# Region Growing and Region Merging Segmentation for Medical Ultrasound Images

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**Abstract:** Due to the presence of speckle noise and similarities, it is difficult to recognize the boundaries of abnormal regions in ultrasound images. An automatic segmentation is motivated because manual method is not effective for segmentation of large data sets. An automatic region growing and region merging algorithm for the segmentation of ultrasound images is presented in this paper. In this paper, seed is automatically selected and then far away values of similar regions were also merged to neighbouring regions. The proposed method outperforms the existing state-of-the-art techniques based on the texture features and visual results.

**Keywords**: Ultrasound*, region growing, region merging, seed point, segmentation and texture analysis.*

## Introduction

Ultrasound imaging [1] is also known as ultra-sonography. It has been given careful consideration than other imaging strategies due to advantages of ultrasound imaging strategy, for example, convenientce of the gadget, ease, less time required for imaging, wellbeing of imaging procedure to the patient, and element review of dynamic structures.The significant downside of ultrasound pictures is their low quality because of nearness of dot commotion, obscured edges and low difference. For correct and effective diagnosis, it is important to segment the ultrasound images [2].Different segmentation algorithms [3] have been proposed to mark complications in ultrasound images. The different segmentation techniques are thresholding based method [4], region based method [5], boundary based method [6], active contour method [7] and hybrid techniques [8].

In thresholding based strategy for segmentation [4], no spatial data of pixels is examined. Gray-level picture is changed over into a paired picture in thresholding. In ultrasound pictures, commotion and limits of strange districts are not dealt with well in this division system. Region based segmentation [5] is based on partitioning an image into regions. Homogeneous regions are found based on the intensity value or texture feature. Its aim is to characterize the detected objects by parameter analysis (shape, size, position etc.). The best known region based category is split and merge algorithm. Boundary based method [6] overcome the pitfallsof region based segmentation. This method is used for searching implicit and explicit boundaries between regions which are correlated with different types of tissues. Edge detection is the standard category of boundary based method. The hybrid technique [8] is a combination of both boundary based method and region based segmentation method. In active contour method [7] of segmentation technique, objects are detected using techniques of curve growth. This method is used to detect the edges of regions in image in which gray scale intensities are different with respect to surrounding region.

It starts with assigned seeds, and grow regions by merging a pixel into its nearest neighboring seeded region. SRG is robust to the large variety of images because the characteristics of rapid and free to tune the parameters, and the considering of local information such as regions similarity, boundaries and smoothness. However, the selection of the initial seeds much influences the segmentation results.

People are master in doing division [9] however because of less productivity to portion extensive informational collections, a programmed or automated division is roused. A programmed division concentrate on mechanized extraction of protest limit highlights and assumes pivotal part in comprehension picture content for investigating and separating in restorative picture reports. A testing issue is to perceive limits of strange districts [10] because of similitude between locale of intrigue and

foundation. The mechanized framework utilizes diverse sorts of strategies to section the therapeutic pictures. A programmed district developing division system for ultrasound pictures is exhibited in this paper. This technique chooses seed point naturally in view of textural components. Area developing and division is finished by utilizing force mean measure.

## Automatic Seed Selection

This segment incorporates the programmed determination of unusual districts of ultrasound pictures in view of separating textural highlight of the picture [11]. Seed is consequently chosen by joining distinctive textural include estimations from picture, for example, dark level co-event elements and run length highlights.

### GLCM(Gray Level Co-occurrence Matrix)

GLCM [12] is the course of action in which distinctive relationship of pixel dim levels happen in a picture. GLCM is a matrix P(i,j,d,θ)in which i, j speaks to the dim level sand two neighboring pixels are isolated with separation information introduction θ. The co-event lattice is for extraction of surface features. Relationship between two pixels i.e. reference pixel and neighbor pixel is considered at once in GLCM surface. Co-event grid inside a picture communicates the spatial relationship of splendour qualities. To figure this spatial relationship of dark levels different surface elements are proposed by Haralick [12]. These elements are Entropy, Energy, Contrast, Homogeneity, Mean, Variance, and Correlation. Entropy measures the level of spatial issue of dark levels in the GLCM. Vitality is utilized for identification of confusion in surface image. In the proposed work, entropy and vitality elements are utilized as a part of request to extricate strange locale from ultrasound picture. It is anything but difficult to separate homogeneous locale from non-homogeneous district by applying these elements [12]. The irregular locale dependably is by all accounts homogeneous in ultrasound pictures.
Vitality is adequate measure keeping in mind the end goal to distinguish the turmoil in surface picture. Here vitality is ascertained from GLCM. In GLCM, vitality conveys the whole of the square of components.

$$\text{Energy} = \sum_{i=1}\sum_{j=1}(p(i,j))^2 \qquad (1)$$

Entropy is a measure of impulsiveness in which texture of the input image is characterized.

$$\text{Entropy} = \sum_{i=1}\sum_{j=1} p(i,j)\log(p(i,j)) \qquad (2)$$

There is a need to select abnormal region from ultrasound image. These parameters help to select seed point from abnormal region. The abnormal region always seems to be homogeneous in ultrasound images. Energy and entropy has low values in non-homogeneous regions and high values in homogeneous regions. Seed point is selected by using these parameters based on values of energy and entropy but in some cases seed point is selected from normal region which is one of the drawbacks. So in order to get rid of this drawback run length features are used which are discussed in next section.

### Run Length Features

Run length features [13] are used in an image matrix to represent strings of symbols. A gray level run for a given image is a set of successive pixels having equal gray level. The length of the run is the number of pixel points in the run. The use of run length matrix is proposed by Galloway [13] for texture feature extraction. Roughness of a texture is captured by run length statistics in a specific direction. Run length matrix $p(i,j)$ is described by specifying direction and then number of runs occurred for each gray levels and length in this direction are counted, where $i$ is the gray level with length equivalent to maximum gray level and $j$ is the run length with length equivalent to maximum run length.
In proposed work, two texture features Long Run Emphasis (LRE) and Run Length Non-Uniformity (RLNU) are calculated to perfectly differentiate homogeneous region from non-homogeneous regions.

$$\text{LRE} = \frac{\sum_{i=1}^{G}\sum_{j=1}^{R} j2p(i,j)}{\sum_{i=1}^{G}\sum_{j=1}^{R} p(i,j)} \qquad (3)$$

$$\text{RLNU} = \frac{\sum_{i=1}^{R}\sum_{j=1}^{G}(p(i.j))^2}{\sum_{i=1}^{G}\sum_{j=1}^{R} p(i,j)} \qquad (4)$$

where $p(i,j)$ is run length matrix, G is number of gray levels and R is longest run.
After considering the co-occurrence matrix in order to find out whether selected seed point is from abnormal region or not, run length features are used for this purpose. For the homogeneous region LRE is high whereas RLNU is low and for non-homogeneous region LRE is low but RLNU is high. Run length features have been calculated throughout the selected points

of co-occurrence features. The center pixel of the block with maximum LRE value and minimum RLNU value is selected as a seed point.

## Proposed Work

Area developing [14] is an approach for division of picture that begins with one pixel of an unmistakable locale and develops it by including contiguous pixels till pixels being thought about are excessively unique. In the vast majority of area developing techniques [15], seed point is chosen physically [16] or computed from histogram [17]. It is a testing undertaking to naturally choose a seed point in ultrasound pictures. Division in proposed method is finished by developing area from naturally chose seed point. Seed point is chosen from unusual areas and afterward district developing is done to portion the proper locale.

In the proposed work, the picture is separated into squares and calculation is done on every piece. Dim level co-event network is connected on every piece for highlight extraction. Energy and entropy elements of GLCM are utilized to separate the anomalous area from ultrasound picture. These elements make it simple to recognize homogeneous locale from non-homogeneous district.

Run length highlights [18] are utilized to cover the disadvantage of co-event network highlights which once in a while select typical locales. Run length elements of chose purposes of co-event elements are computed and after that seed point is chosen as an inside pixel of the piece having greatest LRE esteem and least RLNU esteem. After programmed determination of seed, division of the area is finished by utilizing district developing calculation. In this technique, locale is developing by utilizing force mean measure in which district is iteratively developed by contrasting all unallocated neighboring pixels with the area and the distinction between pixel's power esteem and locale mean is utilized as a measure of closeness. The pixel with littlest contrast measured along these lines is designated to the area.

Steps took after for the proposed strategies are compressed beneath:

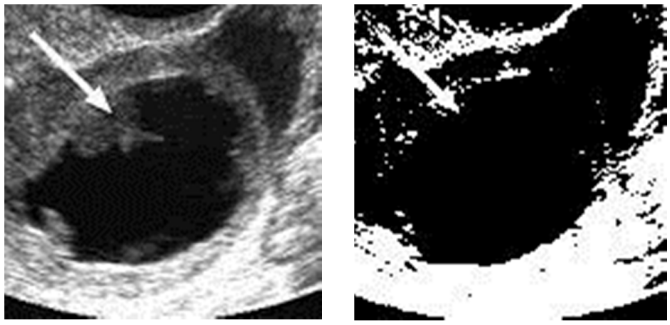
- Whole picture is separated into pieces as a sliding window.
- GLCM [12] is connected on every piece to concentrate highlights. Vitality and entropy elements are figured and put away.
- Minimum, greatest and normal estimation of vitality is ascertained and focuses in the middle of normal and most extreme estimation of vitality are chosen.
- Run length highlights [18] Long Run Emphasis (LRE) and Run Length Non-Uniformity (RLNU)are figured for chose squares utilizing condition 3 and 4

## Experimental Results

The proposed strategy for programmed district developing division for ultrasound pictures is compared to part and-union technique [19] and Otsu segmentation strategy [20]. The proposed work indicates better outcomes as just anomalous districts are portioned though in part and-union strategy and Otsu method both strange area and also typical locale is sectioned.

Visual outcomes in Figure 3 demonstrate correlation of results for division of liver tumor by utilizing proposed technique, Otsu strategy and Split-and-union strategy.

TABLE I indicate correlation of proposed strategy, Otsu system and split-and-union method in light of entropy, vitality, long run accentuation, run length non-consistency and short run accentuation. Entropy, Energy highlight of GLCM and long run accentuation highlight of dark level run length are high for homogeneous locales. For better division vitality, entropy and long run accentuation ought to be high though run length non-consistency and short run accentuation to be low. In the TABLE I, it is demonstrated that entropy, vitality esteem and long run accentuation are high for proposed strategy and run length non-consistency qualities are low. Henceforth the proposed technique delivers more powerful outcomes than Otsu strategy and split-and-consolidation division technique in light of the fact that these strategies separate both typical and anomalous districts from ultrasound picture.



(a) (b)

(c) (d)

Figure. 1.(a) Original image. (b) Otsu method. (c) Split-and-merge method. (d) Proposed method

Table 1.Comparison Of Segmentation Techniques

| Segmentation techniques | Energy | Entropy | Long run emphasis (LRE) | Run length non-uniformity (RLNU) | Short Run Emphasis (SRE) |
|---|---|---|---|---|---|
| Proposed method | $1.5618 \times 10^{-4}$ | 0.9710 | 472 | 47 | 3.1419 |
| Otsu method | $1.4332 \times 10^{-4}$ | 0.9257 | 460 | 56 | 9.3321 |
| Split-and- merge method | $1.2103 \times 10^{-4}$ | 0.8082 | 436 | 64 | 4.1493 |

## Conclusion

A programmed locale developing strategy for ultrasound pictures has been proposed in this paper. The proposed strategy precisely finds the limits of anomalous locales which is extremely useful for sonographer. In this strategy seed point is consequently chosen in light of the surface components and no human association is required. The correlation of proposed system with Otsu technique and split-and-merge shows that the proposed strategy is more effective for division of ultrasound pictures on the grounds that the proposed strategy portion strange locales just though Otsu method and split-and-consolidation technique fragment both typical and additionally unusual district.

In future, this work can be further enhanced by lessening the time utilization in selecting the seed point.

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