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HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

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APPENDIX/ANNEXURE

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MEAN-SHIFT FILTERING AND SEGMENTATION IN ULTRA SOUND THYROID IMAGES

S. BINNY
ASST. PROFESSOR
KRISTU JYOTI COLLEGE OF MANAGEMENT & TECHNOLOGY
CHANGANACHERRY

ABSTRACT

In medical imaging, image removal of noise has become a very necessary matter all through the diagnosis. In medical images there must be a compromise between noise reduction and the preservation of useful diagnostic information. The goals of an imaging modality is to provide the clinician with the necessary information needed for an accurate diagnosis .Speckle noise is an intrinsic artifact found in Ultrasound images. In this project, the Mean shift filter (MS) has been applied for speckle filtering and segmentation of medical images. The mean shift with uniform kernels was compared with the Lee filter in, proving that the mean shift can outperform the Lee filter in texture and edge preservation. To complete this study, Gaussian kernels have been used in this paper. As expected, the results are better, because it reduce the complexity of image and improve segmentation accuracy, with no significant increase in the average number of iterations, for a given lower bound of the magnitude of the Mean shift vector. A segmentation approach based mean shift has been applied, but some modifications have been introduced to adapt it to the characteristics of the considered medical images. As in the filtering case, the power of the Mean shift is related to the use of a combined spatial-range processing and the corresponding bandwidths. Both bandwidths combined with the clustering algorithm allow smoothing image areas, losing texture information, and maintaining edges.

KEYWORDS
Clustering, mean shift, Segmentation, Speckle noise, Ultrasound images.

INTRODUCTION

In the medical field ultrasound imaging systems is currently available medical equipment, which is portable, reliable, low cost and safe to the human body and does not affect human tissues. These features (and the last one in particular) make the ultrasound imaging be the most prevalent diagnostic tool in hospitals around the world, the quality of ultrasound images is limited due to various factor, which can be from image acquisition and due to image system design imperfection

Due to the growth of Thyroid cells, Thyroid nodules appear in the Thyroid gland or a thing walled abnormal sac containing fluid known as cyst. It become large enough to press on nearby structures in the neck, they can overproduce thyroid hormone (hyperthyroidism) or they may be indicative of thyroid cancer The use of high-resolution diagnostic ultra sonography (US) for clinical evaluation of thyroid nodules has proved to be a useful clinical diagnostic method. Ultrasound is one of the non-invasive low cost imaging techniques for thyroid scanning.

It can follow anatomical deformations in real time during biopsy and treatment and it is non-invasive and does not require ionizing radiation consists of resolution enhancement, contrast enhancement to suppress speckles and imaging of spectral parameters Contrast enhancement is a technique that able to suppress speckle in thyroid ultrasound image. One of the popular methods in contrast enhancement is histogram equalization.

Histogram Equalization is a technique for recovering some of apparently lost contrast in an image by remapping the brightness values in such a way as to equalize and distribute its brightness values Segmentation is a collection of methods allowing interpreting spatially close parts of the image as objects. Active contour is one of the methods in image segmentation and used in the domain of image processing to locate the contour of an image and allow a contour to deform so as to minimize a given energy functional in order to produce the desired segmentation Traditionally different image filtering techniques, such as mean and median filtering, other adaptive filtering techniques, like the Kuna, Lee, or Frost techniques, and new versions of these filters have been proposed to reduce speckle noise. Most of them use a defined filter window to estimate the local noise variance (NV) of a speckled image and perform individual filtering process. The result is generally a high reduction of speckle noise in areas that are homogeneous, but the image is over-smoothed due to losses in details and edges in heterogeneous areas.

The Lee in filter is often used as a reference because it combines an efficient noise reduction while maintaining the sharpness of the image. Disadvantage in Conventional image filtering is that provide Low segmentation accuracy and High complexity Note that the applicability of the wavelet de-noising to the problem of speckle noise reduction had been initially demonstrated in the field of SAR imaging, where the first work on this subject Since then, many of the wavelet de-speckling methods have simply migrated from this field to the field of medical ultrasound imaging utilizing the similarity between the processes of producing the SAR and ultrasound images.

RELATED WORKS

Ultrasound image are widely used tool for clinical diagnosis. Ultrasound is also used as a popular research tool for capturing raw data, that can be made available through an Ultra Sound research interface, with the intension of tissue characterization and contrivance of new image processing procedures. Ultrasound is operated mainly on sound waves transmission and receipt of sound waves which is mainly differs from other medical imaging pattern. Based on the composition of the different tissues the high frequency sound waves are sent; the signal will be attenuated and advent at discreet intervals, multilayered structure is found in the part of reflected sound waves. Which can be described by input acoustic impedance and the relatives structures of reflection and transmission co-efficient. It does not cost any harmful effects and save to use. It is cheaper and rapid to perform

Various speckle noise removal technique are available in the literature[1][18][24][25][27].Linear filtering techniques like spatial averaging have blurring effect. Adaptive filtering technique based on local statistics is good for preserving boundaries but suffers from speckle noise. The median filter is used to remove speckle noise[24].The lee filter is used to remove speckle noise based on mean and variance of the pixel of the interest is equal to local mean and variance of all pixels with in the moving[24.].Wavelet de-noising procedure is also used to remove speckle noise present in the signal by preserving the signal character regardless of frequency contents.

Speckle noise is a phenomenon that degrades the ultra sound image quality and arises because the relative phase of individual scatterers within a resolution cell is strongly dependent upon the viewing angle the resulting fluctuations generate ultra sound images with grainy appearance, which makes detection and classification tasks difficult. Speckle noise is a multiplicative noise

MEAN SHIFT ALGORITHM

Preprocessing is a very simple implementation of a mean shift filter that can be used for edge-preserving smoothing or for segmentation. Using mean shift filtering Important edges of an image can be easier detected. The circular flat kernel is used and the color distance is calculated in the YIQ-color space. In computer vision and image proc essing the Mean shift filtering algorithm is used. For each pixel of an image is having a spatial location and a distinct color, for each pixel, the set of neighboring pixels is intented.The new spatial center and the new color mean value are calculated For the set of neighbor pixels. for the next iteration, The calculated mean values will aid as new centre. The method will be repeated until the spatial and the mean stops adapting. At the end of the interaction, the final mean color will be of the iteration, the final mean assigned to the starting position of that iteration.

Mean shift is also known as mode seeking algorithm and non-parametric feature space technique. It is used clustering in computer vision and image processing It is a procedure for locating the maxima of a density function given discrete data sampled from that function. It is useful for detecting the modes of this density.

It is an Repetitive method, and we start with an initial estimate a. Let a kernel function $K_1(a_i - a)$ be given. For the re-estimation of the mean, This method intents the weight of near by points. Particularly, we use the Gaussian kernel on the distance to the current estimate, $K_1(a_i - a) = e^{d\|a_i - a\|^2}$.

The weighted mean of the density in the window is intented by K_1 is

$$M(a) = \frac{\Sigma a_{i \varepsilon N(a) K_1(a_i - a) a_i}}{\Sigma a_{i \varepsilon N(a) K_1(a_i - a)}} \quad (1)$$

where $N(a)$ is the neighborhood of a, a set of points for which $K\,a \neq 0$. The mean-shift algorithm now sets $a \leftarrow M(a)$, and repeats the estimation until M (a) converges.

Mode estimation is of utmost importance in many domains, and particularly in image processing. This field have a great place in our every day life, as widely used devices in multimedia, entertainment and professional applications in medicine, geography, or security use advanced signal processing and image de noising techniques. One of the most striking use of mode estimation methods is image de noising. Noise in pictures can arise because of poor light condition, short exposure and low photon detection, among others. The origin of this noise determines its statistical properties; it can be either additive or multiplicative, Gaussian, Poisoning, or follow a more complex model.

Image clustering and categorization is a means for high-level description of image content. The aim is to find a mapping of the sequential images into clusters. The generated cluster provides a summarization and visualization of the image content that can be used for distinct works related to image database management. Mean shift is a non-parametric feature – space analysis technique, a so-called mode seeking algorithm. Application domains include clustering in computer vision and image processing. Mean shift is a method mainly used for determining the maxima of a density function given for different data samples and used for finding the modes of this density. It is a repetitive function .Suppose we begin the initial estimate a. The kernel function $K_1(a_i - a)$ be given. This method identifies the weight of nearby points for mean re-estimation. Particularly, the Gaussian kernel is used on the distance to the current estimate, $K_1(a_i - a) = e^{d\|a_i - a\|^2}$. The window weighted mean of the density is intented by K_1 is

$$M(a) = \frac{\Sigma a_{i \varepsilon N(a) K_1(a_i - a) a_i}}{\Sigma a_{i \varepsilon N(a) K_1(a_i - a)}} \quad (2)$$

where $N(a)$ is the neighborhood of a, a set of points for which $k(a) =$ ≠0.

The mean-shift algorithm Now sets $a \leftarrow M(a)$,as mean shift algorithm and repeats the computation until $M(a)$ coincides.

A nonparametric clustering technique is mean shift filtering algorithm, which does not require shape of cluster and knowledge of the number of clusters.

let n data points a_i, i = 1, ..., n be on a d-dimensional space Rd, with kernel $K_1(a)$ and window radius h , the multivariate kernel density estimate obtained

$$f(a) = \frac{1}{nh^e} \sum_{i=1}^{n} K_1\left(\frac{a - a_i}{h}\right) \quad (3)$$

For symmetric kernels, it is adequate define the profile of the kernel $k_1(a)$ content as

$$K_1(a) = e_{k,e} k(\| a \|^2) \quad (4)$$

Here ck, d is a normalization constant which assures K1(a) integrates to 1. The modes of the density function are located at the zeros of the gradient function rf (a) = 0. The gradient of the density estimator (1) is

Where g(s) = −k0(s). The first term is proportional to the density estimate at a computed with kernel G(a) = cg, dg (kak2) and the second term

$$M_h(a) = \frac{\sum_{i=1}^{n} a_{ig} (\| \frac{a - a_i}{h} \|^2)}{\sum_{i=1}^{n} g(\| \frac{a - a_i}{h} \|^2)} - a \quad (5)$$

is the mean shift. The mean shift vector intended towards the maximum density. The mean shift method, acquired by continuous

•calculation of the mean shift vector $mh(at)$

• the window Translation by $a_t + 1 = a_t + mh(at)$

Until all point converge when the gradient of density n is zero. The process of finding Mean shift mode is demonstrated Figure 3.1.

The application of the mode finding method mean shift clustering algorithm.

FIG. 3.1: MEAN SHIFT PROCEDURE

1. Begin on data points
2 Use mean shift method until a standstill points of the density function
3 Sort these points by maintaining the local maxima The points which belongs to same group is related to same cluster

SYSTEM ARCHITECTURE

The development of software in this project is to overcome the problem occur due to the detection of thyroid region and problem in ultrasound image. Then literature reviews need to know the anatomy physiology and pathology of thyroid to identify the position and shape of the thyroid region. After that the suitable method of segmentation and image enhancement is identified for the software development for automatic segmentation of ultrasound. Some step is needed to be done to develop the software system that able to segment and enhance the thyroid ultrasound image. Problem detection related to the topic is important before any system can be developed. In this work focused on technique to improve the quality and information of content of ultrasonic image of the thyroid, where the methods chosen are contrast enhancement to suppress speckles Ultrasound image

FIG. 4.1: SYSTEM ARCHITECTURE

READ ULTRASOUND IMAGE
↓
CHANGE RGB TO GREY SCALE IMAGE
↓
MEAN SHIFT FILTERING
↓
MODE ESTIMATION
↓
MEAN SHIFT CLUSTURING
↓
SEGMENTED IMAGE

The ultrasound image is in RGB type which is an additive color of red, green, and blue. The image is converted into gray scale image for further processing.

FIG. 4.2: ORIGINAL THYROID IMAGE

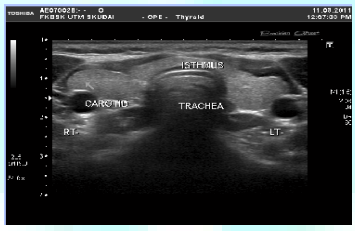


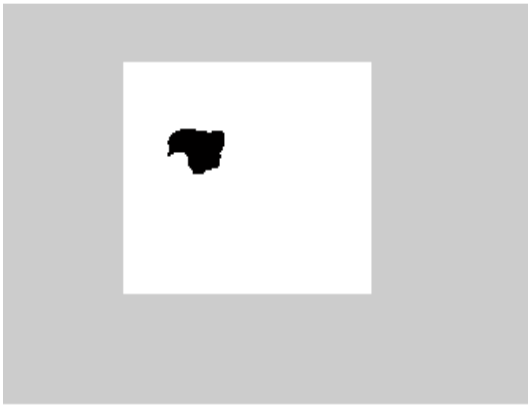
FIG. 4.3: AFTER PROCESSING THYROID IMAGE

For the clustered method, the thyroid region will be segmented into different size. Resizing the image pixels into only the region of interest using initialization mask is significant for efficient image processing.

FIG. 4.4: AFTER REMOVING NOISE

After the image is inverted, removing black spot on white area by converting black spot into white color in the thyroid region. Then, the small pixel of region will be removed as we assume it is the noise. In this case, the black color is filled if the spot.

FIG. 4.5 FINAL RESULT IMAGE



EXPERIEMENTAL RESULT

These results prove the efficient using MS filtering stage, which allows us to reduce speckle noise and preserving edges.

FIG. 5.1 PERFORMANCE GRAPH

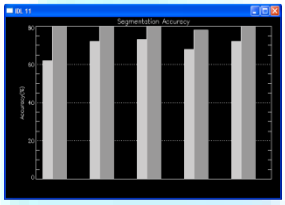
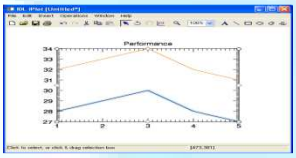


FIG. 5.2: PERFORMANCE ANALYSIS



In this project, the MS has been applied for speckle filtering and segmentation of medical images. The MS with uniform kernels was compared with the Lee filter in, proving that the MS can outperform the Lee filter in texture and edge preservation. As expected, the results are better, with no significant increase in the average number of iterations, for a given lower bound of the magnitude of the MS vector (this value is reduced in some cases). A segmentation approach based mean shift clustering on has been applied, but some modifications have been introduced to adapt it to the characteristics of the considered medical images. As in the filtering case, the power of the MS is related to the use of a combined spatial-range processing and the corresponding bandwidths. Both bandwidths combined with the clustering algorithm allow smoothing image areas, losing texture information, and maintaining edges.

This section deals with the results that are obtained from the system. Fig 5.3 shows the processed image.fig 5.4 shows noised image .Fig 5.5 shows that mean shift filter is applied and noise is reduced. Fig 5.6 Resultant image shows the whole clustered image is obtained.

FIG. 5.3

FIG. 5.4

FIG. 5.5

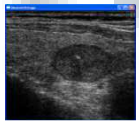
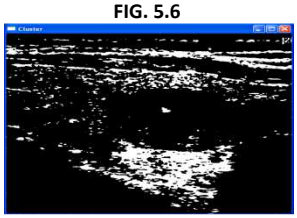


FIG. 5.6



CONCLUSION

As a conclusion, In this works, the MS has been applied for speckle filtering and segmentation of ultra sound images The MS with uniform kernels was compared with the Lee filter in, proving that the MS can outperform the Lee filter in texture and edge preservation. The advantage of MS is that provide high segmentation accuracy of the image and also have low complexity in our future work, the proposed work would be an essential structure which could be enhanced by speeding up the training phase, which will contribute to the possibility of training with multiple ultrasound images. Moreover, it could be embedded within an integrated system that will combine heterogeneous information to support thyroid nodule diagnosis. . In future this system can be extended using different techniques to make this available more useful in different areas.

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