another domain, where the distribution overlap between different tissues is significantly suppressed. This paper presented a novel level set approach to simultaneous tissue segmentation and bias correction of Magnetic Resonance Imaging (MRI) images.

3. Fuzzy C-Means Clustering Techniques

Bezdek introduced Fuzzy C-Means clustering method in 1981, extend from Hard C-Mean clustering method. FCM is an unsupervised clustering algorithm that is applied to wide range of problems connected with feature of analysis, clustering and classifier design. FCM is widely applied in agricultural engineering, astronomy, chemistry, geology, image analysis, medical diagnosis. This algorithm is used for analysis based on distance between various input data points. The clusters are formed according to the distance between data points and the cluster centers are formed for each cluster. The degree of membership of each data item to the cluster is calculated which decides the cluster to which that data item is supposed to belong. Fuzzy clustering is a powerful unsupervised method for the analysis of data and construction of models. In many situations, fuzzy clustering is more natural than hard clustering. Objects on the boundaries between several classes are not forced to fully belong to one of the classes, but rather are assigned membership degrees between 0 and 1 indicating their partial membership. Fuzzy c-means algorithm is most widely used. Fuzzy c-means clustering was first reported in the literature for a special case (m=2) by Joe Dunn in 1974. The general case (for any m greater than 1) was developed by Jim Bezdek in his PhD thesis at Cornell University in 1973. It can be improved by Bezdek in 1981. The FCM employs fuzzy partitioning such that a data point can belong to all groups with different membership grades between 0 and 1.

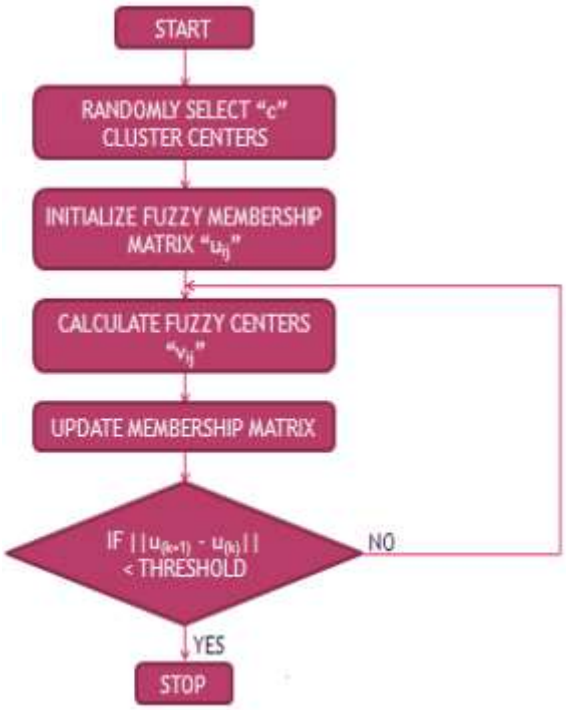

Figure 1: Fuzzy C-Means Algorithm

Among the presented fuzzy clustering techniques, threshold level-based fuzzy clustering is the only fuzzy clustering technique that caters for intensity variation in the images, besides being robust to noise and intra-class dependencies. Threshold level- based fuzzy clustering was applied on the biological image during segmentation of cell, membership connectedness; size-weighted fuzzy clustering and fuzzy statistics-based affinity propagation were applied on multispectral images. Spatially weighted fuzzy c-means (SWFCM) clustering algorithm was applied on synthetic images. The five recently presented fuzzy clustering techniques are described in the subsections that follow.

3.1 Spatially Weighted Fuzzy C-Means (Swfcm) Clustering Algorithm

The technique was presented by incorporating the spatial neighbourhood information into the standard FCM clustering algorithm. In this algorithm, k-nearest neighbour (k-NN) algorithm was used to calculate the weight in the SWFCM algorithm in order to enhance the performance of image thresholding. Iterations were carried out with gray level histogram thresholding of the image for a faster segmentation process. According to the author SWFCM is fast and the algorithm is less sensitive to noise since it incorporates spatial information.

3.2 Threshold Level-Based Algorithm Based On 3 Class Fuzzy C-Mean Clustering

The technique was proposed by inorder to segment the cells. In this technique, segments the images (sensed image and reference image) into three classes using FCM clustering thresholding. The threshold is obtained by averaging the maximum in the class with the smallest centre and the minimum in the class with the middle centre. According to the author, the method is robust to noise, prevents weak-edge leakage and has the ability to handle interior intensity variation, also it can used for further analysis but however the method was not tried on other cell types or rather on other applications.

3.3 Membership Connectedness Method

This technique in order to utilize spatial information, in this algorithm, a combination of fuzzy connectedness and fuzzy clustering were applied during the functional form of membership connectedness in order to automatically select the required seeds. According to the author the membership connectedness segmentation method considers the local and global spatial relations

which leads to reduced sensitivity to noise and false segmentation results, the method also utilizes the expert knowledge in the form of selected seeds and segments the images as desired by the expert which increases the chance of its success.

3.4 Size-Weighted Fuzzy Clustering

The technique was presented in order to deal with the spatial and the intraclass redundancy that exists in the image faced by the membership connected method, in this unsupervised algorithm, watershed transform was used to deal with the spatial redundancy., Sizeweighted fuzzy clustering was also used to deal with intra-class redundancy. During watershed phase, the spatial redundancy is omitted, and in the Membership connectedness construction phase, the spatial relation among image pixels is taken into account. According to the method can not only detect small regions (that often appear in remote-sensing images) but also it can detect the overlapped regions in the satellite images, although the method does not provide detailed information about the clusters.

3.5 Fuzzy Statistics-Based Affinity Propagation (Fs-Ap)

The technique was presented in order to extract land cover information in multispectral images, in this algorithm, affinity propagation (a clustering algorithm) was used to find clusters with small error in large datasets and fuzzy statistical similarity measure was used to determine the clusters to which the pixels belong to through obtaining objective estimates of how closely two pixel vectors resemble each other. According to the method is fast ,robust to noise, and works well in the case of mixed pixels, since it treats all pixels equally which reduces on dependence and avoids poor solutions caused by hard decisions during clustering.

3.6 Ant Colony Optimized Fuzzy C-Means Clustering

The techniques was presented to obtain obvious edge and segmentation result, in this algorithm the centres and number of clusters are determined by ant colony optimization algorithm, then later initialization fuzzy C-means algorithm is used for remote sensing image classification. According to the method is fast and the visual interpretation of segmentation results is improved but the method is good on land cover/use detection, i.e. Impervious area, water, etc.

Conclusion

During segmentation, incorporation of spatial information is an important practice in order to avoid noise, and also to treat clusters equally. In order to avoid poor solutions caused by hard decisions (pixels finding it hard to decide cluster to belong to) during clustering hence avoiding misclassification of clusters especially small clusters leading to quality segmentation and classification results. Fuzzy c means is one of the algorithm which is used in data mining for clustering. As compare to other clustering algorithms fuzzy c means is more efficient, reliable and robust than others in certain cases or applications by its performance. But after the

internal review of above papers we conclude that fuzzy c means take/have more computation time than other clustering techniques.

References:

[1] Usman seljud,Rashid Hussein, "SAR Image clustering by fuzzy c-means clustering technique with thresholding for icebags",2014.

[2] Soumi Ghosh and Sanjay Kumar Dubey,amity university ,,"Comparative Analysis of K-Means and Fuzzy CMeans Algorithms" ((IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 4, No.4, 2013.

[3] O. A. Mohamed Jafar and R. Sivakumar, "A Comparative Study of Hard and Fuzzy Data Clustering Algorithms with Cluster Validity Indices",emerging research in computing, information, communication and applications ERCICA 2013.

[4] Subhagata chattopadhyay,dilip kumar pratihar,sanjib chandra de sarkar,"A comparative study of fuzzy c-means algorithm and entropy-based fuzzy clustering algorithms", computing and informatics, vol. 30, 2011, 701–720.

[5]. Y. Guo, K. Liu, Q. Wu, Q. Hong, H. Zhang, "A New Spatial Fuzzy C-Means for Spatial Clustering", Wseas Transactions on Computer, vol. 14, pp. 369-381, 2015

[6] Marathe Dagadu Mitharam "Preprocessing in Web Usage mining", International Journal of Scientific & Engineering Research, February -2012.

[7] Aditi Shrivastava, Nitin Shukla, "Extracting Knowledge from User Access Logs", International Journal of Scientific and Research Publications. April-2012.

[8] Soniya P. Chaudhari , Prof. Hitesh Gupta , Prof. S. J. Patil(2013), "Web Log Clustering using FCM and Swarm Intelligence Based Algorithms", International Journal of Innovative Research in Science, Engineering and Technology.janurary-2013.

[9] K.Poongothai , M.Parimala and Dr. S.Sathiyabama"Efficient Web Usage Mining with Clustering", IJCSI International Journal of Computer Science Issues, November 2011.

[10] Kuo-lung wu, "Parameter Selections of Fuzzy C-Means Based on Robust Analysis", World Academy of Science, Engineering and Technology 41 2010.

[11] Deepak Kumar Niware Dr. Setu Kumar Chaturvedi, "Web Usage Mining through Efficient Genetic FuzzyCMeans" ,(IJCSIS) International Journal of Computer Science and Information Security,Vol. 11, No. 9,September 2013.

[12] K. Suresh ,R .Madana Mohana, A. Rama Mohan Reddy, A. Subrmanayam, "Improved FCM algorithm for Clustering on Web usage Mining"published by IEEE 2011.

[13] Pal N.R, Pal K, Keller J.M. and Bezdek J.C, "A Possibilistic Fuzzy c-Means Clustering Algorithm", IEEE Transactions on Fuzzy Systems, Vol. 13, No. 4, Pp. 517–530, 2005.

[14] R. Krishnapuram amd J.M. Keller, “A possibilistic approach to clustering”, IEEE Trans. Fuzzy Systems, Vol. 1, Pp. 98-110, 1993.

[15] Vuda Sreenivasarao and Dr.S. Vidyavathi, “Comparative Analysis of Fuzzy C- Mean and Modified Fuzzy Possibilistic C -Mean Algorithms in Data Mining”, IJCST Vol. 1, No. 1, Pp. 104-106, 2010.

[16] J. C. Dunn, "A Fuzzy Relative of the ISODATA Process and Its Use in Detecting Compact Well-Separated Clusters", Journal of Cybernetics 3: 32-57

[17] J. C. Bezdek, "Pattern Recognition with Fuzzy Objective Function Algorithms", Plenum Press, New York.

[18] Mohamed Fadhel Saad and Adel M. Alimi,” Modified Fuzzy Possibilistic C-means,” Proceedings of the International MultiConference of Engineers and Computer Scientists 2009 Vol I IMECS 2009, March 18 -20, 2009, Hong Kong

[19**].** M. Yambal, H. Gupta, "Image Segmentation using Fuzzy C Means Clustering: A survey", International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 7, pp. 2927-2929, 2013.

[20]. X. Hu, L. Li, "Improved fuzzy c-means algorithm for image segmentation", Journal of Electrical and Electronic Engineering, vol. 3, no. 1, pp. 1-5, 2015

[21]. R. R. Gharieb, G. Gendy, "Fuzzy C-Means with Local Membership Based Weighted Pixel Distance and KL Divergence for Image Segmentation", Journal of Pattern Recognition Research, vol. 10, pp. 53-60, 2015.